Shelve Microcopy

THE JOURNAL

OF THE

Quekett

MICROSCOPICAL CLUB.

EDITED BY

HENRY F. HAILES.

SECOND SERIES.

VOLUME II.

London:

[Published for the Club.]

WILLIAMS and NORGATE

14, Henrietta Street, Covent Garden, London,

and 20, South Frederick Street, Edinburgh.

THE JOURNAL

OF THE

Quekett Microscopical Club.

On an undescribed Acarus of the genus Myobia.

By A. D. Michael, F.L.S., F.R.M.S., &c.

Read April 25th, 1884.

S1

PLATE I.

Some short time since the Revd. C. R. N. Burrows, of Brentwood, Essex, sent me, for examination, a specimen of an *Acarus* which he had found parasitic upon a bat of the common small species, *Scotophilus pipistrellus*, which he had obtained from a cavern in Gloucestershire.

Mr. Burrows recognised the mite as belonging to the genus *Myobia*, and suspected that it was unusual; I at once saw that it was, as far as I know, undescribed, and that it was sufficiently distinct and interesting to merit a notice. I have a great objection to describing any species relying solely upon a single specimen; it unfortunately is not possible to avoid doing so sometimes; but this necessity has, in my opinion, been the source of numerous and perplexing errors in zoological works. Moreover, in most creatures as high up the scale of organization as the *Acari*, a single specimen can only belong to one sex; and the sexes differ in several respects in *Myobia*. I therefore begged Mr. Burrows to try and obtain further examples, and he was good enough to take great trouble in the matter. An organized bat-hunt was commenced in the caves, and the results were sent to Mr. Burrows. He forwarded to me a living specimen of *Scotophilus pipistrellus*, but, although it was very interesting, both for itself and its parasites, it was not the host of any *Myobiæ*. Mr. Burrows examined about six specimens of the

same species, and one of the long-eared bat, *Plecotus auritus*, all from the same locality, but with the like negative result. The *Chiroptera* above-named were, however, accompanied by six specimens of that much rarer member of the order, *Rhinolophus hipposideros* (the lesser horse-shoe bat), and upon three of these the same *Myobia* was found, although not abundantly. I have thus had the opportunity of examining seven or eight specimens, some of each sex, but unfortunately not any immature stages.

The first notice we possess of the singular creature which, up to the present time, constitutes the only known species of *Myobia* is due to Schrank,* who called it *Pediculus muris musculi*, and classed it a long way from the position which it has now assumed. The name *Myobia* (from the Greek μυς, a mouse, and βιόω, I live) was given by Heyden,† and it is from this name, which has been generally accepted, that that author's most puzzling work on the *Acarina* will be chiefly remembered.

C. L. Koch, of Regensburgh,‡ found the creature, as indeed, he found most others which have any title to be called *Acarina;* but that most industrious collector was not equally painstaking in searching prior authorities, and, not recognising that he was dealing with Schrank's species, he gave his supposed discovery a new name, and introduced it to the world as *Dermaleichus lemnius;* thereby putting it in a genus which it certainly did not belong to, although he was a good deal nearer than Schrank had been. From Koch's error arose another by an even better-known zoologist, Gervais,|| who gives Schrank's *Pediculus muris musculi* as a synonym of Koch's *Sarcoptes musculinus*, which is really a *Mycoptes*, instead of a synonym of that author's *Dermaleichus lemnius*, which it actually is. This error was repeated by van der Hoven § and others, until Claparède ¶ turned his attention to *Myobia*, and pointed out what the real synonyms were. It is to this beautiful work that we owe the chief part of what we know concerning

* "Enumeratio insectorum Austriæ indigenorum." Augustæ Vindelicorum, 1781, p. 501, t. i., Figs. 5-7.

† "Versuch einer systemstischen Eintheilung der Acariden." "Oken's Isis," 1828, p. 613.

‡ "Deutschlands Crustaceen, Miriapoden und Arachniden." Regensburg, 1834-9 (forming Hefts 1 to 40 of Heinrich Schäfer's "German Insects"), Heft 33, Pl. v.

|| "Histoire naturelle des insects, Aptères." Walckenaer, t. iii., p. 265.

§ "Handbuch der Zoologie" i., p. 556.

¶ "Studien an Acariden." Zeit. Wiss. Zool., Band 18 (1868), p. 519.

Myobia, which evidently struck Claparède as being one of the strangest creatures that he had met with.

There certainly are two or three points about *Myobia* which are very curious, and justify the Swiss naturalist's astonishment. The first of these is that the genital openings in both sexes are on the dorsal surface, both on slight elevations, that of the female not being very far from the posterior margin, while in the male the intromittant organ emerges in the median line of the back between the second and third pairs of legs, an arrangement extremely unusual in nature, although it occurs in some few other *Acarina*. The next point that strikes the observer is the exceptional form of the tarsi and claws of the first pair of legs. *Myobia* lives upon hairy mammals, and the front tarsi and claws are developed into broad scoop-like organs, each with a curved hook projecting from it, the whole forming a most efficient apparatus for holding on to the hairs of the host.

The third matter which is rather exceptional is that the claws of the second, third, and fourth pairs of legs, although didactyle, are unequal (on each leg). Of course, a tridactyle claw with the central unguis different from the lateral ones is common enough, but a didactyle claw with the two ungues unequal is somewhat rare.

As before stated, the *Myobia* hitherto known was supposed by its discoverer, and most subsequent naturalists, to be a parasite of the mouse only, although it did not appear to be confined to any particular species of mouse, being found both on field-mice and house-mice, perhaps most abundantly on old specimens of the latter. During the last two or three years, however, a *Myobia* has been found upon the mole, which does not appear to differ from that of the mouse in any respect except its somewhat greater size; and no acarologist has as yet ventured to make two species of them, so that *Myobia musculi* still remains the sole representative of the genus.

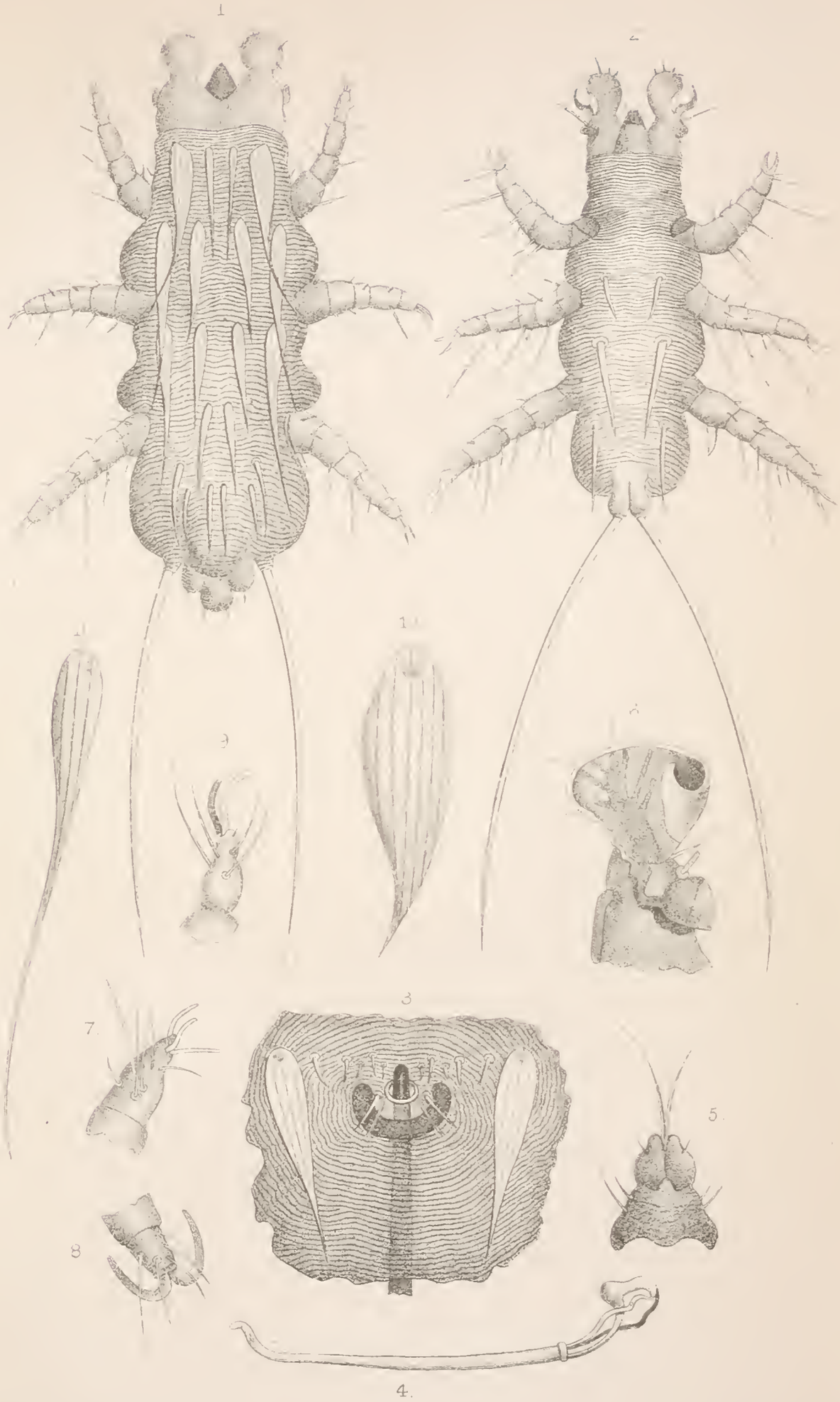
The finding of a species of *Myobia* on the bat is not wholly devoid of a certain quaint interest, when we remember that the early zoologists looked on the bats as a link between birds and quadrupeds, and that Linnæus classed them amongst the Primates; while, on the other hand, the popular instinct in most languages has usually associated them with mice, whence came such names as "Rere-mouse" (from the Anglo-Saxon "ræran," to raise or rear

up), and "Flitter-mouse" in English, "Fleder-maus" in German, "Chauve-souris" in French, &c.; and that modern classification places the bats between the mice and the moles, certainly with the squirrels and a few other things between the mice and the bats, but very close together.

This phase of the subject does not quite end here, for upon the squirrel is found another parasite, which, although clearly different from *Myobia*, is yet nearly allied, namely, *Listrophorus*, which is also a mouse-parasite, and which, in spite of the marked resemblance which it bears to *Myobia*, is, at present, placed in a different main division of the *Acarina* by the exigencies of modern classification, the order being now usually divided into two primary groups, the *Tracheata* and the *Atracheata*. The two genera unfortunately are separated by this classification of Dr. Kramer's, which is probably the best, because *Myobia* possesses well-marked and even conspicuous tracheæ, chiefly consisting of a main tracheal trunk on each side of the body, considerably branched, and ending anteriorly in two stigmata near the base of the rostrum; while in *Listrophorus* tracheæ have not been discovered as yet.

Myobia is evidently a true parasite, living permanently upon, and at the expense of its host; the whole life-history of the creature is known, and its embryology and subsequent changes have been ably investigated by Claparède, who did not usually leave much for other people to do after him; and the whole round of existence was found to be passed upon the unfortunate mouse, or other vertebrate, which the acarid has selected for its board and lodging. The mouth-organs of *Myobia* are essentially those of a creature feeding upon its host, being composed of two lancet-like maxillæ lying together in a soft tube or lip, and forming a piercing and sucking organ, but without capturing organs, such as are found in the *Trombidiinæ*, *Cheyleti*, *Gamasidæ*, and other rapacious, predatory *Acarina*, whose palpi or mandibles are converted into seizing organs.

It remains to consider the name which should be given to the present species. The much greater numbers which have been taken on the *Rhinolophus* would seem to point to adopting that genus as a basis for the specific name; but, on the other hand, one specimen was found on the *Scotophilus*, and the experience is hardly yet sufficient to justify a conclusion as to what bats are infested by it; nor must it be forgotten that, where bats are abundant, they usually hybernate in caverns, or other suitable places, in closely-packed



A.D. McIntosh ad nat. del. W. Rhair sc.

West Newman & Co. imp.

Myobia chiropteralis.

masses, hanging from the walls or roof of the place, or even from each other, and that these masses have been found to consist of several species, if found in the neighbourhood; so that, if the parasites can live on various bats, they would be likely to become pretty widely distributed. For these reasons I have not thought it desirable to select a genus of bats for the foundation of the specific name, and provided it be, as I imagine, unrecorded, I propose to call it *Myobia chiropteralis.*

MYOBIA CHIROPTERALIS. Sp. nov., Pl. I.

I do not think it necessary in this description to detail the numerous points in which the species is similar to the well-known *M. musculi*, and which are, in effect, generic characters; but only to point out the particulars in which the new species differ from that previously known, so as to facilitate identification.

There is far less variation between the sexes in this creature than in the *Myobia* of the mouse, the form of the males and females being nearly similar.

The principal differences from *M. musculi* are that *M. chiropteralis* is the longer and narrower in form, and that the hairs on its dorsal surface are far more spatulate than those of the mouse-parasite, and mostly terminate in very long points, so that they really cover up the greater part of the notogaster. The great holding claw of the first leg also differs, and there are other minor distinctions.

Myobia chiropteralis.

FEMALE (Fig. 1).

Average length about	·53	mm.
„ greatest breadth about	·20	„
„ length of legs, 1st pair about... ...	·06	„
„ „ „ 2nd „ „	·09	„
„ „ „ 3rd „ „	·10	„
„ „ „ 4th „ „	·12	„
„ „ anal hairs „	·35	„

The form is longer and comparatively narrower than in *M. musculi*, less wide over the third pair of legs, less rounded at the posterior margin; and there is a narrower, slightly-trifid projection for the anus, which is absent, or but slightly indicated, in *M. musculi.*

The most striking characteristic of the species consists in the hairs on the back, which, instead of being straight and spike-like, as in the mouse-parasite, are broadly spatulate, and are drawn out to

points, which, in some of the hairs, are of extreme length, and are curved, or doubly-curved. These hairs, or scales, vary greatly, hardly any two (except the corresponding hairs on the opposite sides of the body) being alike. The arrangement (which is not quite the same as in *M. musculi*) is as follows :—

There are five pairs down the centre of the back, of which the first and fifth pairs are less spatulate than the others. On each side of each of the first three of these pairs is a hair or scale, thus forming three transverse rows of four, of which the lateral are not quite in a line with the central pair; the lateral are the largest, the anterior of them (Fig. 10) being far the broadest and the posterior (Fig. 11) the longest on the dorsum. These hairs have longitudinal ridges running along them ; there are seven or eight of these ridges on the broadest hairs, and two or three on the narrowest. In addition to these there is an irregular circle of spike-like or rod-like spines, some more or less curved, set round the vulva, which is placed on a considerable elevation near the posterior end of the creature. The spatulate hairs cover up the greater part of the dorsal surface, and they do not appear to be attached in the ordinary mode of that class of hair or scale, *i.e.*, by a peduncle springing from the proximal edge, and continued in the plane of the scale, but are almost sessile, the peduncle being very short and thick, and placed underneath, and at right-angles to, the scale, the point of attachment being the centre of the curve formed by the proximal end of the scale; thus the peduncle shows, in optical transverse section, through the semi-transparent scale.

The claw of the first leg (Fig. 6) varies considerably from the same part in *M. musculi*, being much broader and more truncated and scoop-like, and the hook-like or curled portion, which curves under the hair of the host which the parasite is clinging to, being smaller and narrower in proportion to the whole claw, if indeed this vice-like apparatus can be called a claw at all. The expanded lamina of the claw is semi-transparent, but has a curious branched thickening running along its upper surface, a spine being inserted in most of the places where a branch strikes the periphery of the claw. There is a short truncated spine behind the claw, and a strange chitinous piece behind that, like somewhat more than half a hollow sphere, both like those in *M. musculi*, but not quite so large in proportion, and not quite identical in form.

The claw of the second leg (Fig. 7) is didactyle, and is the

smallest of all ; the claws are unequal, but there is a clear, chitinous, curved, blunt-ended rod attached, larger than the ungues themselves. The claws of the third leg (Figs. 8, 9), and of the fourth leg, are slightly curved, unequal, didactyle, and considerably larger than those of the second pair.

The hairs on the ventral surface are spike-like, as in *M. musculi*.

THE MALE (Fig. 2, under-side).

Average length about	·40	mm.
„ greatest breadth about...	·14	„
„ length of legs, 1st pair about... ...	·7	„
„ „ „ 2nd „ „	·9	„
„ „ „ 3rd „ „	·12	„
„ „ „ 4th „ „	·15	„
„ „ „ anal hairs „	·42	„

The male, it will be seen, is smaller than the female, but is of much the same form, except that its legs and anal hairs are longer in proportion ; it is therefore considerably narrower in shape than the male of *M. musculi*, which is broader in proportion to its length than the female.

The whole of the above observations relative to the hairs of the female, except those round the vulva, and as to the tarsi and claws, will apply equally well to the male.

The genital opening (Fig. 3) is placed on the anterior side of an elevation far forward on the dorsal surface, being between the second and third pairs of legs. It consists of a small aperture with slight labiæ, and is protected by a horse-shoe-shaped chitinous piece, not unlike the sternite near the vulva of most *Dermaleichi*, but less developed ; it is surrounded by several short spines. The penis (Fig. 4) is an organ of remarkable size ; it is usually retracted almost wholly into the abdomen, and then nearly touches the hind margin, its point being directed forward ; it is a strong, hollowed rod, of dark chitin, slightly curved, with the concavity upward, and the rod is strongly bent upward near the tip, the actual tip being again turned forward. At its posterior end it has attached to it a somewhat elaborate framework of curved levers, the form of which will be best understood by the drawing. It will be evident that muscles pulling the posterior ends of these levers forward and downward would produce the motion required for extrusion.

As far as could be judged from the present experience, the numbers of males and females appeared about equal.

On the Hexactinellidæ.

By B. W. Priest.

Read May 23rd, 1884.

PLATES II., III.

The order of Sponges to which I wish to draw your attention this evening, and to which I briefly alluded in a former paper on the Histology of Sponges generally, is one which comprises some of the most interesting, as well as the most beautiful in structure of that class of the Animal Kingdom.

As early as 1833 two or three forms were already known and described, first by MM. Quoy and Gaimard, and subsequently by Stutchbury and others.

But it was not until the results of the deep-sea explorations which were instituted between the years 1860 and 1870, and followed up to the present time, became known, that any idea of the number of species of that order were arrived at.

Some of the species are now pretty well known, being represented in several of our museums by the so-called Venus' Flower Basket, the Glass rope Sponge, the Birds' nest Sponge, and others, all of which were well displayed at the late Fisheries Exhibition, and most of the typical species are now to be seen at the Natural History Museum at South Kensington.

In 1867 the late Dr. Gray proposed the term *Coralliospongia* for the order. This answered at the time, as most of the sponges then known and comprised under that arrangement were hard and coral-like, the skeleton entirely formed of siliceous spicules anchylosed together by siliceous matter, forming a netted mass covered with sarcode. When, however, other forms were found, it became necessary to alter this classification. Dr. Oscar Schmidt proposed to distinguish the whole series under the title of *Hexactinellidæ*, from the fact that all the species shared in common the possession of hexradiate spicules.

In 1870 Mr. Saville Kent took the same view, placing Dr. Gray's name, *Coralliospongiæ*, as a sub-order to Dr. Schmidt's pri-

mary one, and forming a new sub-order, the *Callicispongiæ*, the former, *Coralliospongiæ*, comprising those sponges with a siliceo-fibrous skeleton, the latter those whose skeleton is composed of an interlacing spicular formation, never reticulate and continuous.

Later on, in 1875, Mr. Carter, whose classification will, I think, still hold good, retained the order *Hexactinellidæ* of Schmidt, dividing it into three families :—First, the *Vitreo-hexactinellidæ*, or those sponges whose spicules are held together by silicified fibre ; secondly, the *Sarco-hexactinellidæ*, or those whose skeleton spicules are held together by amorphous sarcode ; and thirdly, the *Sarco-vitreo-hexactinellidæ*, or those whose spicules are held together in one part by vitrified fibre, and in the other by amorphous sarcode, and which at present contains only one species. These, again, are divided into six groups, namely, *Patulina*, *Tubulina*, *Scopulifera*, *Rosettifera*, *Birotulifera*, and the single species, *Euplectella cucumer* of Owen, in the third Family.

In all the *Hexactinellidæ* known we find a minute flesh spicule in the form of a rosette, which may be defined as an equi-armed, sexradiate spicule, from the ends of whose arms proceed a certain number of rays, which, although the same on each arm of the specimen, vary in form, number, and arrangement with the species, but always project from the ends of the arms. These spicules often afford, in conjunction with others, a means of specific distinction. When I say that the spicules are formed on the hexradiate plan, I mean that there is a primary axis, which may be long or short, and at one point four secondary rays cross this central shaft at right angles. Often one half of the central shaft is absent or shortened, or is represented by a rounded boss, and we have then a spicule with a cross-shaped head, an often occurring form in the defence and ornament of the surface layer of these sponges. Sometimes the secondary rays may be partially or wholly undeveloped, which occurs in young spicules and others which are slightly abnormal, but in their place may be seen four little elevations near the middle of the spicule, maintaining the permanence of the type.

In some cases a fifth ray is developed, as in the surface layer of *Holtenia Carpenteri*. At the distal end of the central shaft a rosette similar to the flesh spicule may be found, as in *Euplectella* and *Dendrospongia*.

Those sponges which are found in the deep water ooze, as most

in this order are, anchor themselves by means of delicate glassy filiments, like fine white hair or spun glass, which in case of the *Hyalonema*, or Glass rope Sponge, sends down through the soft mud a coiled wisp of strong spicules, each spicule about as thick as a moderate sized needle, which opens out into a brush, and fixes the sponge in its place. The ends of these spicules are supplied with an anchorate or grapnel form of termination.

In the case of *Euplectella aspergillum*, the late Sir Wyville Thompson tells us that this sponge is imbedded up to its fretted lid in the grey mud of the seas of the Phillippines.

In a short paper, as the present one must be, I can only just touch on one or two of the sponges contained in the first two families of this order, hoping at some future time to bring others before your notice.

First, then, taking an example of a sponge held together by silicified fibre, we have *Euplectella aspergillum*, Euplectella being derived from two Greek words signifying "well-woven."

Most of you are familiar with the cornucopia-shaped sponge, that at first sight can hardly be imagined to have been formed by any member or aggregation of members so low in the Animal Kingdom, but so it is, and the structure being so intricate, I shall take my description from Mr. Carter.

"It has its spicular basket-work, both of the body and lid, throughout, cemented together by an envelope of vitreous, ladder-like fibre, which ladder-like fibre in a horny state is also a peculiarity of some of the Keratose sponges. The main lines of spicules are longitudinal and transverse, so that cutting each other at right angles and at nearly equal distances, they leave a number of squarish areas in the intervals, occupied alternately by round holes and matted basket-work. Through this arrangement the squares with holes and basket-work respectively form diagonal lines, again crossing each other, but now obliquely and somewhat spirally round the body; while a number of compressed ridges or frills, about a quarter of an inch high, formed of the same kind of vitreous spicular structure as the rest of the sponge, run along in more or less continuous spiral lines, obliquely through the squares of matted basket-work, leaving those with holes free between them, finally terminating above in a line which encircles the lid-like end, where the latter is joined to the body. The lower end, on the other hand, which is also closed, but of a conical form, similar to the end of a

conical sac, is enveloped in a bunch of white horse-hair-like, long, anchoring spicules, respectively smooth and spiniferous, with hooks at the free extremity of the latter.

"The flesh spicule, a rosette many-rayed ; rays of equal length, sigmoid, clavate, and dentate outwards, claw-shaped, flexed and grouped *en fleur-de-lis*, or with rays of equal length, straight and pointed; occasionally with straight rays, few, and terminated by three or more spines at the free ends laterally." Those with the claw-shaped rays, or, as the late Dr. Bowerbank called them, the florocomo-sexradiate spicules, are found on the outer surface of the sponge, immediately beneath the dermal membrane, cemented to the apex of the distal portion of the central shaft of the spicules forming the beautiful quadrangular network surrounding the sponge. Specimens are difficult to obtain with these spicules *in situ*, as the majority of the sponges have been well washed before they come into our hands. When the first specimens of *Euplectella* were brought to England there was some little contention regarding its place in Natural History, some supposing, along with the fishermen who dredged them, that they were formed by some species of Crustaceæ as many were found with crabs in their interior; but how came the creatures there? Once in, they could not escape, and then again it was not always the same species that was found in them. Some naturalists thought that the sponge belonged to the Alcynoid family, forgetting the presence of the polyps which characterize an *Alcyonia*. At last it was decided that the *Euplectella* was a sponge, and that the crabs must have obtained entrance when both were in a young stage, and had grown up together. The base of *Euplectella* has often much sand and extraneous matter attached to the glassy filaments which yield very rare Foraminifera and other minute organisms.

I will now just draw your attention to the skeleton framework of *Farrea* and *Aphrocallistes*, both being comprised under the same family as *Euplectella*.

The *Farreas* are sponges more or less tubular and branched ; branches open, and slightly expanded at the free extremities ; walls thin, of only one layer.

Aphrocallistes is also tubular and branched ; branches closed at their free extremities ; wall thick and formed of polyhedrally reticulated fibre.

In some of the members of both may be found a scopuline spicule distinguishing the species.

The framework of both species shows how the hexradiate type is maintained throughout, although at first appearance it seems lost in the process of growth.

You will see that the fibre of both is formed by an extension of silicified sarcode, over a regular arrangement of sexradiate spicules, indicating that, whilst in a young stage, what is now siliceous was then horny, but that during the progress of growth of the sponge, silica was deposited, which gradually extending over the fibre, enclosed the original spicules. This conclusion was arrived at from the fact that in some specimens of *Farrea occa* and *Aphrocallistes Bocagei*, the anastomosing fibre was charged with minute sex-radiate and scopuline spicules of the sarcode imbedded in a confused way, showing that the silicification of the fibre was more or less of a secondary formation.

Fig. 10, Pl. III, shows the lattice-work of *Farrea occa*, Fig. 12, the same of *Aphrocallistes beatrix*, and Fig. 11, Pl. III, a fragment of *Farrea occa*, after Carter, enclosing a scopuline spicule with pointed rays.

All the sponges of this family will stand boiling in nitric acid, losing only the organic matter, the skeleton coming out a beautiful structure as if made of the purest glass. Of course the rosettes and minute spicules of the sarcode falling through the meshes and collecting at the bottom of the vessel, can be washed with water carefully, and mounted so as to be examined with higher powers than can always be used when they are *in situ*.

We must now pass on to the second Family of this Order, or those sponges whose skeleton spicules are held together by amorphous sarcode.

Perhaps foremost will stand the *Hyalonema*, the now well-known Glass rope Sponge, first brought over from Japan, and described by the late Dr. Gray in 1835, subsequently dredged off the coast of Portugal, and since then at various places by the "Porcupine," "Challenger," and other expeditions. This sponge having been now so often and well described, along with the deceptions practised by the Japanese regarding its position, &c., I shall take one of a comparatively new genus, named *Rossella*, after Sir John Ross, who brought over a few spicules only. This genus contains three species, viz., *R. Antarctica* (Carter), *R. Phillippensis* (Gray), and *R. velata* (Thompson). Taking *Rossella Phillippensis*, that being the specimen I have on the table, it is, in form, generally glo-

bular, or ovate, and occasionally cup-shaped, varying according to age, presenting a somewhat flattened summit in which there is an aperture, and a conical base which is closed, but rendered irregular by mammiform prolongations of the body, out of each of which issues a hair-like lock of long anchoring spicules, sessile, or fixed by the anchoring spicules; colour grey; external surface uniformly even, except where interrupted by the mammiform prolongations; cribbellate immediately below the lattice-work layer, surmounted by one form of spicule only, which issues, as before stated, in hair-like locks from the summits of the prolongations; internal surface of the cavity uniformly smooth, interrupted by depressions so increasing in size downwards as to occupy the whole of the lower part. Structural spicules of the body or wall of three forms;—first, a nail-like or conically headed spicule, the shaft vertically placed in the wall, and the arms spreading out horizontally over the external surface, so as to support the lattice-like layer of minute sex-radiate spicules imbedded in the dermal sarcode; secondly, a long linear spicule, often presenting in the middle two or four tubercles corresponding to the ends of the crucial branches of the sex-radiate central canal, terminating in spines, and more or less inflated extremities, but otherwise smooth; and thirdly, sex-radiates of different sizes, with arms of equal length, spined and pointed, chiefly composing the lattice-like structure and including the right rosette-like forms of spicule of the sarcode.

This species has also longer anchoring spicules than the other two, with the four stout spines or hooks recurved and opposite, which characterises the genus generally of *Rossella*.

Another difference in the structure of the species consists in its being without the veil of singular and beautiful form which is found in the other species, extending about a centimetre from the surface of the sponge, and formed by the interlacing of the four secondary rays of the large five-rayed spicules, which send their long shafts from that point vertically into the sponge body.

Figs. 6, 7 and 8, Pl. III, show forms of rosette occurring in *Rossella*, and Figs. 5 and 7, the free end of the anchoring spicules characterising the genus.

The third family, or that comprising the characters of the two forms combined, and of which only one species is, as yet, known, viz., *Euplectella cucumer*, I shall pass over, as the sponge has been well described by Professor Owen in the "Linnean Transactions" for

1857, and the original sponge may now be seen and examined at South Kensington.

Very little is known, as far as I can find, of the life-history of this order of sponges, the most, perhaps, being where Sir Wyville Thompson, after describing *Holtenia Carpenteri*, says, "When the sponge is living, the interstices of the silicious network are filled up, both outside and in, with a delicate fenestrated membrane formed of a glairy substance like white of egg, which is constantly moving, extending or contracting the fenestræ, and gliding over the surface of the spicules. This "sarcode," which is the living flesh of the sponge, contains distributed through it an infinite number of minute spicules, presenting the most singular and elegant forms characteristic of the species. A constant current of water carried along by the action of cilia passes in by apertures in the outer wall, courses through the passages in the loose texture of the intermediate sponge-substance, carrying organic matter in solution and particles of nourishment into all its interstices, and finally passing out by the large osculum at the top."

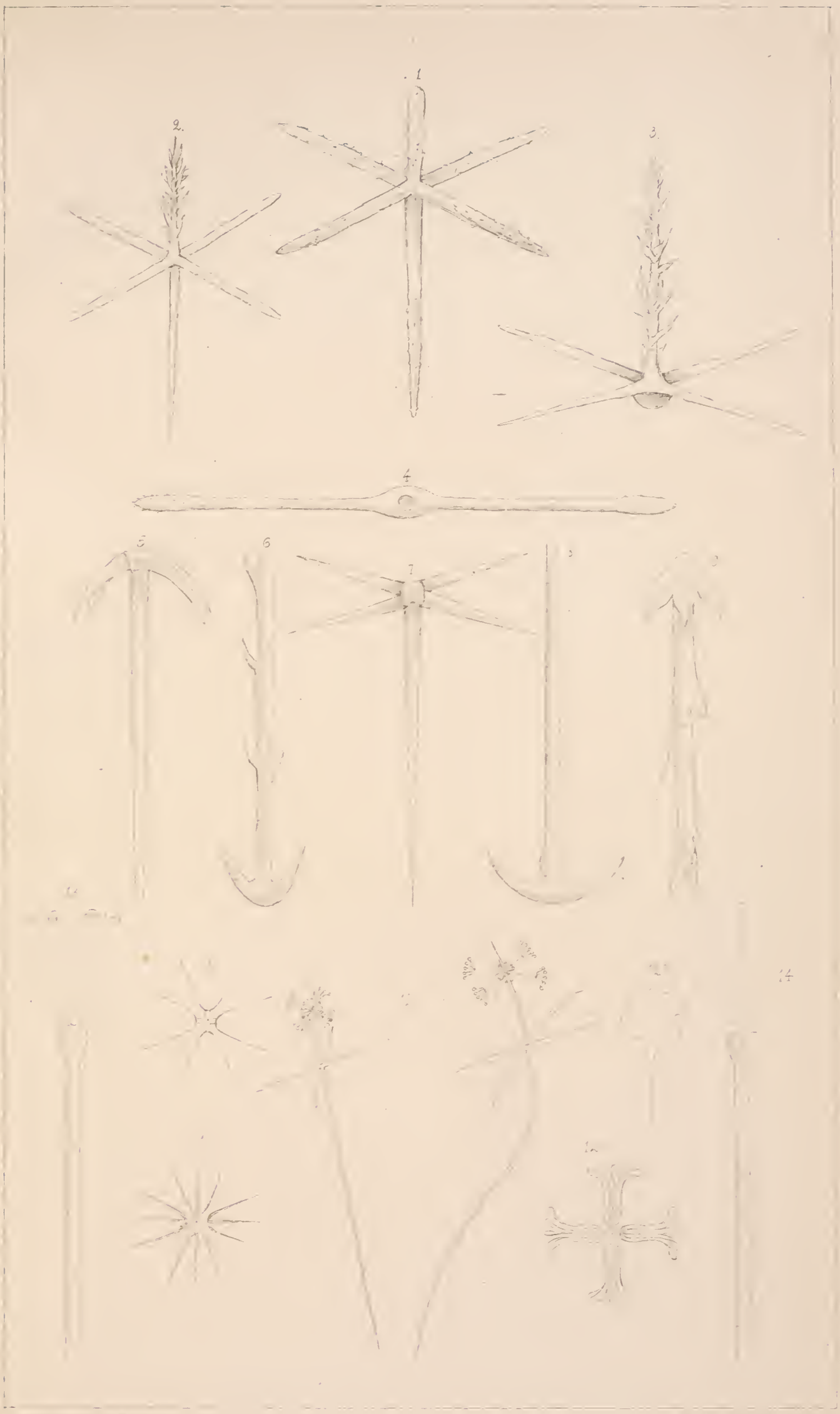
There is another sponge about which there has been much controversy as to whether it should be placed among the *Hexactinellidæ* or the *Tethyidæ*, viz., *Dorvillia agariciformis* of Kent, and *Tethyea muricata* of Bowerbank. This sponge has some of the characters of a *Tethyea*, but is certainly more closely allied to the order we have been considering. It seems to be a link between the two, showing how one species of sponge runs into another, as we may see over and over again.

A large number of the Fossil Sponges found in the chalk and greensand, and known under the name of *Ventriculites*, belong to the *Hexactinellidæ*, and most of them show an octohedral knot structure in the outer skeleton; but Mr. Carter tells me that he only knows of two existing species that show the same structure, viz., *Myliusia Grayi*, a specimen of which is in the Museum, and *Myliusia Zittilii*, from the Phillippine Islands, of which he kindly sent me a fragment."

DESCRIPTION OF PLATES.

Plate II.

Fig. 1, 2, 3, 4.—Typical spicules of the Hexradiate order of Sponges.
5 & 7.—Anchoring spicules of *Rossella*.
6.—Anchoring spicule of *Pheronema*.


1
2.
3.
4
5
6
7
14

A H Searle lith

8.—Ditto of *Labaria.*
9.—Ditto of *Euplectella.*
10, 11 & 12.—Flesh spicules of *Euplectella.*
12a.—Floricomo spicule of *Euplectella.*
12b.—Claw-shaped end of Ray of ditto.
13 & 14.—Scopuline spicules occurring in *Aphrocallistes.*

PLATE III.

FIG. 1.—*Rossella Phillippinensis.*
2, 3, 4, 5, 6, 7, 8, 9.—Some of the spicules of the same.
10.—Lattice-like framework of *Farrea occa.*
11.—Fragment of *Farrea occa*, enclosing a scopuline spicule (after Carter).
12.—Portion of skeleton framework of *Aphrocallistes Beatris.*
13.—Portion of the outer wall of a Ventriculite showing the octohedral structure of the silicious network.

NOTE.—In all the flesh spicules figured, the third axis, comprising the fifth and sixth rays, is omitted, in order to avoid complicating the drawing.

Description of some New Diatomaceæ found in the Stomachs of Japanese Oysters, by Fred. Kitton, Hon. F.R.M.S., Hon. Memb. Q.M.C.; with a List of the Species observed by E. Grove, F.R.M.S. Also a Description of some New or Undescribed Forms from other Localities, by F. Kitton.

Read June 27th, 1884.

PLATE IV.

The stomachs of Oysters and other molluscs have frequently been examined by Diatomists in the expectation of finding the siliceous skeletons of the Diatomaceæ mixed with the partially digested food ingested by the mollusc, among others by Gaillon, who, in 1820 described his *Vibrio ostrearius* (= *Navicula ostrearia*, Turpin = *N. fusiformis*, Grun., var. *ostrearia*, Turpin). M. De Brébisson found a new species of Amphora (*A. ostrearia*) in Calvados Oysters (Kützing, "Sp. Alg.," p. 94), and M. Bornet says that the Oysters in the beds at the mouth of the Loire become green by feeding on *N. fusiformis*, var. *ostrearia* (Grunow and Kitton in "Month. Mic. Jour.," 1877, p. 179); see also the details of M. Puységur's investigations "On the Green Colour of Oysters," in "Revue Maritime et Coloniale," Feb., 1880, and "Trans. Roy. Mic. Soc.," Vol. iii, 1880, p. 931.

M. P. Petit obtained from some Chinese Oysters two new species *Cocconeis Ningpoensis* and *Triceratium rostratum* and two new varieties *Achnanthes subsessilis*, var. *enervis*, and *Coscinodiscus lineatus*, var. *oculatus*, which he figures and describes in his paper, entitled, "Diatomées sur les Huitres de Ningpo et de Nimroud Sound (Chine)." ("Mem. de la Soc. des Sci. Nat. et Math. de Cherbourg," t. xxiii., pp. 201, 209, Pl. I, 1881.) In addition to the above he detected 72 previously described species.

Last year one of our members, Mr. G. Sturt, availed himself of the opportunity of purchasing some "tinned" Oysters from

Japan (of which some cases had been sent to the Fisheries Exhibition at South Kensington) for the purpose of making a microscopic analysis of the contents of their stomachs, and as his *modus operandi* may be of service to others who are desirous of examining the stomachs of Oysters and other mollusca, I give his directions for their preparation : "After opening the tin and pouring off the liquid contents, I empty out the Oysters and pick out the stomachs (which look like dark little sacs, and as a rule are free, or only partially surrounded by a little fatty matter, which is easily taken off). I then heat in a flask to boiling point five or six ounces of nitric acid, in which I drop one by one the stomachs, waiting until each is dissolved before adding another. After all have been dissolved I add an ounce of hydrochloric acid, and continue the boiling for five minutes, dropping in at intervals a little bichromate of potash. I now fill up the flask with hot water and empty the whole into a large beaker, filling up with the hot water (the fat rises to the surface, and on cooling congeals on the top, and is easily skimmed off). I wash away the acid, using hot water, and boil in soap and water according to Prof. H. L. Smith's direction.* If this does not get rid of the organic matter, I boil in sulphuric acid and chlorate of potash."

In addition to the numerous more or less well-known species found in these stomachs, Mr. Sturt detected several valves of an *Aulacodiscus*, which he exhibited at a meeting of the Club, held Dec. 14, 1883, as *A. angulatus*, Grev. Having some doubt as to the identity of the two forms, he forwarded to me for examination several specimens of the form he had found, and, on placing them under the microscope, I saw that they differed from any published species with which I was acquainted, and also from any of the numerous specimens in my cabinet. Under a low power they somewhat resembled *A. angulatus* and *A. amœnus*, Grev., but a greater amplification ($\frac{2}{3}$) showed the resemblance to be very slight, the difference being, in my opinion, of sufficient importance to constitute a new species. I, therefore, have much pleasure in naming it after the discoverer.

Aulacodiscus Sturtii, n. sp. F.K. Frustule cylindrical, valve with a large central elevation (usually flat on the top), not bullate below the processes, processes placed on the angles of

* The water used for washing must be filtered rain or distilled water, and free from all trace of acid.—F. K.

the central elevation, furrows distinct, puncta moniliform,* radiant between the margin and elevations, upon which they are more distant and less regularly radiant. Diameter, ·0029″ to 62″. Pl. IV. Fig. 1. The number of processes varies from 3 to 5.

The most conspicuous feature of this species is the flat, elevated centre, aptly compared by a correspondent to a miniature fort, the projecting processes resembling the guns.

Podosira maxima, Kütz., var.? Valve hyaline, and the punctate striæ more distant than in the type species.

P. maxima, abnormal. This remarkable monstrosity cannot be clearly understood excepting by reference to the drawing. The irregular configuration, apparently upon the valve, is really below it, and is probably a malformed internal valve. The specimen is a frustule, of which the upper valve appears to be normal, and shows conspicuously the irregular "black spots" which Herr Grunow, in his paper on the "Caspian Sea Diatoms" ("J. R. M. S.," Vol. ii. p. 689), says mostly mark the beginning of new rays of puncta, but from some observations I have recently made on styrax mounted specimens this does not appear to be the case, an examination under a binocular and a power of 400 diameters, illuminating with a paraboloid, showed the black spots to be trumpet-shaped tubuli extending in a direction more or less perpendicular to the upper and under surfaces of the valve, but apparently imperforate, as the styrax has not penetrated them, sometimes they appeared to be composed of elongated vacuoles like air-bubbles rising through a viscous medium, and which had become suddenly arrested.

The trumpet-shaped tubuli are not unlike those seen in a section of *Waldheimia australis*, or the pseudopodal apertures in Globigerina, &c. Pl. IV., Fig. 2, frustule. Fig. 3, diagrammatic section of valve.

Amphipleura pellucida, var. *rectus*, F. K. Valve linear, margins parallel up to the commencement of the furcate ends of the raphe, when the valve becomes lanceolate. Length, ·009 ; breadth, ·00075 ; striæ punctate, 65 in ·001″. Pl. IV., Fig. 4. Rare.

* Mr. E. M. Nelson has called my attention to the markings between the beadings, which give a granular or shagreen-like appearance to the surface of the valve, similar to that on *A. formosus*, in the immature valves of the latter species they appear as distinct punctæ, but as the valve increases in thickness they become less apparent. He also informs me that the *Aulacodiscus Hartianus* shewn by him at the meeting held Feb. 8, 1884 (*vide* Journ., Vol. i, S. 2, p. 371), was the above, Hartianus being a misprint.

In this variety the "porte-crayon" terminations of the raphe, so conspicuous in *Navicula Lewisiana*, and more or less so in all the species and varieties of the Vanheurckian group, is more distinct than in the other varieties of Amphipleura.

Navicula scopulorum, Bréb. *Forma major*. Valve punctato striate, about 65 in ·001." Length, ·008" to ·009"; breadth at centre, ·0006 to ·00065. Raphe and nodules somewhat resembling *Vanheurckia rhomboides*. Rare.

My friend, Mr. E. Grove, F.R.M.S., of Saltburn-by-the-Sea, has very carefully examined the Diatomaceous forms obtained from these Oysters, and has kindly permitted me to append his list to my description of the new species.

M. P. Petit's list, as previously stated, contains the names of 72 species. Ours contains more than 100, exclusive of the new forms. Probably several of those named in the list may prove, on further examination, to be new species or new varieties.

LIST OF MARINE SPECIES OF DIATOMACEÆ OBSERVED BY MR. GROVE IN PREPARATIONS FROM JAPAN OYSTERS.

Achnanthes longipes, Ag.
„ *subsessilis*, E.
Actinocyclus Ehrenbergii, Rlfs. Rare.
Actinoptychus undulatus, E.
Amphora marina, W. S. (*proteus*, Greg.). Scarce.
Arachnoidiscus ornatus, E.
„ *Ehrenbergii*, Bail.
Amphiprora alata, E. var. ?.
„ *elegans*, W. S. Scarce. (Qy., *A. vitrea*.)
Asteromphalus Brookei, Bail. Rare.
Auliscus cœlatus, Bail. Scarce.
„ *pruinosus*, Bail. Rare.
„ *Stockhardtii* ? Fragments only.
Biddulphia aurita, Breb.
„ *reticulata*, Rop.
Brébissonia Weissflogii, Grun. var. ? (Qy., *Schizonema Grevilleii*, W. S. large form.)
Campylodiscus dœmelianus, Grun.
„ *echeneïs*, Ehr. Scarce.
„ *undulatus*, Grev. Rare.
„ *græffii*, Gren. var., "Atl." xvi., 2. Rare.
„ *biangulatus*, Grev. Rare.

Cocconeis scutellum, E.
,, ,, var. *ornata*, Grun. (Qy., *C. Morrissii*, W. S.)
,, *diaphana*, W. S. ?
,, *intermedia*, Grun. ?
,, *distans*, Greg. Scarce.
Coscinodiscus oculus-iridis, E.
,, *centralis*, E. var.
,, *omphalanthus*, E. ?
,, *radiatus*, E.
,, *heteroporus*, E.
,, *eccentricus*, E.
,, *subtilis*, E.
,, *subconcavus*, E. ?
,, *subglobosus*, Grun.
,, *armatus*, Grev. ? Scarce, small form.
Cyclotella Dallasiana, W. S. Rare.
Denticula lauta, E. ? Scarce.
Epithemia musculus, E.
Gomphonema (Rhoikosphema) marinum, W. S.
Grammatophora marina, K.
,, *hamulifera*, K.
Mastogloia exigua, Lew. Rare.
Melosira sulcata, E.
Navicula interrupta, K. Rare.
,, *didyma*, E. Rare (small form).
,, *Smithii*, Breb.
,, *prætexta*, E. Rare.
,, *spectabilis*, Greg. Rare.
,, *carinifera*, Grun., "Atl." i., Fig. 2.
,, *Baileyana*, Grun.
,, (*Scoliopleura*) *convexa*, W. S.
,, *directa*, W. S.
,, *liber*, W. S. Also a var. with central stigmata.
,, *yarrensis*, Grun. Rare.
,, *aspera*, E. (*Stauroneis pulchella*, W. S.).
,, *bleischii*. Rare.
,, *formosa*, Greg. Rare.
,, *peregrina*, E. Small form.
,, *scopulorum*, Breb.
Nitzschia (Tryblionella) punctata.
,, ,, var. *granulata*, Grun.
,, ,, *gracilis*, Hantzsch. vars. A small hyaline form. (Qy., *Tryb. debilis*, W. A.).
,, ,, *constricta*, Greg. Scarce.
,, *panduriformis*, Greg. Rare.
,, *jelineckii*, Grun. Rare.

Nitzschia socialis, Greg.
,, *angularis*, W. S.
,, *sigma*, W. S. vars.
Hantzschia marina, Donk. Scarce.
Pleurosigma balticum, W. T.
,, *formosum*. W. T. var. Broad, with blunt ends.
,, *elongatum*, W. T. Small form.
Podosira maxima, K.
,, ,, *minima*, Grun.
Pyxidicula cruciata, E. ? Scarce.
Rhabdonema crozierii, E.
Rhaphoneis surirella, E.
Rhizosolenia hebetata, Bail. Scarce.
Stictodiscus californicus, Grev. Rare.
Surirella fastuosa, E.
,, *striatula*, Turp. var. Narrow, resembling *S. gemma* in outline.
,, *gemma*, E.
Synedra affinis, K. vars.
Triceratium arcticum, E.
,, *sculptum*, Shad. var. ? A central spine. (Qy., *T. maculatum*, Kitt., V.H., 112, 9, 10, 11.*

A considerable number of Freshwater species were observed, which were more numerous in some preparations than in others.

Campylodiscus noricus, E. Rare. *Cymbella*, two or three species, *Epithemia turgida*, *Navicula rhomboides*, E. *N. amphigomphus* (*firma*), E. *N. commutata*, Grun. *Surirella splendida* and vars. *S. spiralis*, S. W., not uncommon; *S. nobilis*, scarce; *Nitzschia (Hantzschia) amphioxys*, *Tabellaria*, &c., &c.

UNDESCRIBED SPECIES FROM OTHER LOCALITIES.

Surirella carinata, n. sp., F. K. Valve panduriform, apices broadly rounded, alæ slightly produced, costæ reaching to pseudo, raphe margin striate. Length, ·0055″; breadth, ·0036; width at construction, ·0026. Dredging—Lat., 20·1 S.; long., 57·25 E.; depth, ·1350 fms.—Pl. IV., Fig. 5., *a-b*, longitudinal and transverse sections (ideal).

The small quantity of material at my disposal yielded several valves, and fragments of valves, these showed very little variation in outline or markings. The centre of the valve has a longitudinal

* I have seen a form like the species figured in Schmidt's "Atlas," Pl. LXXVI., Fig. 11, which is a var. of *T. sculptum*.—F. K.

elevation like a reversed V (Λ), the top of which constitutes the pseudo raphe.

Sceptroneis ? clavus, n. sp., F. K. Valve cuneate, superior apex broad, rapidly diminishing to half its breadth, afterwards tapering gradually to the rounded inferior apex. Proceeding from the margins of the superior apex are nine longitudinal folds, gradually diminishing in length as they approach the sides; the raphe becomes forked a little below the three longest folds which it embraces. Striæ moniliform, about 28 in ·001″; length, ·01; breadth of superior apex, ·0016, do. inferior, ·0006. "Challenger" dredging. —Pl. IV., Fig. 6, *b-a*, superior apex.

I, at one time, thought this form might be an abnormal state of some species of Synedra or Sceptroneis, but having found several fragments all resembling the perfect specimen from which the illustration was made, I have come to the conclusion that it is a new species if not a new genus. In outline it very much resembles a horse-shoe nail.

Navicula Lyra, abnormal. Valve with one end broadly rounded, the other produced and mammiform; raphe imperfect, obsolete on the upper half of the valve, the smooth, lyrate spaces on each side of the raphe in the normal form are here represented by a horse-shoe shaped hyaline band, commencing a little above the central nodules, and terminating near the mammiform apex. Striæ moniliform, radiant on the upper half and sometimes confluent, having the appearance of radiating costæ, not reaching the margin of the rounded end. Length, ·0042; breadth at centre, ·0020; broad apex, ·0009; narrow apex, ·0003. In a gathering from Pensacola, Gulf of Mexico, sent to me by A. W. Griffin, Esq., of Bath.

This form very much resembles in outline two abormal forms of *Navicula (Stauroneis) maculata*, of which Herr Weissflog has kindly sent me photographs. In both specimens the striæ on the upper portion do not reach the margin of the broad end. In one specimen an irregular smooth space surrounded the central nodule, and a slight trace of raphe exists near the small apex; length, ·0048″; breadth at centre, ·0023″. In the second specimen a circular sub-central smooth area is visible, the terminal nodules lying just within its circumference. The lower half of the raphe is normal, but that of the upper part is nearly at right angles with it. Length, ·0043; breadth, ·0023.

F. K. & H. Sarrie de.

These forms occurred in a gathering from Marble Head, Mass., U.S.

DESCRIPTION OF PLATE IV.

FIG. 1.—*Aulacodiscus Sturtii*, × 600 dia.
2.—*Podosira maxima*, × 400 dia.
3.— ,, diagrammatic section of valve.
4.—*Amphipleura pellucida*, × 400 dia.
4*a*.— ,, apex, × 800 dia.
5.—*Surirella crinata*, × 400 dia.
a-b, ideal sections of do.
6.—*Sceptroneis clavus*, × 360 dia.*
a, superior apex of do., × 600 dia.
7.—*Navicula Lyra*, abnormal, × 600 dia.

This valve is apparently slightly abnormal, the pseudo raphe is not central, and one angle of the broad apex is lower than the other. Fig. *a* represents a fragment of another valve.

* Shows the moniliform character of the striæ.

Note on Mermis Nigrescens.

By R. T. Lewis, F.R.M.S.

Read June 27th, 1884.

Those members of the Quekett Club who are old enough in that relationship to remember its earlier proceedings, will perhaps recollect that at the Ordinary Meeting in August, 1867, a paper was read "On *Mermis Nigrescens*," a hair worm which at that time was attracting considerable attention. At that remote period of our history the Quekett did not possess a Journal of its own, but the paper in question was preserved from oblivion by the then Editor of "Science Gossip"—our now respected President.

Referring to the paper as it appeared in that periodical for October, 1867, it seems that on the 2nd of June in that year a thunderstorm occurred, accompanied by heavy rainfall, and that on the following morning immense numbers of these worms were found upon trees and shrubs, as well as on the grass and on the soil, throughout the counties of Sussex, Kent, Surrey, and Middlesex. The facts were mentioned at the time at the Entomological and Linnean Societies, as well as the Quekett Microscopical Club; and specimens were exhibited here which had been forwarded by a friend at Bognor. It was also stated that similar sudden appearances of these worms in large numbers occurred in the years 1781, 1832, and 1845—on each occasion in the month of June, and after thunderstorms with heavy rainfall. During the 17 years which have intervened my enquiries for further specimens of these creatures have proved fruitless, but on the 5th of June, 1884, we were visited with a severe thunderstorm, followed by heavy rainfall, which continued without interruption for about 24 hours; and on the following day, whilst stooping to remove a weed from a flower-bed, my attention was arrested by *Mermis Nigrescens*, suspended by the tail from a carnation plant, and waving its slender body to and fro in the air. Further search speedily resulted in the discovery of

numerous other specimens, some on rose bushes and plants, others upon the ground, but all alive and active, and in a mature condition ; I could, however, only find them on the western side of the garden, the wind during the day having blown from the east, and the eastern side being much sheltered by trees. On the following morning not one could anywhere be found, and where they came from, or went to, remain as much unanswered queries as in 1867, though at that time, as on former occasions, a belief prevailed amongst the rural population that they had fallen from the clouds during the storm.

The finding of these specimens during the present month enabled me to repeat and to verify the observations made in 1867, and this under the more favourable conditions that these recently obtained were living, whereas those formerly received from Bognor were dead and dry when they came to hand. In general appearance the two lots are precisely similar—from $3\frac{1}{2}$ to 5 inches long by about $\frac{1}{30}$ inch in diameter, their colour varying with the quantity of ova which they contained, the darkest specimens probably enclosing not far short of 10,000.

The spirally striated character of the translucent integument is very marked in the living specimens, and seems to furnish a clue to their extraordinary muscular power and movements, for whilst readily able to coil up into a helix of about $\frac{1}{10}$ inch in diameter, it was noted that when seized by one end the body became almost rigid, and many specimens were taken which were erect and waving to and fro in the air for at least $\frac{3}{4}$ of their total length. One specimen, whilst under the microscope, was observed to expel a quantity of ova which, when placed under a $\frac{1}{2}$ inch objective, were at once seen to possess the curious appendages formerly noticed, each ovum being enclosed in a delicate hyaline capsule, having one or more extremely fine brush-like processes at each end. Specimens of the worms, both alive and mounted, are exhibited in the room, and under another microscope the ova, with their appendages, are also shown ; these are simply placed under a cover glass upon a hollowed glass slide, in a little water, as any attempt to mount them has hitherto only resulted in the rupture of the capsule and escape of the worm. It is mainly with the hope of eliciting some suggestions as to the probable use of these appendages that I have ventured this short note upon an old subject.

Note.—Since the above was written and on the afternoon of

July 6th a severe thunderstorm again occurred, rain falling heavily for about two hours ; immediately on the cessation of the storm I searched the garden for Mermis, and succeeded in finding six more specimens.

My attention has also since been directed to the observations of Dujardin on this subject, as quoted by our late President, Dr. T. S. Cobbold, in his work on "Entozoa," p. 59, in which these processes are regarded as *funiculi*.—R. T. L.

Q.M.C. EXCURSIONS.

List of Objects Found on the Excursion to the Gardens of the Royal Botanic Society of London by Messrs. Badcock, Bartlett, Cocks, Dr. M. C. Cooke, Messrs. Dunning, Funston, Glasspoole, Hardy, Mainland, Parsons, and Rousselet.

19th April, 1884.

ALGÆ.

Cladophora fracta.
Oscillaria Frölichii.
,, *tenerrima.*
Scytonema Hoffmanni.
,, *Julianum.* W. and N.

DESMIDIACEÆ.

Closterium lunula.
,, *moniliferum.*
Pediastrum Boryanum.
,, *granulatum.*
Scenedesmus quadricauda.

DIATOMACEÆ.

Amphipleura sigmoidea.
Cocconema lanceolatum.
Encyonema cæspitosum.
Naviculæ.
Pinnularia nobilis.
Pleurosigma littorale.
Synedra capitata.

INFUSORIA.

Acineta tuberosa and various forms of *Podophrya.*
Actinophrys.
Amblyophis viridis.
Amœba princeps.
Astasia limpida.
Cothurnia imberbis.

INFUSORIA.

Dileptus folium.
Epistylis anastatica.
„ *grandis.*
Euglena longicauda.
Paramecium aurelia.
Phacus longicaudus.
Spongilla fluviatilis.
Stentor, sp.
„ *cæruleus.*
„ *Mülleri.*
„ *polymorphus.*
Stylonichia.
Vaginicola crystallina.
Vorticella microstoma.
„ *nebulifera.*
Zoothamnium simplex.

ROTIFERA.

Brachionus amphiceros.
Dinocharis tetractis.
Distemma forficula.
Floscularia cornuta.
Limnias ceratophylli.
Mastigocerca carinata.
Metopidia.
Monocerca rattus.
Œcistes crystallinus.
Œcistes umbella.
Phylodina erythrophthalma.
Pterodina patina.
Rattulus lunaris.
Stephanocerus Eichhornii.

POLYZOA.

Fredericella sultana.
Plumatella repens.

ENTOMOSTRACA.

Cyclops tenuicornis.
Canthocamptus.
Chydorus.

And other common species.

PLANARIA.

Sp.

ANNELIDA.

Nais digitata.

Thirty-five members of the Club, with three friends and nine members of other Societies, making a total of forty-seven, joined the excursion, and were very delighted with the opportunity of visiting these Gardens, afforded by the kindness of Mr. Sowerby, who conducted the party through the conservatory and other houses and the grounds. Mr. Sowerby's great attention was highly appreciated by all present.

List of Objects Found on the Excursion to Chingford by Mr. Cocks, Dr. M. C. Cooke, Messrs. Glasspoole, Mainland, J. T. Powell, Dadswell, and Funston.

3rd May, 1884.

ALGÆ.

Oscillaria tenuis.

Protococcus.

Spirogyra decemina.

Spirogyra quinina.

Volvox globator.

DESMIDIACEÆ.

Closterium acerosum.

,, *Ehrenbergii.*

,, *moniliferum.*

Cosmarium botrytis.

Penium margaritaceum.

Straurastrum polymorphum.

,, *punctulatum.*

MUSCI.

The protonema of a moss, easily mistaken for a species of *Stygeoclonium*, very numerous in the ditch at the Cuckoo pits.

Aulacomnion palustre.

Dicranum.

Pogonatum piliferum.

Sphagnum.

FUNGI.

Byssosphæria aquila, Fr.

FUNGI.

Peziza aphala, B. & Br.

,, *Curreyana*, B.

CHARACEÆ.

Nitella opaca, male plant with antheridia in beautiful condition.

DIATOMACEÆ.

Nitzschia.

Pinnularia nobilis.

,, *viridis.*

INFUSORIA.

Actinophrys Eichhornii.

,, *sol.*

,, *viridis.*

Anthophysa Mülleri (vegetans).

Arcella dentata.

,, *vulgaris.*

Bursaria vernalis.

Euglena longicauda.

Lacrymaria proteus.

Peridinium cinctum.

Stentor Mülleri (white in gelatinous tubes).

,, *polymorphus.*

ROTIFERA.

Anuræa curvicornis.

Brachionus.

Conochilus volvox.

Dinocharis tetractis.

Euchlanis sp.

Floscularia, sp.

Hydatina senta.

Melicerta ringens.

Metopidia sp.

Monocerca rattus.

Œcistes umbella.

Philodina.

Tardigrada.

ENTOMOSTRACA.

Chydorus sphericus.

Cyclops.

Daphnia.

PLANARIA.

Planaria lactea.

MYRIAPODA.

Polyxenes lagurus.

ARACHNIDA.

Chelifer cancroides.

PHANEROGAMS.

Drosera rotundifolia.

Ruscus aculeatus.

And many other common species.

Twelve members of the Club, and three members of other Societies attended. The weather was very unpromising, and doubtless deterred many from joining the Excursion.

List of Objects Found on the Excursion to Totteridge by Dr. M. C. Cooke, Messrs. Dadswell, Funston, Hardy, Mainland, and J. T. Powell.

17th May, 1884.

ALGÆ.

Aphanothece stagnina.

Apiocystis.

Bulbochæte setigera.

Chætophora pisiformis.

Gonium pectorale.

Mesocarpus, sp. Without fruit, and therefore cannot be named.

Nostoc piscinale.

Œdogonium ciliatum.

,, *Vaucherii.*

Olpidium endogenum, in Mesocarpus.

Oscillaria limosa.

,, *tenuis.*

Spirogyra flavescens.

,, *nitida.*

,, *quinina.*

Staurospermum, sp. Without fruit, and therefore cannot be named.

Stigeoclonium protensum.

Ulothrix tenerrima.

Zygnema stellinum.

A filamentous alga—cells about length of four diameters, with two stellate bodies in each cell.

Volvox globator, with yellow resting-spores, but some, although revolving, were without spores and full of a filamentous substance.

DESMIDIACEÆ.

Closterium Ehrenbergii.
„ *lunula.*
Euastrum oblongum.
Pediastrum Boryanum.
„ *Ehrenbergii.*
„ *granulatum.*
Scenedesmus acutus.
„ *quadricauda.*
Straurastrum gracile.

DIATOMACEÆ.

Cocconema lanceolatum.
Pleurosigma angulatum.
Surirella.
A stipitate diatom.
„
Micrasterias.

CHARACEÆ.

Nitella flexilis—in fruit.

INFUSORIA.

Actinophrys sol.
Anthophysa Mülleri.
Arcella vulgaris.
Bursaria truncatella.
Chætonotus larus.
Chætotyphla armata.
Coleps hirtus.
Euglena viridis, and the red form of ditto.
Epistylis.
Stentor niger.
„ *viridis.*
Vaginicola crystallina.
Vorticella, many varieties.
Stylonichia.

ROTIFERA.

Euchlanis triquetra.
Floscularia cornuta.
„ . *ornata.*
Limnias ceratophylli.
Melicerta ringens.
Œcistes crystallinus.
Rattulus lunaris.
Stephanoceros Eichhornii.
Triarthra longiseta.

ENTOMOSTRACA.

Camptocercus macrourus.
A Cyclops, not figured in Baird.
Diaptomus castor.

HYDRACHNIDA.

Arrenurus globator.

NEMATOIDEA.

Anguillula fluviatilis.

MISCELLANEA.

A globular gelatinous cyst, the size of a pea, containing numerous ova and nearly hatched larvæ, probably dipterous.

PHANEROGAMS.

Ranunculus lingua (Greater Spearwort).
Acorus calamus (Sweet Flag).
Sherardia arvensis (Field Madder).

The day was fine, but the excursion was not so well attended as might have been expected. Possibly Totteridge may be thought by some to be exhausted, but the foregoing list shows that there are still many objects to be obtained in that neighbourhood ; in addition to those enumerated some curious forms of *Volvox* and some very beautiful Rotifers were found by the Secretary, who regrets that he had not time to identify them. Other interesting objects were also found by him.

The number of members of the Q.M.C. who attended the Excursion was twelve. Four members of the Hackney Society were also present, as also one member from the S. London ; these with one or two friends, made up a total of nineteen.

List of Objects Found on the Excursion to Woking by Messrs. Dadswell and Parsons.

Saturday, 7th June, 1884.

ALGÆ.

Volvox globator.

INFUSORIA.

Vaginicola.

Stentor Mülleri.

ROTIFERA.

Conochilus volvox.

Floscularia.

Melicerta ringens.

Stephanoceros Eichhornii.

Limnias ceratophylli.

ENTOMOSTRACA.

Daphnia pulex.

A Daphnia—probably *reticulata*, having the eye at the end of a blunt rostrum.

Diaptomus castor, male and female.

Eurycercus lamellatus.

Polyphemus pediculus.

CHARACEÆ.

Nitella opaca, female plant with archegonia.

PHANEROGAMS.

Drosera rotundifolia.

„ *intermedia.*

Owing to the weather during the week having been very wet, the Excursion, as regards numbers, was a failure, only four members, three of whom are on the Excursions Sub-Committee, attending, but they had a very enjoyable afternoon. Mr. Fredk. Enock kindly met them at the station and pointed out the likely spots for finding objects of interest.

Fredk. A. Parsons.
Hon. Sec., Excns. Sub-Com.

PROCEEDINGS.

April 25th, 1884.—Ordinary Meeting.

Dr. M. C. Cooke, M.A., A.L.S., 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. Jno. Higgins and Mr. J. W. P. Laurence.

The following donations to the Club were announced :—

"Journal of the Royal Microscopical Society"	From the Society.
"Proceedings of the Geologists' Association"	,, ,,
"Journal of the Postal Microscopical Society"	,, ,,
"Proceedings of Belgian Microscopical Society"	,, ,,
"Science Gossip"	,, Publisher.
"The Analyst"	,, Editor.
"Science Monthly"	,, ,,
"The American Naturalist"	In exchange.
"The American Monthly Microscopical Journal"	,, ,,
Dr. Cooke's "Fresh Water Algæ," Part 8 ...	Purchased.
"Annals of Natural History"	,,
Coles' "Studies in Microscopical Science" ...	,,
"Challenger Reports," Vol. 8	,,
"Album of Woods," by Wilmusdafer	,,
"The Flora of Middlesex"	From Mr. Crisp.

The thanks of the meeting were voted to the donors.

The President, on behalf of the Excursion Committee, wished to remind the members that the excursion season had commenced, and that two excursions had already taken place. It was intended this season to introduce a new feature by giving out papers to the members to be filled up and returned to the Secretary, indicating the various objects found, and giving figures of such as it had not been possible to identify. The papers filled up at the first excursion were so satisfactory that it had been thought desirable to lay them upon the table that evening, so that others who purposed attending future excursions might see how it was done, and that others might be able to judge of the practical utility of the plan. He thought that the collection thus formed would be a most interesting record of the out-door work of the Club. And he would just call attention to the sketches which accompanied many of the papers as evidencing that there was drawing power as well as singing power in the Club.

Mr. Badcock thought he might say that these two excursions illustrated the necessity for looking in unlikely places, for they were very apt to become accustomed to look only in what they considered to be likely places, forgetting that others were very often those where something very rare might be found. At Keston many were disappointed at not finding any *Batrachospermum* at the well as usual, but others who went to another pond found large masses of it in fine condition. In the bog he found *Surirella bifrons*, and on looking at it under the microscope he discovered that which had been a subject of some dispute, namely, the filmy pseudopodia, very clearly defined. The same remark would equally apply to their last excursion to the Botanic Gardens, where in the Victoria Regia house, on the rootlets of one of the water plants, *Epistylus* and *Philodina* were found in greater abundance than he had ever seen them before.

Mr. Ingpen described a new form of Camera Lucida, by Dr. Schroeder. At first sight it might not appear to be new, but there was a very special and interesting difference between this and any other. Dr. Schroeder admitted that he made out the principle of it whilst working out Mr. Wenham's prism for high powers. By means of a drawing upon the board he (Mr. Ingpen) showed that the usual displacement was got rid of, owing to the image having two reflections, and that the whole of the field was taken in, the light being moderately bright from the object, and the image of the pencil being beautifully clear. Until he had tested the results Mr. Wenham had been equally sceptical with others as to the value of any Camera Lucida with superimposed images.

Mr. Michael called attention to an unrecorded species of the genus *Myobia*, which he found some time since amongst some specimens which were sent to him by the Rev. C. R. M. Burrows, of Brentwood. It was amongst a number of others taken parasitic upon the ordinary small Bat, found in a cavern in Gloucestershire. A diagram of the specimen was drawn upon the board, and its distinctive features, particularly the peculiarity of the foot, were pointed out. It was proposed to call it *Chiropteralis*.

Mr. E. T. Newton (occupying the chair in the absence of the President) proposed a vote of thanks to Mr. Michael, which was unanimously carried.

Mr. E. M. Nelson read a letter from Professor Hamilton Smith, with regard to diatoms mounted in his new high refractive media. Professor Smith had sent over three more slides—those formerly sent having gone bad—and one of these, a specimen of *Amphipleura pellucida*, was exhibited under a ¼in. with student's microscope.

Mr. Nelson also drew attention to a prize of £100, recently offered by the Linnean Society of Sydney, for the best paper on the Bacilli of typhoid fever.

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

Announcements of meetings, &c., for the ensuing month were then made, and the proceedings terminated with the usual conversazione, and the following objects were exhibited :—

Spirorbis nautiloides	Mr. F. W. Andrew.
Philodina erythropthalma	Mr. J. Badcock.
Epistylis anastatica	"
Cristatella mucedo	Mr. W. G. Cocks.
Section of stem of *Carex paludosa* (Sedge) ...	Mr. C. G. Dunning.
Marine mite. *Halacarus*, sp.	Mr. H. E. Freeman.
Larva of *Tabanus* (Gadfly)	Mr. J. D. Hardy.
Stentor Mulleri	Mr. T. J. McManis.
Myobia chiropteralis, ♀ and ♂ n.s.	Mr. A. D. Michael.
Larva of an eutozoon	Mr. E. M. Nelson.
Gonium pectorale	Mr. C. Le Pelley.
Fredericella sultana	"
Section of scale from *Sciadopitys verticillata*	Mr. J. W. Reed.
Scale leaves of ditto	"
Fredericella sultana	Mr. C. Rousselet.
Trans. sec. Tongue of Cat	Mr. F. Steele.
Diatom, *Triceratium Normannianum*	Mr. G. Sturt.
Clava squamata	Mr. A. Wildy.

Attendance—Members, 66; Visitors, 4.

May 9th.—Conversational Meeting.

A demonstration on polarized light was given by Mr. Charles Stewart, F.L.S., F.R.M.S., &c., who observed that, as it was some 20 years since he had worked at the subject, he had hoped to have had an opportunity of revising his knowledge, but a pressure of business had borne especially hard upon him, and he really had not had an opportunity of doing what he would have liked to do.

He purposed, as this was a *demonstration*, to first explain shortly the various arrangements he had brought to illustrate the theory and use of polarised light.

Having briefly explained the generally accepted theory of light, as consisting of certain vibrations of the ether caused by the active molecules in the source of light, as, for example, the flame of a lamp, and illustrated his remarks by diagrams on the blackboard, he passed on to consider what changes were found in light when modified by polarization.

The vibrations being restricted to some one particular direction, causing lineal or plane polarization, the beam would display distinct sides, one in the plane of its vibrations, and the other in a plane at right angles to the first.

The simplest form of table polariscope for examining light was a series of thin glass plates, the lowest one blackened at the back, a piece of ground glass being placed between the lamp and the bundle of plates to diffuse the light, and a piece of clear glass being placed between the bundle of plates and the observer, and forming an inclined support on which the films of selenite and mica could be conveniently placed and manipulated.

It would be found that, when light was received by the bundle of glass plates at the proper angle, which angle varied with different bodies, but was about 56° 35′ for glass, a portion of the beam of light was refracted and passed through the glass, being absorbed by the blackened surface at the back. If the light that is reflected is examined by another bundle of glass plates or a rhomb of Iceland Spar, known as a Nicol's Prism, the beam no longer behaved as white light, but appeared to possess sides, the light vibrating in a plane corresponding to the parallel surface of the glass.

By means of a diagram, he showed how the waves of light would force their way into the bundle of glass. It would be seen that by using a bundle of thin plates or a Nicol's Prism it was possible to analyse the beam of reflected light.

In one position the prism allowed the light to pass through, and a bright field was seen, but if the prism was rotated until it was at right angles, no light could pass, and a dark field was the result. This was illustrated by first placing the fingers of one hand parallel with those of the other, and then placing the fingers of one hand at right angles to those of the other, in which latter position they could not, of course, pass in the same plane.

He next directed attention to a disc of mica, mica being preferable for these experiments because it was far more easily split into large and uniform films. This disc of mica had a direction in which there was a special strain or tension. An ordinary ray of light, in passing through such a crystal, was divided into certain vibrations in the direction of this strain and others at right angles to it.

When this piece of mica was placed on the table polariscope, with the line of tension at an angle of 45° to the plane of vibration of the polarized ray, the mica would present various colours according to its thickness, because the vibrations in the direction of the particular strain were passing through the crystal with different velocities: the one the ordinary ray, and the other the extraordinary ray, and these differed in their rate of transmission.

These rays entered the rhomb of Iceland Spar, and were again split up into two by the same law as the original beam, so there were now four sets of vibrations to deal with, two of which were vibrating at right angles to the other two, the extraordinary ray of one set corresponding with the ordinary ray of the other. [This was illustrated and explained by a diagram on the blackboard.]

Now these four sets of rays, of which two sets were parallel but passing with different velocities, reached the film of Canada balsam which cemented the two halves of the rhomb together; the vibrations in the plane of the balsam film were reflected to the side and absorbed by the tube in which the rhomb was placed, and the others were transmitted to the eye.

The result was that two sets of vibrations were wiped out, and two sets remained to be dealt with, which were coincident with each other; one of these had got out a little in advance of the other. Meeting in opposite phases, the vibrations of a certain length—say red—would clash with the red of the other; the ether particle would not move at all, but would come

to rest. In other words, there would be a polarized object presenting a green colour.

To ascertain whether any object would polarize or not, it was necessary to turn it round in all positions ; so the polariscope must be capable of rotation, or the object must be capable of rotation on it. Sometimes it was more convenient to rotate the polarizer, sometimes the object. The analyser should also have a rotating motion.

He then explained by means of a diagram in which the bands of colours given by different thicknesses of films were shown in their proper position, that the effect was precisely the same whether there was a minimum of tension or a minimum of thickness in a given film, and traced the changes of colour given by the different thickness of films of mica.

In practice, it was often found more convenient, instead of trying to split a film to a particular thickness, to use two or more films of mica or selenite of a uniform thickness.

Taking a glass disc on which were fixed two small semi-circles of mica of different colours, he placed over them another larger circular film with a hole in the centre, and, placing the two plates on the table polariscope, the effect of the added film was seen at a glance.

Through the central aperture, the single films could be seen ; further out, the result of the added film ; and, beyond the smaller films, the colour of the added film. The changes effected by rotating the films were shown with the greatest clearness and simplicity.

Then as to the various thicknesses of films which were best to use in the microscope. If it was desired to produce the more beautiful effects, it was simply a matter of taste ; some preferred the most brilliant colour, with dashes of black, giving more vivid features such as so many people admired. A Spanish lady would prefer scarlet or orange with a black shawl, and she would show her good taste.

There were others who would prefer softer, gentler tints of pink, and so on, and it could not be said they were wrong.

Those who wanted vivid colours of the first type should view the object without selenite ; with selenite the black of the first case is replaced by the colour of the selenite used.

What was actually learned by using the selenite film, with the least possible trouble, was not only whether a body was in a state of tension or not, but what was the direction of the tension, whether pulled, strained, or squeezed. This was done in a second, because if it were known what colour an object presented with any given film of selenite whose direction of tension was known, say blue, and the object previously blue appeared black when examined without the selenite, it was perfectly clear that the tension was at right angles to that of the film of selenite.

But how can the direction of the tension in the film of mica or selenite be determined ? Many years ago he adopted the following plan:—He took small squares of glass, placed them in an ordinary clay pipe, put them into a clear fire until of a nearly red heat, and then cooled them at an open window. A good many of them cracked, but he obtained a number in a state of

unequal tension, caused by the contraction of the surface, and the interior trying to shrink into a smaller compass, but being prevented by the hard jacket outside. Taking one of these as a standard, he was enabled to determine easily the condition of the piece of mica. With the crossed Nicol's Prisms, there would perhaps be found a black cross bisecting the white square, in consequence of the glass being in a state of tension—now suppose a piece of mica, blue of the second series, placed over the glass gave the colours green and red, the direction of tension of the mica would be the same as that of the green parts of the glass. Having determined one film and marked it, it was very easy to determine others.

There was another fact that was useful, not so much for instruction as for the beauty of some of its effects. Under ordinary circumstances the colours simply passed from the red into green through the neutral zone. If a piece of mica were used which had only the thickness which corresponded with the quarter of the space between the first purple and the commencement of pure white [as shown on a diagram], then it would be found that by this so-called $\frac{1}{4}$ film, when placed over any of the doubly refracting objects with its principal section corresponding with, or at right angles to, the plane of polarization, the light is so retarded that, instead of plane polarized light, there would be produced circularly polarized light. The advantage was this, that where with a simple selenite no colour was obtained, with the $\frac{1}{4}$ film the colours would change on turning from indigo blue, through yellow, orange, red, and purple, to green, which of course greatly enhanced the beauty of many objects when viewed with a $\frac{1}{4}$ film.

The question then arose, What thickness of film was most useful? He had not the slightest doubt it was what was known as the blue of the third series. This was the most sensitive of all, simply because this blue was a very narrow belt; on one side close against it was a very bright red, and on the other side a brilliant emerald green. A very thin film will at once change this blue to brilliant green or brilliant red, either contrasting vividly with the pale blue ground.

If the deep blue of the second series were used, it would not give half the effect, because it was so broad.

In one of the table polariscopes he would place a couple of films touching each other; over that he would put a blue film of the same thickness as that combined with the orange. In one position this makes the blue black; in the other the blue becomes red, and the orange becomes green, according to the position of the film. Take off the blue film and rotate the analyser, the orange becomes blue and the blue orange. If, however, the $\frac{1}{4}$ film be used, instead of each passing through a neutral point to its complimentary colour, it would pass through all the series of colours.

Norremberg's Doubler was a simple arrangement for passing the rays twice through the film, which was the same as if we had the power of practically doubling the thickness of the film. This arrangement was particularly useful for testing the thickness of films.

The eye was very treacherous as regards colours, and could not always be trusted, but by the above plan the accuracy of one's judgment can be tested.

In concluding his remarks, Mr. Stewart said that he had placed under several microscopes some objects to illustrate the various points he had explained, and he shortly pointed out some of the most interesting features, showing how useful polarised light was in searching out details of structure which could not be detected by ordinary light.

At the close of his remarks the members were invited to examine the following objects with various arrangements of mica and selenite films exhibited by Mr. Stewart and Mr. C. J. Fox, when further explanations were given by those gentlemen :—

Sulphate of nickel and potash	Mr. Chas. Stewart.
Striped Human Muscle	,, ,,
Ovarian tube of Cidaris	,, ,,
Epidermis from Human Foot, showing sweat ducts, &c.	,, ,,
Various Mica and Selenite films and designs for table polariscope	,, ,,
A series of Norremberg Mica Plates by convergent light	Mr. C. J. Fox.
A pair of Mica Wedges of 24 films, giving the three orders of Newton's colours; when crossed producing checks, and when placed diagonally, a series of points	,, ,,
A micro slide of two strips of Selenite ground thin along their centres and crossed, showing a central square figure with four radial arms	,, ,,

The following objects were exhibited in the Library :—

A new species of Rotifer	Mr. F. W. Andrew.
Section of Grape Vine	Mr. A. L. Corbett.
Horned Aphis, *Cerataphis latonie*	Mr. F. Enock.
Trophi of Wild Bee—*Halicthus*	Mr. H. E. Freeman.
Nitella opaca	Mr. H. G. Glasspoole.
Section of *Dolerite*	Mr. A. V. Jennings.
Sulphate of Cadmium	Mr. G. E. Mainland.
Diatoms, *Triceratium arcticum*	Mr. W. H. Morland.
,, *Amphipleura pellucida* in Prof. Smith's new medium	Mr. E. M. Nelson.

Attendance—Members, 74; Visitors, 9.

May 23rd, 1884.—Ordinary Meeting.

Dr. M. C. Cooke, M.A., A.L.S., 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 C. Havers, Mr. Ernest L. Lancaster, Mr. Alfred C. Tipple, and Mr. Charles West.

The following donations, &c., to the Library were announced:—

"Proceedings of the Royal Society"	From the Society.
"American Monthly Microscopical Journal"...	In Exchange.
"Quarterly Journal of Microscopical Science"	Purchased.
"Annals of Natural History"	"
Ray Society's last volume (Michael's "British Oribatidæ")	"
Prantl's "Text Book of Botany"	"
Rutley's "Studies of Rocks"	"
Cole's "Studies in Microscopical Science" ...	"
Klein's "Elements of Histology"	"
Pascoe's "Notes on the Origin of Species" ...	"
Re-statement of the Cell Theory, by Pat. Geddes	"

The thanks of the Club were voted to the donors.

The following extracts from a letter from Mr. Kruitchnuit, of New Orleans, was read by the Secretary:—"The perusal of an article 'On Sand,' by J. G. Waller, published in the 'Quekett Journal' for July, 1882, gave me the idea that I had discovered a new source (at least to me) of sand. Two years ago when I sojourned a few days at Hot Springs, Arkansas, I discovered in one of the hot-water tanks some conferva. The water was almost boiling hot. The formation in which the springs are found is chiefly clay slate. A bushel of the quartz crystals adhering to the filaments of the conferva would certainly be taken for sand, and for sand of the purest kind."

Mr. J. G. Waller said—Having given the slide sent with this letter a complete examination, I fail to detect the usual character of quartz crystalline formation. Viewed by ordinary light, the particles are dull and dirty-looking, not clear and transparent, neither when examined by polarized light is there the response indicated by quartz. One very minute particle gives colour, but it does not seem to belong to the rest. The outlines of the particles are rounded, but not by attrition; it is the character of their formation, which is generally ovate. Much consists of a conglomerate of minute parts. Where some crystalline forms are seen, they resemble more that of calcareous matter, such as spar, talc, &c. Some test is required before we can affirm these particles to be silex at all; and I am inclined to think otherwise. At any rate, they are not of quartz, which is always more or less translucent, and never has the dull appearance which is here indicated.

Mr. Ingpen said that the question with regard to it was—Whether it was

quartz? Because if so, it became interesting to know how the quartz became collected. A piece of *nitella* growing in perfectly pure water had the power somehow of secreting mineral matters, so that they might find within its structure not only the usual calcareous secretion, but also nodules of what he supposed was carbonate of lime, which had been secreted by the plant, and it seemed an interesting question whether quartz had been secreted in some similar way.

Mr. Waller said the fracture gave the granules the appearance of small particles of quartz sand.

Dr. Matthews said it was a well-known fact that *Equisetum* and the grasses secreted silex, and that in the bamboo small nodules of secreted silex were found. These were collected by the natives of the districts in which it grows, under the belief that they possessed great medicinal properties.

Mr. T. C. White said he had a lot of confervæ some time ago which were corked up in a bottle; after a while, the colour all went out of the confervæ, and they became surrounded by crystals similar to those of the slide. These were not silicious, and as they dissolved in acid he assumed them to be calcareous.

Mr. Ingpen, referring to the new mounting medium introduced by Professor Smith, said that he did not think he had ever seen a slide of *Amphipleura* so well shown as the one which Mr. Nelson exhibited, which was mounted by Professor Smith. No doubt the objective and the manner of showing it had something to do with the matter, but there was also no doubt that something was due to the medium. He could only say that probably the exhibition had never been surpassed or equalled, and the fact was to be recorded as an era in the history of resolution.

Mr B. W. Priest read a paper "On the Hexactinellidæ," which he illustrated by numerous diagrams.

Mr J. G. Waller thought that Mr. Priest was to be thanked for having brought this subject before them, and for having compiled it in a very easy and familiar manner.

A hearty vote of thanks to Mr. Priest for his paper was proposed by the President, and carried unanimously.

The President said he had two or three small matters with regard to the excursions, to bring before the notice of the Club, some of which related to the past, and others to the future. He wished to say, First, that the plan which had been adopted of placing in the hands of members blank forms to be filled up with the particulars of specimens found, and to be posted to the Secretary of the Excursions Committee during the week, had been eminently successful, not only in identifying and preserving a record of the objects, but also in stimulating those concerned to exert themselves to know something of the objects which have been found. Secondly, at each of the gossip nights the Secretary proposes to bring down the papers relating to the previous excursions for the members to look over.

The President then read lists of the objects found at the excursions to the Botanic Gardens and to Chingford, and expressed a hope that a larger

proportion of members than one-fourth would take the papers on the next occasion, and would do their best to fill them up.

Announcements of excursions and meetings for the ensuing month were made, and it was mentioned that owing to continued illness Mr. Gilburt would be unable to fulfil his engagement to give a demonstration on June 13th, but that the Secretaries were doing their best to provide some substitute.

Members were reminded that at the next ordinary meeting they would be called upon to nominate gentlemen to fill four vacancies upon the Committee, to be filled up by election at the annual meeting in July.

The proceedings terminated with the usual conversazione, and the following objects were exhibited:—

Silk cotton (qy., *Bombax*)	Mr. F. W. Andrew.
Section of Pampas grass, *Gynerium* Sp. ...	Mr. H. E. Freeman.
Ova and larva of *Tabanus*	Mr. G. E. Mainland.
Euplectella	Mr. B. W. Priest.
Bursaria truncatella	Mr. C. Rousselet.
Trans. Sec. stem of *Bignonia clanbrasiliana* ...	Mr. W. D. Smith.

Attendance—Members, 61; Visitors, 2.

May 30th, 1884.—Special Exhibition Meeting.

By the kind permission of the College a special meeting was held for the exhibition of objects of microscopical interest, which meeting was attended by about 130 members, and 160 visitors. The following is a list of the principal objects exhibited in the library, the museum of the College being also thrown open for the occasion:—

Leptodora hyalina	Mr. F. W. Andrew.
Serpentine from the Lizard	Mr. J. W. Bailey.
Gabbro from Silesia	,, ,,
Carcinus mœnas (Shore crab). Zoë stage ...	Mr. W. R. Browne.
Asterina gibbosa (Gibbous starlet). Young ...	,, ,,
Larva of *Carcinus mœnas*	Mr. E. Bucknall.
Epiera diadema, just hatched	,, ,,
Œcistes (*umbella?*)	Mr. W. G. Cocks.
Crystals of silver	Mr. A. L. Corbett.
,, ,, santonine	,, ,,
Antenna of Emperor Moth	Mr. H. Crouch.
Tingis hystricellus	,, ,,
Tongue of Mason Wasp...	,, ,,
Crystals of Platino-cyanide of magnesia ...	,, ,,
Foraminifera (*Miliolina oblonga*)	,, ,,
Diatoms, *Coscinodiscus*, sp.	,, ,,
Fredericella sultana	Mr. E. Dadswell.
Circulation in the gills of a Newt	,, ,,
Cyclosis in *Nitella fragilis*	,, ,,

Figure, tinted by coloured light, and seen through the eye of *Dytiscus* ...	Mr. A. Dean.
Cyclosis in *Chara*	Mr. C. A. Drake.
Young locust, *Œdipoda cruciata*	Mr. F. Enock.
Hemileia vastatrix. Fungus of coffee plant ...	Mr. H. Epps.
Section of Cacao Bean, showing crystals of Theobromine and starch grains in situ	,, ,,
Lophopus crystallinus	Rev. H. Fase.
Diatoms, *Arachnoidiscus*, in situ	,, ,,
Eyes of Spider	,, ,,
Leg of Blowfly, showing muscles, nerves, &c.	Mr. F. Fitch.
Rectal valve and papillæ	,, ,,
Reproductive organs of male bird's beak fly...	,, ,,
Micro harmonic curves and micro rulings, 4,000 lines to the inch; larger figures on glass for lantern, and various pendulographs...	Mr. H. E. Freeman.
Cyclosis in *Nitella*	Mr. W. Hainworth.
Statoblasts of *Cristatella mucedo*	,, ,,
Tubifex rivulorum	Mr. A. Hammond.
Limnodrilus Udekemianus	,, ,,
,, *Hoffmeisteri*	,, ,,
Spongilla fluviatilis	Mr. J. D. Hardy.
Carchesium, sp.	,, ,,
Photo-micrographs of Rock sections, crystals, &c., taken by polarized light ...	James How and Co.
Section of Butcher's Broom	Mr. C. Le Pelley.
,, ,, Mistletoe	,, ,,
Circulation and respiration in the tadpole ...	Mr. T. J. McManis.
Young fry of the Stone Loach...	Mr. G. E. Mainland.
Scale of Turbot...	Dr. Matthews.
Tortoise-shell Beetle	,, ,,
Marine annelids	Mr. A. D. Michael.
Schizonema Grevillei	Mr. H. Morland.
Dermaleichus from Woodpecker	Mr. T. S. Morten.
Leptodora hyalina	Mr. J. H. Oliver.
Archerina Boltoni	,, ,,
Acineta tuberosa	Mr. F. A. Parsons.
Podophrya, sp.	,, ,,
Melicerta tyro	Mr. T. Plowman, junr.
Ova of *Galathea squamifera*	,, ,,
Aphides on Primrose	Mr. F. Reeve.
Fern spores	,, ,,
Lophopus crystallinus	Mr. C. Rousselet.
Plumatella repens	,, ,,
Sections of coal	Mr. James Russell.
Cyclosis in *Nitella*	,, ,,

Helozoa	Mr. James Russell.
Pediculus vestimenti	Mr. W. Smart.
„ *scabei*...	„ „
Volcanic ash from Charnwood Forest... ...	Mr. G. Smith.
Phonolite from Cornwall	„ „
Leucite and *Dolorite* from Eifel	„ „
Trachyte „ „ „ Rhine	„ „
Trans. sec. spinal cord of Calf	Mr. F. Steele.
„ „ Human Kidney	„ „
Planorbis corneus	Mr. J. G. Tasker.
Cholestrin from alveolar abscess	„ „
Foraminifera. *Lagena*...	Mr. A. C. Tipple.
Ichneumon fly, *Diapria*	Mr. J. J. Vezey.
Saprolegnia Gabbardensis	Mr. J. G. Waller.
„ *Varniensis*	„ „
Crystals, Platino-cyanide of Strontium ...	Mr. J. Willson.

June 13th, 1884.—Conversational Meeting.

The sixth and last of the second series of demonstrations "On Staining Vegetable Tissues," which was to have been given by Mr. Gilburt, was taken up by Mr. W. Dalton Smith.

After remarking that he had been somewhat hastily called upon to supply the place of Mr. Gilburt, whose absence by reason of illness all must regret, Mr. Smith proceeded substantially as follows :—

"Staining, as applied to Vegetable Tissues, is used for *three* chief purposes —

1st. For rendering objects, which would otherwise be too transparent, more distinct, *e.g.*, cell-walls.

2nd. For differentiating one tissue from another, *e.g.*, cells from vessels.

3rd. For differentiating the protoplasm from the formed material.

The various kinds of stains employed for these different purposes may be conveniently grouped in accordance with the end in view, thus :—

1st. For rendering cell-walls, &c., more distinct, the single stains, logwood, carmine, or one of the aniline dyes.

2nd. For differentiating various tissues, double stains, of which the more usually employed are carmine and aniline green, picro-carmine, and magenta and aniline blue.

3rd. For staining the protoplasm only, Dr. Beale's carmine solution is usually employed.

It is not my purpose to describe all these processes to-night, since many of them have been fully treated of already; notably, single staining in aniline dyes, and double staining in magenta and aniline blue, by Mr. Gilburt, in a paper read before this Club May 25th, 1877; and double staining in picro-carmine by Mr. Stiles, in the "Northern Microscopist" for July, 1881. Dr. Beale, too, in "How to Work with the Microscope,"

gives directions for the preparation of the carmine stain that bears his name.

I propose, therefore, to bring before your notice to-night two processes only, viz., single staining in logwood, and double staining in carmine and aniline green, and shall refer only to the staining of *sections*, the methods being equally applicable to sections of stems, petioles, peduncles, leaves, ovaries, &c. In every case I shall confine myself to facts, and only describe methods that I have tried and proved to be successful.

Before I begin the practical part of this demonstration, let us assume that we have a piece of the stem of a plant, from which we wish to mount some sections. The various processes which will have to be employed before the section is ready to be put away in the cabinet may be conveniently grouped as follows :—

1st. Cutting, which may be subdivided into three processes —

(*a*) The preliminary preparation of the stem, hardening or softening, as the case may be.

(*b*) The process of imbedding in a suitable material, and

(*c*) The cutting process.

2nd. Staining, which may in like manner be sub-divided into two processes —

(*a*) Bleaching, and

(*b*) Staining proper.

3rd. Mounting, which may include also labelling.

Whether we use logwood, carmine, or other stain, we must first prepare the sections for receiving the stains by bleaching, except in the few instances where they are already colourless. If, as in the present instance, we wish to stain the formed material only, without having regard to the cell-contents, either in order to render the outlines of the cells, fibres, and vessels more distinct, or to differentiate them one from the other, the only preparation I have found of any use is a solution of chlorinated soda, which may be prepared as follows :—

Dissolve 2oz. of powdered washing soda (hydrated sodium carbonate) in half-a-pint of distilled water. Then shake up thoroughly 1oz. of chloride of lime in a like quantity of distilled water; add to this the solution of soda, and again shake thoroughly. A precipitate of carbonate of lime will be formed, the chlorinated soda remaining in solution. Allow the precipitate to settle, pour off the clear solution, filter it, and preserve it in a well-stoppered bottle in the dark. It is essential that the soda should be slightly in excess, as, if the chloride of lime is not completely neutralized, the lime that is left will combine with the carbonic acid of the air during the process of bleaching, forming a film of chalk, which will settle on the sections and completely ruin them. It will be best, after the preparation is completed, to test a small quantity of the fluid by adding to it some more solution of soda, when, if no precipitate is formed, we may conclude that the chloride of lime is completely neutralized. Should a precipitate, however, be formed, we must add more solution of soda to the bleaching fluid, re-filter, again test, and, if necessary,

repeat the process until we get a satisfactory result. The chloride of lime should be as freshly prepared as possible, and therefore it will be best to purchase it as we require it. It should be a perfectly dry powder—if at all moist it will be useless for our purpose.

If the sections have been preserved in dilute spirit, they must be floated on distilled water, and, when they have all sunk to the bottom, as much of the water as possible must be drained off, and a considerable quantity of the bleaching fluid poured over them. Examine the sections from time to time, holding the vessel containing them against a white background; a white china tile, such as can be bought at any artists' colourman for a few pence, answers admirably. Do not allow them to remain in the bleaching fluid longer than is necessary, but, directly they are quite bleached, pour off the fluid and fill the vessel up with clean water. Repeat the washing at least five or six times, allowing the sections to remain in the water for at least 12 hours, and using distilled water for the last washing; then preserve them in a mixture of equal parts of methylated spirit and water until they are required for staining.

In order to stain the sections with logwood, the first thing, of course, is to procure a suitable staining fluid, and for this purpose a preparation invented by Dr. Mitchell, of Philadelphia, and described in "The Science Monthly" for March last, gives by far the finest results of any stain I have yet seen. The principles involved in its preparation are as follows: Logwood contains, besides the colouring matter, considerable quantities of tannin, and vegetable infusions containing tannin are quickly influenced by the action of light and air. This is the cause of the muddy sediment deposited by most logwood stains, the colouring matter being also seriously affected by the decomposition. Now, tannin is readily soluble in cold water, whilst the colouring matter is but very slightly soluble in that fluid; hence, by washing the logwood, finely divided, with cold water, the injurious tannin will be removed without the staining properties of the logwood being materially affected.

Dr. Mitchell's directions, slightly modified, are as follows: First grind up some logwood chips in a coffee-mill. Then place the ground chips in a linen bag in a percolator, and pour cold distilled water over them until the liquid coming through is very slightly coloured and has no astringent taste. Then squeeze out as much of the water as possible, and spread the logwood on a plate to dry.

Take of the dried prepared chips, 1 oz.

Ground potash alum, $4\frac{1}{2}$ drs.

Distilled water, 6 fl. oz.

Glycerine, 2 fl. oz.

Dissolve the alum in the water, then add the glycerine and mix thoroughly. Macerate the logwood in this mixture for 48 hours, stirring at intervals, filter the resulting stain, and preserve it in a stoppered bottle.

Not only does the stain, thus prepared, give a very beautiful colour to the sections, cool to the eyes, and wonderfully sharp in outline; but it is also so selective that the various kinds of tissue are really differentiated, so

that for many sections a double stain is scarcely required. The process of staining with it is as follows:—

First, place the sections in distilled water, then add 20 drops of the logwood stain to 1 fl. oz. of distilled water, filter, and then place the sections in this for *about* half an hour.

Some sections, of course, will require a longer time than others. They must be examined from time to time, and when sufficiently stained should be washed *thoroughly* in distilled water. They are now to be placed in methylated spirit for at least half an hour, when they will be ready for mounting.

If it is not desired to mount them at once, they can be preserved for any length of time in the spirit.

Let us now consider the method of double staining in carmine and aniline green. You have all probably seen the directions given in various books on this subject, the whole process occupying something over 24 hours. Doubtless this plan has answered in some hands, but, although I have spoilt some hundreds of sections in endeavouring to stain them according to the directions given, I have never succeeded in getting even fairly good results. When I was almost in despair, my friend, Mr. Martin Cole, kindly showed me a very superior method of staining in borax carmine, and this method, somewhat modified, I have adopted ever since, with the most satisfactory results. One difficulty was to get the aniline green stain to take a firm hold of the wood and bast tissues, so as not to wash out during the soaking in alcohol; and, after various experiments, I found that the only way to ensure this was to stain the sections with an *aqueous* solution of the colour, and then to wash them in alcohol and so fix the stain, which, however, clung to them so tenaciously that they would bear soaking in water for a considerable time without any fear of its being washed out. I found also that it was necessary to stain with the green *before* staining with the carmine, since the latter was very speedily removed by water, and required washing in alcohol to fix it. Acting on the knowledge thus acquired, I have now entirely discarded the use of alcohol in all the staining fluids I employ, and invariably make use of glycerine as a preservative in its stead. I should also mention that I have given up the use of iodine green, and always use a solution of an aniline dye known as "acid green," since I find this gives far better and more reliable results. It can be bought at Messrs. Skilbeck Brothers, 205, Upper Thames Street, E.C., ¼lb. of the best quality costing 3s. 3d.

The green stain is prepared as follows:—

Take of acid green, 2 grs.

Distilled water, 3 fl. oz.

Glycerine, 1 fl. oz.

Thoroughly mix the glycerine and water, dissolve the acid green in the mixture, filter, and preserve in a stoppered bottle.

The borax carmine stain is prepared thus:—

(*a.*) Powdered borax, 10 grs.

Distilled water 1½ fl. oz.

Glycerine, ½ fl. oz

Dissolve the borax in the water, then add the glycerine and mix thoroughly.

(*b.*) Carmine, 5 grs.

Liquor ammoniæ fortiss, 20 m.

Distilled water, 30 m.

Dissolve the carmine in the ammonia and water in a test tube, with the aid of heat, and set aide to cool. Then add *a* to *b*, mix thoroughly, filter, and preserve in a stoppered bottle.

I have found that the glycerine being mixed with the borax solution effectually prevents the solution of carmine from changing to the dull lilac colour it assumes when the glycerine is not so employed. The stain, when completed, should be of a pure and brilliant ruby red.

The method of double staining in these two colours is as follows :—

1. Soak the sections in distilled water for a few minutes.

2. Place them in the acid green stain for from 3-5 minutes. They will then be uniformly stained green.

3. Wash them *thoroughly* in two changes of distilled water.

4. Place them in the carmine stain for *five* times as long as they were in the green, *i.e.*, for from 15-25 minutes, stirring them about in the stain with a camel's-hair brush from time to time.

5. Wash them *very thoroughly* in two changes of methylated spirit, allowing them to remain in it for at least 15 minutes.

6. Float them in oil of cloves, and as soon as they sink to the bottom of their own accord they are ready for mounting in balsam, the whole process, at the outside, taking no more than an hour for its completion.

The sections can be preserved for some time in the oil of cloves if they are kept carefully in the dark, but it is best to mount them as soon after staining as possible.

It will be observed that by this method, although the bast and wood are very perfectly differentiated from the cellular tissue, they are not differentiated at all from each other. I would suggest that the differentiation of the fibres from the vessels may prove a profitable direction in which to experiment.

In order to *cut* really good sections, three things are absolutely necessary :—

1st. The object must be properly prepared.

2nd. It must be properly imbedded ; and

3rd. It must be properly cut.

I am afraid people generally look upon the first as a rather superfluous proceeding. Animal tissues, of course, require very careful preparation, but vegetable stems or leaves are looked upon as quite ready to be cut just as they are taken from the plant. Never was there a greater mistake ; woody stems are generally much too hard to be cut without previous softening, whilst leaves, petioles, peduncles, and tubers are generally far too soft.

The plan I would suggest is this :—

1st. If the object is too large to be cut whole, divide it into pieces of a

suitable size for the well of the microtome, removing, at the same time, all extraneous matter, and all parts of which it is not desired to make sections.

Stems, petioles, and peduncles should be cut into pieces about an inch long.

Leaves of Dicotyledons should include the mid-rib if possible.

Roots and tubers should be first cut with a cork-borer into cylinders of about $\frac{1}{2}$ to $\frac{3}{4}$ inch in diameter, taking care that the axis of the cylinder is at right angles to the direction in which the sections are to be cut.

2nd, Hard objects, such as woody stems, are placed in distilled water for two or three days, changing the water every day, to dissolve out gummy matters.

3rd, They are placed in pure methylated spirit for three or four days, changing the spirit every day, to dissolve out resinous substances. They may then be placed in a mixture of equal parts methylated spirit and distilled water, until it is desired to cut them up.

If any of the objects are still too hard, they must be soaked in distilled water for a day or two, immediately before cutting. If this does not suffice, they must be placed in hot, or even boiling, water, for as long as may be necessary, the vessel containing them being kept in a warm place.

4th. Soft tissues must be hardened in alcohol—dilute, strong, or even absolute, as may be required.

It must be remembered that these are only general rules. The experience gained by practice will enable special cases to be treated in an appropriate manner.

By far the best substance in which to embed the object is carrot. It is important that this should be quite fresh and crisp, so as to break short off, without bending. If it is flabby it will not hold the object sufficiently firm; it may be preserved in good condition for a few days by being placed in cold water, and kept in a cool place.

A piece should be cut with a suitable punch to accurately fit the well of the microtome, and the ends cut off square. It is then to be divided longitudinally down the centre, and the object imbedded in it, so that, when the two halves are placed together, the object may be *rigidly* supported on all sides, without being unduly squeezed. The whole secret of successful imbedding lies in this. If the object be not sufficiently firmly held, or if it be pressed too hard, in either case good sections cannot be cut. They will either be of unequal thickness, owing to the material giving under the pressure of the knife, or will be broken by the squeezing it has received.

The plug of carrot containing the object is placed in the well of the microtome, when it will be ready for cutting; the microtome should be clamped to the table, so that both hands are at liberty, and the object should be kept flooded with a mixture of spirit and water.

The stroke should be made *from*, never *towards*, the operator; the razor should be hollow ground, and must have been rubbed down on a hone until, when placed on a level surface, every point of both back and edge touch at the same time; this is absolutely essential if we wish to cut good sections.

As regards the thickness of the sections, they should generally be of about

that of a row and a half of cells; but this must, of course, vary with the special point it is required to elucidate.

After the sections have been cut they may be preserved for any length of time in a mixture of spirit and water, until required for bleaching and staining.

In mounting the preparations when stained, two things must be considered, viz., the medium to be used, and the method of using it.

The only medium I have found suitable for mounting sections, stained by either of the methods I have described, is Canada balsam, hardened and dissolved in benzole. I have never yet been able to purchase any ready prepared that I considered suitable, and have been compelled to make my own; the method which I employed, and found successful, is as follows:—

About half a pound of ordinary Canada balsam is placed in a soup-plate, and warmed *gently* for some weeks, being stirred two or three times daily. I prepared mine on the top of the hot-water cistern of a bath-room, and found this answer very well. As soon as when cool—not cold,—it can be drawn out into tough threads, and does not stick to the fingers, it is to be placed in a bottle, and covered with benzole. In a few days it will be dissolved, and is then to be filtered through filtering paper moistened with benzole, when it will be ready for use. I find I get a far better preparation by dissolving the balsam whilst tough than by continuing the drying until it becomes hard and brittle, as recommended by some. If properly prepared, it should be of a pale colour, and of about the consistency of oil of cloves.

The method of using it is as follows:—

A glass slip is breathed on, and a clean cover placed instantly on the slip, to which it adheres. A drop of two of the balsam, prepared as I have described, is then placed on the cover. The object, which must be mounted direct from the oil of cloves, has as much as possible of the oil drained off, and is then placed in the balsam and covered with a few drops more of the same medium, and the whole is put away out of the dust for 12 hours or longer.

A fresh drop of balsam is now placed on the object, and the cover, with the object and balsam on it, is turned over on to a clean slip. The latter is then gently warmed, and the cover pressed down.

In a few hours the superfluous balsam can be scraped off, and the slide cleaned with a rag dipped in methylated spirit. If the balsam has been prepared as I have described, there need be no fear of the cover being displaced during this process.

The slide can then be finished off with white zinc cement, or any other that is preferred, and, when this is hard, can be labelled and put away in the cabinet.

The following objects were exhibited in the Library:—

Alcyonella fungosa	Mr. F. W. Andrew.
Trans. sec. Sciatic Nerve	Mr. M. J. Cole.
Vert. sec. Mucous Membrane from Stomach of Dog	" "

Diatomaceæ from Ormsby Broad	Mr. H. G. Glasspoole.
Tubifex rivulorum	Mr. A. Hammond.
Capitella capitata	,, ,,
Coccus of the vine	Mr. G. E. Mainland.
Diatoms, *Aulacodiscus Sturtii*	Mr. H. Morland.
Diatoms, *Amphipleura pellucida* in Prof. Smith's new medium	Mr. E. M. Nelson.
Floscularia ornata	Mr. R. Nevins.
Sections of leaves of *Pinus pinea*	Mr. J. W. Reed.
,, cotyledon of *Pinus pinea* ...	,, ,,
Fredericella sultana	Mr. C. Rousselet.
Trans. sec. stem of Mistletoe	Mr. W. D. Smith.
,, ,, leaf stalk of Camelia	Mr. J. Woollett.

Attendances—Members, 51 ; Visitors, 3.

June 27th, 1884.—Ordinary Meeting.

Dr. M. C. Cooke, M.A., A.L.S., 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. Edward Bates, Mr. Walter L. Burrows, and Mr. Sydney Cooper Tress.

The following donations to the Club were announced:—

"Proceedings of the Geologists' Association"...	From the Society.
"Proceedings of the Hertfordshire Natural History Society"	,, ,,
"The American Naturalist"	In Exchange.
"The American Monthly Microscopical Journal"	,,
"Science Monthly"	From the Editor.
"Science Gossip"	,, Publisher.
Cole's "Studies in Microscopical Science" ...	Purchased.
"Annals of Natural History"...	,,
Two photographs of Excursionists at Chingford	From Mr. T. C. White.

The thanks of the Club were voted to the donors.

Mr. T. C. White said that in presenting the photographs he should like to say that they must be considered as the work of only just a beginner. He regretted that they did not include the whole of the 63 members who went to the excursion, but they were most of them wandering, and he just caught the few only who sat down together by the pool at Fairmead. The photograph of the hotel was not so clear as it ought, and was desired, to be, but it was taken about six o'clock in the evening, when the light was by no means good, and although there was five seconds' exposure with open aperture the result was a rather dark picture.

The President reminded the members that the time had come round again for them to nominate gentlemen for election as officers and Council for the

ensuing year. The election would take place at their next meeting, being the annual meeting of the Club. He asked the Secretary to read the list of officers nominated by the Committee.

The Secretary then read the list of nominations as follows, viz. :—

As President, Dr. W. B. Carpenter, F.R.S.; as Vice-Presidents, Dr. M. C. Cooke, Dr. Matthews, Mr. Chas. Stewart, and Mr. Michael. Other officers the same as last time, and as auditor on behalf of the Committee, Mr. Hainworth.

The President then requested the members to nominate gentlemen to fill the four vacancies caused by the retirement of Dr. Matthews, Mr. Priest, Mr. Waller, and Mr. Hembry. Though only four would be elected, they liked to have at least six nominated, so that the election by ballot was not a mere matter of form.

The following nominations were then made :—

Mr. J. W. Reed,	proposed by	Mr. Parsons,	and seconded by	Mr. Newton.	
Mr. J. Parsons	,,	,, Mr. Waddington	,,	,, Dr. Matthews.	
Mr. T. C. White	,,	,, Mr. Dadswell	,,	,, Mr. Dobson.	
Mr. B. W. Priest	,,	,, Mr. Hardy	,,	,, Mr. Emery.	
Mr. E. T. Newton	,,	,, Mr. Lewis	,,	,, Mr. A. Smith.	
Mr. H. E. Freeman	,,	,, Mr. Andrew	,,	,, Mr. Buffham.	
Mr. Waller	,,	,, Mr. Newton	,,	,, Mr Michael.	

The President having requested the members to appoint an auditor to act on behalf of the Club, and Mr. Dobson having been duly nominated, Messrs. Hainworth and Dobson were unanimously elected as auditors.

Mr. R. T. Lewis read "A further Note on *Mermis nigrescens*," the subject being illustrated by coloured diagrams, and by specimens of both the worm and its ova exhibited under microscopes in the room. Living specimens were also shown.

The President said that Mr. Lewis had commenced with an apology for having brought up an old subject before them, but he thought that subjects of this kind, upon which additional information was desired, were just the kind they ought to have brought there.

Mr. G. C. Karop said that the whole subject was so involved in obscurity that it was not easy to say what was the entire life-history of these creatures. It would appear that the ova entered the larvæ of insects and there underwent development; when fully grown the first thunder shower seemed to induce them to quit their first hosts, probably for the purpose of seeking some other habitat in which to fully mature.

Mr. Lewis thought that the fact that all these worms were found containing large quantities of ova, which whilst under observation they continually expelled, indicated that they were in a mature condition. Those which he had kept since June 6th had remained alive and active, until they had extruded the whole of their ova; a few days after this was accomplished they died, their purpose in nature being then, as he supposed, accomplished. On a former occasion it had been suggested that the electrical conditions of the atmosphere might have had something to do with their remarkable appearances in such large numbers after thunderstorms.

Mr. Michael doubted whether the electrical conditions had much to do with the matter, except that during the summer months large quantities of rain rarely fell unless in connection with thunderstorms. He thought that if the ground could be equally flooded without any thunder the worms would no doubt come out in the same manner, their object, probably, being that they might get washed out and carried down into the streams or watercourses; it was, in all probability, a process by which they were transferred from a terrestrial to an aquatic host. Their occurrence was so rare that their life-history was not very perfectly understood. As regarded their being found upon trees and shrubs, it should be remembered that they were able to move in a very thin film of water, such as existed upon plants after a heavy shower of rain.

Mr. Hardy asked in what manner they were found attached to plants or shrubs?

Mr. Stokes enquired if there was any evidence to show that they were really aquatic worms?

Mr. Karop said the contention was that being sexually immature they were in course of transference from one host to another, in which their final development might take place.

Mr. T. C. White said he had once, when dissecting an insect, been surprised at seeing a worm of considerable length issue from its body.

Mr. Michael thought that this was probably one of the filarian worms.

Mr. Karop, referring to Huxley's "Anatomy of the Invertebrata," p. 644, read the following note:—"The insect parasites, *Gordius* and *Mermis*, are sexless so long as they are parasitic, but when they have attained their full growth they leave the bodies of their hosts, acquire sexual organs, copulate, and lay eggs; from these the embryos proceed which bore their way into the bodies of insects."

Mr. Lewis, in reply, said that they attached themselves to plants by coiling the tail round the stem of a leaf; the body then hung down and waved to and fro, much the same as a tree snake attached itself to a branch. He had no evidence of their being aquatic, but as they dried up and became hard and shrivelled when deprived of moisture he had put them into water as a likely means of keeping them alive for observation. Those exhibited in the room had lived under these conditions for more than three weeks, but having meanwhile laid nearly all their eggs he expected that they would now soon die.

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

Mr. F. Kitton's paper "On some New Diatoms found in Japanese Oysters" was taken as read, it being of a somewhat technical character. It will be found printed *in extenso* on a previous page.

Mr. J. D. Hardy exhibited and described a useful contrivance for collecting and examining aquatic specimens whilst out on excursions—it consisted of two plates of glass with a narrow strip of thick indiarubber cemented between them on three sides, the fourth side being left open, and thus forming a very convenient flat bottle for the side coat pocket. The space

between the glasses being sufficient to allow of Anacharis 5 in. long to be inserted without pressure, at the same time enabling the collector to bring all parts of the weed into good focus. By the insertion of an indiarubber flat cork the bottle is rendered water tight, and can be used as a slide on the stage of the microscope so as to obviate the necessity of disturbing the weed should any object of interest be observed when collecting. He also showed a simple and effective method of straining the water poured into or out of an ordinary wide-mouthed collecting bottle, by means of a small cylinder of copper wire gauze which extended up above the neck of the bottle.

Mr. Waddington said he could speak very favourably of the first described form of collecting bottle, having used the same thing for the last two years when collecting Zoophytes at the seaside. The only difficulty he had found was in getting a cement which would stand the action of sea water. He had, however, used with entire success a sea water varnish made of marine glue dissolved in chloroform, which he found was entirely impervious to sea water. It formed a thick paste, and was used cold. It was an excellent varnish for the joints of square aquaria.

Mr. Hardy said he had used liquid marine glue, and a great many other cements, but he found simple lard would do almost as well as anything else. Some chemical action seemed to take place which hardened the lard.

Mr. Karop exhibited and described a very simple and ingenious gauge made by H. Hensoldt for measuring the thickness of cover glasses. It was graduated to measure from O up to $\frac{1}{2}$ mm.

The thanks of the meeting were voted to Mr. Kitton, Mr. Hardy, and Mr. Karop for their communications.

The President directed the attention of the members to the book containing the results of the work done at the excursions, and referred to the list of objects obtained on the last two occasions.

Announcements of excursions and meetings for the ensuing month were then made, special attention being called to the whole day's excursion to Whitstable on July 5th, in connection with which a letter was read, and members intending to join were requested to give in their names at once to Mr. Parsons. Members were also reminded that the next ordinary meeting, on July 25th, would be the annual meeting.

The proceedings then terminated with the usual conversazione, and the following objects were exhibited:—

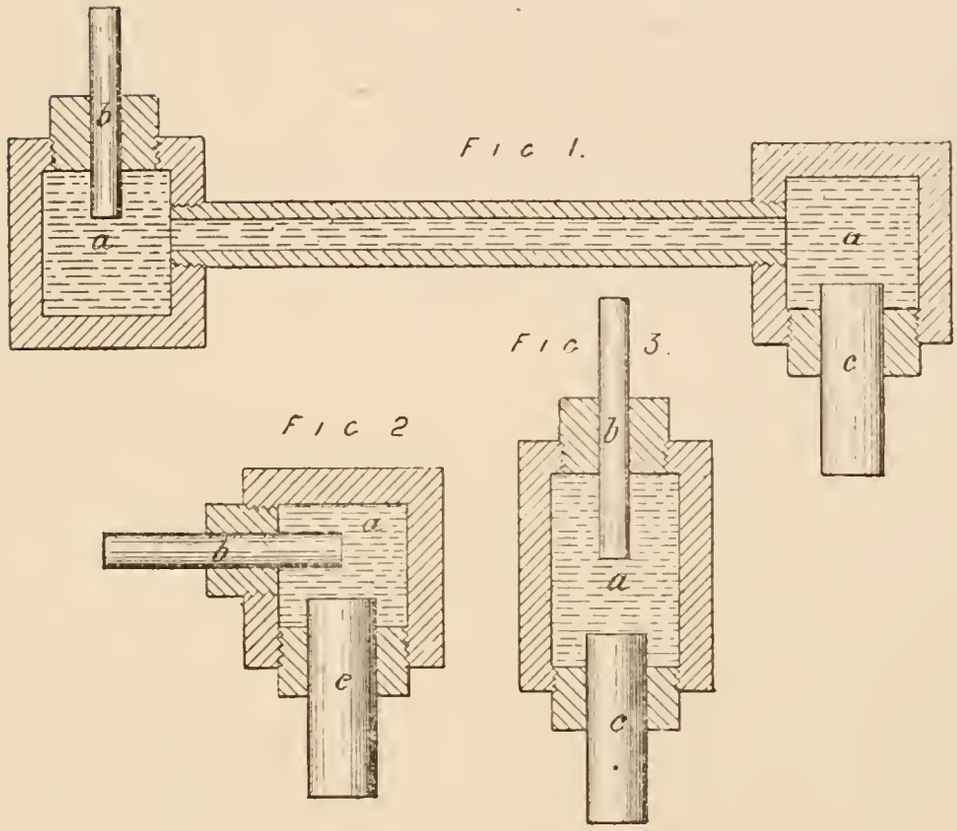
Fredericella sultana	Mr. F. W. Andrew.
Mermis nigrescens	Mr. R. T. Lewis.
Ova of *Mermis nigrescens*	,,
Trichodetes scalaris	Mr. T. S. Morten.
Trans. sect. of leaf of *Cryptomenæ japonica*...	Mr. J. W. Reed.
,, ,, ,, *Cryptomenæ elegans* ...	,,
Asplanchna Brightwellii	Mr. C. Rousselet.
Trans. sec. central canal of spinal cord of Calf	Mr. F. Steele.

Attendance—Members 48; Visitors 2.

On a Hydrostatic Fine Adjustment.

By E. M. Nelson.

(*Read August 28th*, 1884.)



The growing increase in the use of wide-angled object-glasses calls for some improvement in the fine adjustment of the microscope.

It must be remembered that depth of focus is inversely proportional to the numerical aperture, that the microscope is now used in a far more scientific manner than the rough-and-ready way of former days, and that critical pictures are now the only ones accepted by the best workers. A vast improvement has taken place in the construction of object-glasses, but the arrangements for fine adjustment remain pretty much the same as they were five-and-twenty years ago. The above diagrams illustrate a method of fine adjustment which has occurred to me, which I think would, if adopted, effect an improvement in this direction.

Fig. 1 shows in section the arrangement as adapted for a micro-

scope with a bar movement, Fig. 2 as adapted for the "Jackson Lister" form, and Fig. 3 as adapted for the continental model, or "student's" microscope. In Fig. 1 there are shown two iron chambers (*a*, *a*) connected together by a transverse pipe and filled with mercury; one of these chambers is provided with a plunger (*b*), the other chamber being similarly provided with a ram (*c*). The fine adjustment screw is intended to act on the plunger, and the ram on a stud carried by the nose-piece of the microscope, the stud being pressed against the ram by means of a spring.

In Fig. 2, the plunger (*b*) and ram (*c*) are both fitted to one chamber (*a*), so as to permit of its being used on the Jackson Lister model, and the fine adjustment screw may, in this case, be placed so as to act on the plunger on either side, or at the back of the instrument.

In Fig. 3, the plunger and ram are fitted to opposite ends of the chamber (*a*), in order to adapt the apparatus to the continental model. The application of the apparatus to this form of microscope would, in my opinion, be especially useful, and would materially increase its efficiency, for, as the fine adjustment is at present constructed, it precludes the possibility of fine and accurate pathological work being done with the instrument.

As shown in the Figs., the ram has a sectional area four times greater than that of the plunger; therefore the movements of the fine adjustment screw would be reduced in the proportion of one to four; but it is obvious that, by varying the relative diameters of the plunger and the ram, the ratio may be varied almost indefinitely, as, for example, a plunger of $1\frac{1}{2}$ inch and a ram of $\frac{1}{2}$ inch would give a ratio of one to thirty-six, so that one turn of a screw having fifty threads to the inch would only impart a movement of $\frac{1}{1800}$ of an inch to the object-glass.

Q.M.C. EXCURSIONS.

June 21st, 1884.

List of Objects Found on the Excursion to Epping Forest.

CONFERVOID ALGÆ.

Coleochæte	Mr. J. D. Hardy.
Rivularia pisum	Mr. G. E. Mainland.
Spirogyra quinina	,, ,,
Spirulina oscillarioides ...	,, ,,
Volvox globator, in various stages	Messrs. Hardy and Mainland.

DESMIDIACEÆ.

Closterium Acerosum	Mr. G. E. Mainland.
,, *lunula*	Messrs. Hardy and Mainland.

DIATOMACEÆ.

Pinnularia nobilis ...
,, *viridis* ...

INFUSORIA.

Amblyophis viridis ...
Amphileptus fasciola ...
Anthophysa Mülleri ...
Arcella dentata ...
,, *vulgaris* ...
Astasia hæmatodes ...
Chætonotus larus ...
Chilodon cucullus ...
Dileptus folium ...
Euglena longicauda ...
,, *viridis* ...
Euplotes vannus ...
Peridinium cinctum ...
Stylonichia lanceolata ...

ROTIFERA.

Anuræa, sp. ...
Brachionis amphiceros ...
Conochilus volvox ...

} Mr. G. E. Mainland.

ROTIFERA (continued).

Dinocharis tetractis ...	...	Mr. J. D. Hardy.
Monocerca rattus ...	...	Mr. G. E. Mainland.
Pleurotrocha gibba ...	...	Mr. J. D. Hardy.
Rotifer vulgaris ...	...	Mr. G. E. Mainland.
Scaridium longicaudum...	...	,, ,,

The following list was also received from Mr. Worthington G. Smith, who was a guest of the President:—

FUNGI.

Agaricus rubescens.
Boletus aestivalis.
Reticularia umbrina. Enormous specimen on hornbeam.
Uredo orchidis. On *Orchis maculata.*
,, *suaveolens.* On thistles.

Sixteen members of the Club, with six members of other Societies, started in the morning in accordance with the arrangements previously announced, and were conducted by Messrs. Hardy and Powell through Epping Forest along the route shown on the map issued with the circular. Ten members and eight visitors joined the Excursion in the afternoon. The day was very fine, but, owing to the long period of dry weather which had prevailed, the ponds were not very productive.

After the Excursion 45 of the members and 18 visitors dined at the Royal Forest Hotel.

June 28th, 1884.

The Excursion to Hampton Court was barren in results. In some years many interesting objects have been found, but this year there appeared to be nothing of importance. No papers were sent in, and the attendance was small, consisting of six members only of the Q.M C. and two members of the Hackney Society.

July 5th, 1884.

LIST OF OBJECTS FOUND ON THE EXCURSION TO WHITSTABLE.

ALGÆ.	
Enteromorpha intestinalis	Mr. J. Woollett.
Hypnea purpurascens...	
INFUSORIA.	
Noctiluca miliaris ...	
SPONGIDÆ.	
Grantia ciliata ...	
„ *compressa* ..	
Halichondria, sp. ...	
HYDROZOA.	
ACTINOZOA.	
Beroe, sp. ...	
HYDROID ZOOPHYTES (SERTULARIDÆ).	
Campanularia, sp. ...	... Mr. J. Woollett.
Laomedea dichotoma ...	... Mr. C. G. Dunning.
Plumularia setacea ...	... Messrs. Woollett and Dunning.
Sertularia, sp. ...	... Mr. J. Woollett.
(CORYNIDÆ.)	
Tubularia indivisa ...	... Mr. C. G. Dunning.
POLYZOA.	
Flustra foliacea ...	... Mr. J. Woollett.
Serialaria lendigera ...	... Mr. C. G. Dunning.
ECHINODERMATA.	
Ophiocoma rosula ...	... Mr. J. Woollett.
CRUSTACEA.	
Ammothea pycnogonidæ	... „ „

Ten members of the Club, and one member of the South London M. and N. H. Society, attended the Excursion. The weather was all that could be desired. The success of the day's proceedings was chiefly due to the admirable arrangements so kindly made by Mr. Saunders, of Whitstable, to enable the members to collect, by dredging and otherwise, the many beautiful and highly interesting marine objects to be found in the locality.

July 19th, 1884.

List of Objects Found on the Excursion from Caterham to Godstone.

CONFERVÆ.	Mr. G. E. Mainland.
Gonium tranquillum ...	
Oscillatoria ...	
DESMIDIACEÆ.	
Closterium acerosum ...	
Pediastrum Boryanum ...	
DIATOMACEÆ.	
Navicula ...	
Nitzschia sigmoidea ...	
Pleurosigma ...	
Surirella bifrons ...	
INFUSORIA.	
Amblyophis viridis ...	
Astasia limpida ...	
Euglena viridis ...	
Urocentrum turbo ...	
ROTIFERA.	
Pterodina patina ...	
Rotifer vulgaris ...	
NAIDINA.	
Nais proboscidea ...	
MICRO-FUNGI.	
Puccinea malvacearum ...	
PHANEROGAMS.	
Atropa belladonna ...	Messrs. Mainland and W. W. Reeves.
Carex paniculata ...	Mr. W. W. Reeves.
Chlora perfoliata ...	
Hieraceum murorum ...	
Lathyrus sylvestris ...	
Ranunculus arvensis ...	
Silaus pratensis ...	
MISCELLANEOUS.	
Gall of *Phytoptus aceris* on maple	Mr. G. E. Mainland.

Six members of the Club and five members of the Croydon Club attended the Excursion.

August 23rd, 1884.

LIST OF OBJECTS FOUND ON THE EXCURSION TO WALTON.

DESMIDIACEÆ.

Various species ...	Mr. J. Badcock.

DIATOMACEÆ.

Various species ...	,, ,,

INFUSORIA.

Anthophysa Mülleri ...	,, ,,
Cothurnia imberbis ...	Mr. R. T. G. Nevins.
Epistylis grandis ...	Mr. J. Badcock.
Stentors, various species	Messrs. Parsons and Badcock.
Spongilla fluviatilis ...	Messrs. Nevins, Parsons, and Badcock.
Vaginicola crystallina	Mr. F. A. Parsons.
Zoothamnium, sp. ...	,, ,,

ROTIFERA.

Lacinularia socialis ...	Messrs. Nevins, Parsons, and Badcock.
Limnias ceratophylli...	,, ,, ,, ,, ,,
Melicerta ringens ...	Messrs. Parsons and Badcock.
Stephanoceros Eichhornii	Messrs. Nevins and Badcock.

POLYZOA.

Alcyonella, sp. ...	Messrs. Parsons and Badcock.
,, *stagnorum*	Mr. R. T. G. Nevins.
Cristatella mucedo ...	Messrs. Nevins, Parsons, and Badcock.
Fredericella sultana ...	,, ,, ,, ,, ,,
Plumatella sp. ...	Messrs. Parsons and Badcock.
,, *repens* ...	Mr. R. T. G. Nevins.

HYDROZOA.

Hydra vulgaris ...	Mr. J. Badcock.

MOLLUSCA.

Physa fontinalis ...	Mr. F. A. Parsons.

PHANEROGAMS.

Ceratophyllum demersum	Mr. R. T. G. Nevins.
Villarsia nymphæoides	,, ,,

This excursion was attended by only four members of the Club. Mr. Badcock made a trip to Walton on the following Saturday in company with Mr. Parsons, and the list of objects found by him is given above.

FREDK. A. PARSONS,
Hon. Sec. Excursions Sub-Committee.

THE PRESIDENT'S ADDRESS.

Delivered at the Annual General Meeting, 25th July, 1884.

By M. C. Cooke, M.A., LL.D., A.L.S., &c.

Gentlemen,—On a similar occasion to the present, I took the opportunity last year of suggesting a subject for reflection and consideration, which seemed to me calculated to impart an interest to your holiday hours. On the present anniversary, I purpose, for a very short time, offering a few words of warning, which originate in a sense of duty, as I vacate your chair. A week or two since, whilst pondering a subject, I was skimming over one of those small volumes provided for railway travellers, which are presumed to furnish amusement rather than instruction, and encountered the following short paragraph :—

"The besetting sin of popular authors is the *intense*. I mean intensity of *epithet*—the strongest expression is generally the briefest and barest. Take the old ballads of any people, and you will find few adjectives. The singer says, 'He laughed; she wept.' Perhaps the poet of a more civilized age might say, 'He laughed in scorn; she turned away, and shed tears of disappointment.' But nowadays the ambitious young writer must produce something like this, 'A hard, fiendish laugh, scornful and pitiless, forced its passage from his throat through the lips that curled in mockery of her appeal; she covered her despairing face, and a gust and whirlwind of sorrowing agony burst forth in her irresistible tears.'" *

Naturally enough, as I thought, this little quotation sent me into a dream of intensities, and exaggerations, and sensationalism which seems to pervade everything in these latter days, politics, religion, science, art, business, and even common conversation. Manifest exaggeration, such as led Mark Twain to write his essay on "Decay in the Art of Lying," and to say, "Of course there are people who *think* they never lie; but it is not so—and this igno-

* "Echo Club Diversions," p. 61.

rance is one of the very things that shame our so-called civilization. Everybody lies—every day, every hour, awake, asleep, in his dreams, in his joy, in his mourning ; if he keeps his tongue still, his hands, his feet, his eyes, his attitude, will convey deception—and purposely. Even in sermons—but that is a platitude."

Half an hour's reflection will convince anyone that, in the main, this is a correct estimate of what results from the "intensity of epithet," the "exaggeration with a purpose," that appears to be a marked proclivity of the age. There are times and occasions when even this general tendency to exaggeration in some men, or bodies of men, goes beyond the ordinary standard, and then we recognise phenomena but little removed from insanity, psychological divergences from the standard of a sound mind. Many of these obliquities originate from a small basis of fact, but the fact is soon lost in the distortion, like the true proportions of a human face gazed at in a concave mirror. We are not concerned with revivalism, spirit-rapping, table-turning, millenianism, quaking, shaking, or jumping, or any form of religious fanaticism, as it is termed, but which is really nothing more than exaggeration culminating in sensationalism. Yet, after all, the process is the same, and the results the same, whatever the subject of the hallucination may be.

Those who, like ourselves, have been able from experience to compare these periodical outbursts during half a century must be well satisfied that the mental phenomena are identical. It matters not what the special subject, there is a decided and marked identity in the restlessness, fanaticism, dogmatism, energy, excitement, recklessness, and consequent suspension, or rather distortion, of healthy mental action.

The oldest of these waves, or currents, of popular idiosyncrasy were religious ; the most modern are scientific or artistic.

People have sometimes called them a "craze," and they have not been far wrong. It was the "æsthetic craze" but a short time since, and not long ago it was the "Darwinian craze." Although this did not apply, in any sense, to Darwin, who kept himself wholly clear of exaggeration and sensationalism, yet hosts of those who called themselves his disciples rushed without sense or reason into extremes which he repudiated, and made use of his name as an apology for their fanaticism.

Who does not remember the activity and intolerance of the followers of Pouchet, before their last hopes were shattered,

together with the monstrous extravagances into which some of them were seduced, perhaps at first insensibly, for the sake of argument, or in hopes of victory?

The animal nature of the Myxogasters was a short-lived hallucination which never attained any considerable strength, but the same cannot be said of the dual-Lichen hypothesis, which is so tenacious of life that it still retains a semblance of vitality. In all these instances, and many more which may be cited, the same elements are to be found—there is the same history, and will be the same final collapse. It is noteworthy that most of these "hallucinations"—for it is difficult to give them any other equally suitable name—start with an old prejudice, or a superstition, or a "popular belief," something which gives plausibility to the assumption. Then follows a search after analogies, and probabilities, and the construction of an hypothesis. Subsequently comes the era of experiments, often slovenly performed, but studiously without any exposure of the methods. When these latter become known, as in the case of Pouchet, their inefficiency is readily demonstrated. These experiments, being conducted with the view of proving a preconceived hypothesis, naturally enough furnish the required proof. It would be very strange if it were otherwise. We all know, with the microscope, how very easy it is to believe that you see just what you wish to see. And, finally, comes the agitation, the appeal to the "enlightened public," magazine articles, public lectures, newspaper paragraphs, and all the orthodox paraphernalia of a political campaign. Partisans are speedily made—for no theory was ever conceived that was too absurd to secure converts—and one by one new advocates appear, here and there a journal takes up the cause, provided its director has a notion that it will succeed, or pay, and the bubble glitters and sparkles awhile in the bright sunshine, until at length it shares the fate of all its kindred, leaving nothing behind but a dirty spot, and a bill for soap.

There would not be so much to regret in these manifestations, in most cases dictated by personal vanity, if they did not impose unwelcome labour on those who, whilst able to estimate such ebullitions at their true value, are nevertheless compelled to protest against them as exaggerations and distortions of the truth, lest by silence they are supposed to assent. Undoubtedly, in very many cases, if not in most, the agents are sincere enough, but having

deceived themselves, adopted a prejudice, suffered their judgment to become absolutely a slave to their hypothesis, they are rather to be pitied, in that they have become mentally blind, than blamed for leading others astray to fall into the same ditch.

How much of this unhealthy development is to be traced to the restlessness of the age, the craving after excitement, and a growing habit of exaggeration, I am content to leave to individual opinion. For my own part, I think such causes at least contributory to the class of phenomena alluded to.

Plain, straightforward investigation is safe enough and sure enough, there is no temptation to exaggerate. Facts are observed and recorded just as they occur; it matters little, if anything, to the observer, so long as they are true, what they may be supposed to prove or support, or overthrow, so long as he has no preconceived theory to work out, or controvert. But on the other hand, when a person sits down to his microscope, or his dissecting-table, absorbed with the one idea that some dream has to be realized, that all his facts are to be ranged in support of some hypothesis, or failing to do this, that they are to be buried in oblivion, then, unconsciously, he is no longer the patient observer, no longer the searcher after truth, but the partisan, restlessly, incessantly, fanatically, hunting up support for his own hypothesis with one eye blinded. Whether he starts with this idea or not, he soon falls into it, and, as I believe most strongly, damages himself more than he does good to any cause, however excellent that cause may be.

It is undoubtedly true that theories have been beneficial, and will be again, in the search after truth. An hypothesis is not to be condemned because it is an hypothesis, so long as it is rated as an hypothesis. The danger lies in being led away and made captive by an hypothesis, to be so absorbed by it, and work at it day by day, until it becomes a kind of incipient insanity, or, if you please, the mind is strained and distorted in a particular direction until it can no longer be called a sound and well-balanced mind. Any psychologist would find a ready phrase to characterise such a condition,

Some of the reasons why I would beg of you—especially young men in search of mental occupation—not to be seduced into becoming theorists, in its modern application, shall be placed before you :—

I. Because it has a very strong tendency to warp your judgment; your inclinations leaning ever in the direction of the theory all that supports it receive exaggeration, and all that militates against it is apologised for, or sophistically explained away.

II. Because it depreciates all your work within the circle of the theory. Record never so many investigations, vouch for ever so many facts, and your reward will be to see them received with doubt, or suspicion, not because you are naturally untrustworthy, but because you are a prejudiced witness. Need anyone be reminded of the broad difference of result that is produced in men's minds by the evidence of an independent witness, and the evidence of a friend of the culprit?

III. Because it converts one who should be sound in judgment, unfettered by antecedents, unbiassed by what may follow, into a mere partisan, deaf to all that may be urged on the contrary, not because it is true or false, but simply because it affects *his* side of the question. In season, and out of season, advocating the party side, ever and anon seeking to make converts to his *own* views, not being content to permit truth to work its own way, but, above all, anxious that *his* interpretation of the truth, and that alone, shall prevail, and all who dissent shall be branded as heretics.

IV. Because it leads to dishonesty. This is an almost inevitable associate of partisanship. A little gloss is put upon all that favours one's own side, a little exaggeration, even when least intended, gives a tone to the views we hold. Opposite opinions are never quoted at all, or with corresponding exaggeration. The partisan may attempt to be honest, may flatter himself that he really *is* honest, and yet never does justice to his opponent, because he lacks the feeling and sympathy of the opposition. Hence the best of partisans are unconsciously, and the worst of them habitually, dishonest.

V. Because it favours intolerance, bigotry, and all uncharitableness. Being satisfied themselves that they are the only depositaries of the truth, they utterly contemn those who fail to appreciate their conclusions. Such unfortunates are looked upon as inferior animals, only partially gifted with the faculty of reason, and no opportunity is allowed to slip of bestowing upon them a fraternal sneer.

VI. Because it is prejudicial to friendship. No one would contend that personal friendships can survive an aggressive conflict of

opinion such as that fostered by the average theorist. One who has taken up an hypothesis as an article of faith, and prosecutes it with all the zeal of a political creed, would either make a proselyte, or sacrifice a friend. As community of feeling, taste, and pursuits all serve to cement friendship, so will their opposites speedily dissolve the bond.

VII., and lastly—to come back to the topic which has been before us—because it leads to exaggeration, and especially lends itself to it at a period when exaggeration is the fashion of the age. It is no answer to say that a sound hypothesis does not need to support itself by exaggeration; it is sufficient to show, that, apart from all inducements towards wilful exaggeration, there is a natural tendency to suppression on the one hand, and undue extenuation on the other. Where the fundamental facts are not universally known, and, indeed, can only be known by experience to a few, there is a continual temptation in the direction of exaggeration, on the principle that the end will justify the means, and that a polemic victory will cover a multitude of sins. One has only to turn to any of the records of recent controverted hypotheses, and exercise the judgment of an "outsider" to obtain abundant evidence that exaggeration is resorted to, as a matter of course, and unblushingly, as if it were a virtue. Something of this may be due to the "fashion," and therefore impresses more forcibly those who can compare it with the past, than it does those younger men who have grown with the fashion. At any rate, it is worthy of note that those who are not drawn into the whirlpool of these extravagant hypotheses are chiefly men of ripe years, who contemplate with surprise the large amount of noise that proceeds from very shallow streams.

Perhaps I shall be met with the remark that all these seven reasons are exaggerations, insomuch as they exaggerate the dangers of adopting an hypothesis, pure and simple, whereas I have in view only hypothetical propagandism, the dangers of which it would be difficult to exaggerate.

These reasons are given as the result, not of mere speculation, but as forced upon me by experience. Several times it has been my ill-fortune to oppose hypotheses, and this I have always done with regret. It is not in human nature to suffer in patience when vanity is rebuked. Your "candid friend" is not the most agreeable companion. He who would oppose those who have espoused

an hypothesis must expect to be regarded as a "candid friend," often too candid for continued friendship.

Controversies vary with the character of the controversialists, but the end of all, for both sides, is nothing but "vanity and vexation of spirit." Nothing exposes some of the weak points in humanity more effectually than controversy. The old adage "in vino veritas" finds its analogue here. The man who "speaks his mind" by the inspiration of the bottle is at one with him who "speaks his mind" in the warmth of a polemical contest. Therefore beware of controversy, if you would not be betrayed into exaggeration, or misrepresentation.

It is easy to furnish examples of the process of "intensification" through which simple facts are made to pass in their passage to sensationalism. Recently a correspondent to a weekly paper, with some ambition to be considered a scientific journal, thus expresses himself when writing on the potato disease: "I am in a position to speak confidently upon this point, for the very good reason that for many years past I have been in the habit of every day cutting sections of one or more tubers, and I have never once found a potato diseased by *Peronospora* in the centre, when its exterior did not show traces of infection. Many years is an indefinite period, but these observations have been continuously carried on by me for the past thirty years—rarely have I missed a day. As a rule more than one potato has been sliced by me, so that 10,950 tubers were examined, not one of which has shown the centre diseased by *Peronospora*, while the exterior remained sound. I admit these tubers had been subjected to a temperature of 212° F. before I sliced them, yet it requires a higher temperature than 212° F. to obliterate all traces of the disease. Before I sliced these 10,950 tubers each one had been washed, and in most of them the epidermis had been removed," &c.*

Now, what are the plain facts thus set forth so grandiloquently? Simply these—that the writer was thirty years old, and had potatoes cooked for dinner every day, and *therefore* had experimented on 10,950 potatoes to ascertain whether they were diseased or not. As to experimenting with scientific purpose, of course he had done nothing of the kind. Now, this is a fair example of exaggeration in scientific matters, and, it must be said, of wilful misrepresentation for sensational purposes. What

* "Gardeners' Chronicle," March 15, 1884, p. 349.

reliance can possibly be placed on the evidence adduced by such an authority, and yet he has claimed to have demonstrated scientific facts by experiment—solely on the faith of his own word —on which evidence he seeks to establish a controverted hypothesis.

In this example there is the basis of fact—or assumed fact—seeing potatoes on the table after being peeled, and cooked, for 30 years. Then this fact is distorted and exaggerated by being made to appear that which it was not, viz., a deliberate scientific experiment, made daily for a set purpose. Finally, this "intensified" narrative, which we have characterized as exaggeration, is deliberately published in a controversy, in a sensational manner, as scientific evidence.

I think, when such things are done, it is not a moment too early to warn you against sensationalism in science, to put you on your guard against that "paltering in a double sense" to which some are tempted to backslide, in order to achieve a paltry polemical victory, instead of being content to establish the truth, for the sake of truth, and that alone.

May I not suggest, without offence, that the tendencies towards exaggeration are very manifest in many directions, whereas yet they only exhibit promonitory symptoms?

Can we really say that there is no danger with the Bacilli? Is it not possible to take too much for granted, and exaggerate the relations of these minutest of organisms with zymotic disease? Is it not well to be particularly guarded in such cases lest zeal should outrun discretion? The danger is all the greater since the subject would accommodate itself so readily to sensationalism.

Foreign as the subject may be to our own pursuits, it may, nevertheless, be alluded to in illustration. Are we not in great danger of exaggeration in the direction of popular education? Not the less so because it has a sentimental side, and may be made to conform to sensationalism.

I think I am justified in saying that we should be cautious lest we exaggerate too much our instrument and its powers. If we fancy that the microscope is to do everything for us, without the exercise of application and judgment, and sound discretion, we shall exaggerate to our own final discomfort.

If we rely too confidently on what we suppose that we see, under high powers, without concerning ourselves with verifying it in all

possible ways, then we may be clinging to fallacies by which we deceive ourselves, and, in the end, blame the instrument for our own exaggerations.

If we do not take into account the many ways in which we are liable to err, through a disregard of recent discoveries, especially in the direction of defective vision, we shall be in constant danger of repeating and perpetuating exploded errors, and originating new ones, which are in themselves neither more nor less than practical exaggerations of our own ignorance.

In fine, in proportion as we magnify objects are we in danger of magnifying false impressions, unless we give some little attention to those very "brass and glass" questions which some of us affect to despise.

Having satisfied yourself, from its manifestations, such as I have indicated, that any given subject has passed from the calm region of judicial enquiry, into the excited arena of public disquisition, is being exalted into an article of orthodox faith, in which "whoever believeth shall be saved, and whoever doubteth is damned," rely upon it, that no other course is left to you but to exercise to the fullest extent your privilege of independent judgment, and to insist that it shall be stripped bare of all exaggerations, of all external sophistry, that is gathered about it in order to conceal its barrenness, and confound its true issues. Coolly, without prejudice, to examine all the alleged facts thoroughly and exhaustively, comparing these with your own experiences, and the acknowledged data which the experience of others has determined. All the cobwebs of supposition, and probability, and assumption without authority, must be swept away; and upon authenticated legitimate fact, and upon the hard facts alone, must your judgment be based. The very circumstance of exaggeration entering into the advocacy of any hypothesis is sufficient to invest it with suspicion. Dogmatic assumption and persistent self-assertion is no less suggestive of an unsound basis. More than all, the incessant appeal "to the stump," to popular prejudice, and the "intelligent public" to determine a question which depends upon the exercise of well-disciplined observation, and the calm judgment of experienced investigators, is akin to an appeal on points of law, from the assembled Judges in the High Court of Justice, to the old fishwomen of Billingsgate. It is simply impossible to place reliance upon such an appeal. The translation of scientific terminology into the vulgar

dialect loses in accuracy, in proportion as it is diluted, everything opposing the hypothesis is studiously suppressed, or misrepresented, it may not be intentionally, but inevitably ; exaggeration supplies the deficiency, and the climax is "sensationalism *versus* science." It is no longer the simple truth which is sought, or such an audience would not be appealed to, but simply the paltry gratification of a polemic victory. Once carry a disputed subject out of the circle in which it could be intelligibly discussed, and investigated, into a new circle, in which prejudice takes the place of knowledge, and it is condemned at once, by all sensible men, as a failure in search of compensation for disappointed vanity.

Fragmentary and imperfect as these observations may be, written hurriedly under the pressure of numerous engagements, they will, perhaps, serve as a caution to some of our younger members, and at least convince them that an old microscopist of forty years' experience believes it to be his duty to warn them of one of the vices of the age, and to put them on their guard against exaggeration.

REPORT OF THE COMMITTEE.

JULY 25TH, 1884.

Your Committee, in presenting the Nineteenth Annual Report, are able to record the continued prosperity and activity of the Club during the past year.

Our losses by death have been five, viz.—Mr. Chantrell, Mr. Davey, Mr. Dixon, Mr. Hugh Powell, and Mr. Watson. Mr. Powell was not often seen at the Club, but was one of its earlier members, and was universally known as one of the pioneers of the modern microscope in this country. There have been fourteen resignations, seventy-four struck off the list for non-payment of subscriptions, and thirty-three new members have been elected; although the total number of members is, therefore, somewhat reduced, the practical working strength of the Club remains about the same.

Appended is a list of the more important communications made at our meetings and printed in the Journal:—

1883.

Aug. 24. "On Circumnutation in Fungi," by the President.

Oct. 26. "On an Apparatus for Aerating Fish under observation with the Microscope," by Mr. A. W. Stokes.

Dec. 28. "On the so-called 'Lungs' of the Spider," by Mr. A. D. Michael.

Jan. 25. "On the Structure and Modes of Growth of Nostoc Commune," by the President.

1884.

Feb. 22. "On the Florideæ and some newly-found Antheridiæ," by Mr. Buffham.

Mar. 28. "On Parasitic Vegetable Organisms in Calcareous Particles of the Gabbard and other Sands," by Mr. J. G. Waller.

May 23. "On the Hexactinellidæ," by Mr. B. W. Priest.

June 27. "On Mermis Nigrescens," by Mr. R. T. Lewis.

Besides the above there have been numerous interesting descriptions of objects, apparatus, and methods useful to the members generally, as well as to those pursuing special studies. But, notwithstanding all this shows that there is a large amount of activity in the Club, it is to be hoped that more members will endeavour to place the results of their investigations before the meetings in the shape of papers.

Six demonstrations on Microscopical Technology were given during the year on the Conversational Evenings, and, as before, were eminently successful. Being the outcome of individual experience practically illustrated, and therefore useful to all classes of microscopical students, they will in future be considered as fixtures, and as affording further evidence of the utility of the Club to working microscopists.

The last of the series, "On Staining Vegetable Tissues," was to have been given by Mr W. H. Gilburt, but he was unfortunately unable to carry out his intentions on account of continued ill-health. His place, however, was very kindly and ably taken, at rather short notice, by Mr. W. D. Smith, and his demonstration on the same subject was certainly not the least practical and successful of the series.

Reports of these Demonstrations, of which the following is a list, will be found in the Journal :—

1883.

Dec. 14. "On Cutting Sections of Hard Tissues," by Mr. T. C. White, M.R.C.S., L.D.S.

1884.

Jan. 11. "On Microscopical Drawing," by Mr. J. D. Hardy, F.R.M.S.

Feb. 8. "On The Sponge-skeleton as a means of Recognising Genera and Species," by Mr. J. G. Waller.

Mar. 14. "How to Work with the Microscope," by Mr. E. M. Nelson.

May 9. "On Polarised Light," by Mr. C. Stewart, M.R.C.S., F.L.S.

June 13. "On Staining Vegetable Tissues," by Mr. W. D. Smith.

The remainder (£40) of the munificent donation to the Club by Mr. Frank Crisp, has been, with his approval, laid out in the purchase of indispensable works of reference for the Library.

The following is a list of the books acquired by the Club either by donation, purchase, or exchange :—

	Presented by
"Quatrefage's Metamorphoses of Man," &c....	Dr. M. C. Cooke.
"Steenstrup's Alternation of Generations"...	,, ,,
"Bibliotheca Zoologica"	,, ,,
"Bibliotheca Entomologica," Vol. 1	,, ,,
"Strasburger's Zellbildung und Zelltheilung"	Mr. W. H. Gilburt.
"J. Badcock's Vignettes from Invisible Life"	The Author.
,, ,, ,, ,,	The Publishers.
"McNab's Outlines of Botany"	Mr. T. C. White.
"Notcutt's Handbook of the Microscope and Microscopic Objects"	Mr. F. Crisp.
"Trimen and Dyer's Flora of Middlesex ...	,, ,,
"Transactions of the Linnean Society" ...	,, ,,
,, ,, ,, 2 vols.	Mr W. J. Scofield.
"Journal of the Linnean Society," 12 vols. ...	,, ,,
"Prof. Lindberg on Mosses"	The Author.
"Dr. Braithwaite's British Moss-Flora," Part 7	,,
"Proceedings of the Royal Society"... ...	The Society.
"Journal of the Royal Microscopical Society"	,,
"Smithsonian Institution Report for 1881"...	U.S. Government.
"Hardwicke's Science Gossip"	The Publishers.
"Science Monthly"	,,
"G. B. Buckton's British Aphides," Vol. 4 "A. D. Michael's British Oribatidæ," Vol. 1	Subscription to Ray Society.
"American Naturalist"...	In Exchange.
"American Monthly Microscopical Journal"...	,,
"Challenger Reports," Vols. 7-8 ...	Purchased.
"Gosse's Devonshire Coast"	,,
"Gosse's Tenby"...	,,
"Gosse's Aquarium"	,,
"Gosse's Year at the Shore"	,,
"Siebold's Comparative Anatomy"	,,
"Johnston's British Sponges"...	,,
"Johnston's Catalogue of Worms"	,,
"Hassall's Fresh Water Algæ"	,,
"Testacea Microscopica"	,,
"Pennetier's L'Origine de la Vie"	,,
"Vestiges of the Natural History of Creation," 6th Edition	,,
"Stein's Infusoria," Part 3	,,
"Transactions of the Tyneside Naturalists' Field Club," 6 vols.	,,
"Transactions of the Northumberland and Durham Natural History Society," 6 vols.	,,
"Klein's Elements of Histology"	,,

"Rutley's Study of Rocks"	Purchased.
"Prantl's Elementary Text Book of Botany"	,,
"Quarterly Journal of Microscopical Science"	,,
"Annals of Natural History"	,,
"Dr. Cooke's British Fresh Water Algæ," Parts 6-8	,,
"Grevillea"	,,
"Cole's Studies in Microscopical Science," &c.	,,
"The Microscopical News"	,,

Proceedings and Reports of various Societies and Sundry Pamphlets.

The following slides have been presented to the Cabinet:—

Dr. M. C. Cooke	3
Mr. H. E. Freeman	3
Total	6

In accordance with a resolution passed last year, that the Annual Dinners be officially recognised and placed under the direction of a duly appointed Sub-Committee, the following gentlemen were elected to carry out the arrangements for the Annual Winter Dinner, held Dec. 8th :—Mr T. C. White, Mr. T. Curties, Mr. James Willson, and Mr. J. W. Goodinge, Secretary.

The Dinner was given at the Holborn Restaurant, the President occupying the chair, supported by leading members of the Club and by Fellows of other learned and kindred Societies. Ninety-three members and their friends attended. The musical arrangements were under the direction of Messrs. A. C. Cole and James Willson, and Messrs. Collard kindly lent one of their grand pianos for the occasion. The usual toasts were proposed and responded to, and altogether the dinner and arrangements gave general satisfaction.

With the desire of making the ordinary excursions more useful to the Club at large, forms have been drawn up, and are distributed by the Secretary of the Excursion Committee to the members taking part in them to be filled up with the names, descriptions and localities of the various specimens taken. These forms are then placed in a portfolio, and are open to the inspection of members on the Conversational evenings. In this way it is hoped that members unable to participate in the excursions themselves may share in the results, and that the forms will be valuable for reference in the future.

The Excursionists' Annual Dinner was held on June 21st at the Forest Hotel at Chingford, under the direction of the Excursion Sub-Committee. The attraction of the locality, and the favourable state of the weather, brought together a large gathering, and the dinner itself was greatly enhanced by some very excellent vocal and instrumental music, contributed by members of the Club, under the able direction of Mr. James Willson.

A special exhibition meeting was held, by the kind permission of the College authorities, on May 30th, and was attended by about 130 members and 161 visitors. Although no very great novelties were produced, the exhibits were of a generally excellent and instructive character, and evidently afforded satisfaction to the members and their friends.

The Journals for the past year have been issued with regularity under the able editorship of Mr. Hailes, four numbers having appeared since the last report, and it now only rests with the members themselves to maintain the matter in them at at least as high a standard as heretofore.

The permission to hold our meetings in the College has again been renewed for the ensuing year with the same courtesy and kindness that the Club has always met with from the Council of University College.

Your Committee desire to express their thanks to the officers of the Club for their services during the year, and also to those gentlemen who kindly came forward to give the excellent series of demonstrations which have proved so useful to the members of the Club.

It is with feelings of the sincerest regret that your Committee have to announce the resignation of the senior Honorary Secretary. For eleven years Mr. J. E. Ingpen has fulfilled the arduous and responsible duties of that office with the utmost ability and unremitting attention; his great experience has always been at the service of any and every member of the Club, and he has during the whole time been most assiduous in promoting and sustaining its efficiency in every respect.

Your Committee trust that the endeavour to render the Club a means of instruction and utility to all its members, which has been so successfully maintained hitherto, will still continue, and that no effort will be spared to keep pace with all relating to its special pursuit.

TREASURER'S STATEMENT OF ACCOUNTS.

Dr.
June 30, 1884.

	£	s.	d.
To Balance in hand, July 1st, 1883	104	4	5
Subscriptions	241	10	6
Dividends on Compounding Subscriptions ...	4	6	2
Sale of Journal	2	13	6
	£352	14	7

Cr.
June 30, 1884.

	£	s.	d.
By Printing and Stationery	17	18	0
Postage and Carriage, &c.	7	17	6
Attendance, Lighting, and College Expenses ...	23	14	0
Purchase of Property	58	13	4
Journal	116	4	11
Special Exhibitions and Demonstrations... ...	23	2	2
Petty Expenses	4	5	10
Balance	100	18	10
	£352	14	7

Amount Invested in New Three Per Cent. Annuities, £140.

We, the undersigned, having examined the above statement of Income and Expenditure, and the vouchers relating thereto, hereby certify the same to be correct.

WM. HAINWORTH,
H. H. DOBSON, } Auditors.

July 17th, 1884

PROCEEDINGS.

July 11th, 1884.—Conversational Meeting.

The following objects were exhibited :—

Pandorina morum, and various rotifers ...	Mr. F. W. Andrew.
Fresh-water annelid, *Limnodrilus*	Mr. A. Hammond.
Circulation in young Stickleback	„ „
„ „ Newts	Mr. J. D. Hardy.
„ „ „	Mr. G. E. Mainland.
Parasites of Wood-pigeon, &c.	Mr. T. S. Morten.
Bacterium, sp., from eye disease	Mr. E. M. Nelson.
Various double-stained vegetable sections ...	Mr. F. Oxley.

Attendance—Members, 37 ; Visitor, 1.

July 25th, 1884.—Annual Meeting.

Dr. M. C. Cooke, M.A., A.L.S., 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. Conrad Beck, Mr. Richard H. Wellington, Mr. J. H. Ellis, Mr. W. Marten Holmes, and Mr. John J. Kern.

The following additions to the Library were announced :—

"Proceedings of the Royal Society"	From the Society.
"Paper on Diatomaceæ"	„ Mr. Kitton.
"Report and Proceedings of the Croydon Microscopical Club"	„ the Society.
"Science Gossip"	„ the Publisher.
"The American Monthly Microscopical Journal"	In Exchange.
"The American Naturalist"	„ „
"Cole's Studies in Microscopical Science" ...	Purchased.

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

Announcements of meetings, &c., for the ensuing month were then made and the business of the Anniversary Meeting was proceeded with.

Mr. W. Hainworth and Mr. W. W. Reeves having been duly appointed Scrutineers, the ballot for the election of officers and four members of Committee took place, at the conclusion of which the following were declared to be duly elected :—

President	Dr. W. B. Carpenter, C.B., F.R.S., &c., &c.
Vice-Presidents	Dr. M. C. Cooke, M.A., A.L.S., &c. Dr. J. Matthews, F.R.M.S. Mr. A. D. Michael, F.L.S., F.R.M.S. Mr. C. Stewart, M.R.C.S., F.L.S., &c.

Hon. Treasurer	Mr. F. W. Gay, F.R.M.S.
Hon. Secretary	Mr. G. C. Karop, M.R.C.S., &c.
Hon. Secretary for Foreign Correspondence and Editor of Journal...	Mr. Henry F. Hailes.
Hon. Reporter	Mr. R. T. Lewis, F.R.M.S.
Hon. Librarian	Mr. Alpheus Smith.
Hon. Curator	Mr. C. Emery.
Four Members to Supply Vacancies on Committee ...	Mr E. T. Newton, F.G.S. Mr. B. W. Priest. Mr. J. G. Waller. Mr. T. C. White, M.R.C.S., &c.

The Secretary read the Annual Report of the Committee, also the Treasurer's Annual Statement of Account and Balance Sheet, duly audited and certified as correct.

Mr. Buffham moved the adoption of the Report, which he thought was one upon which the unofficial members of the Club might well congratulate themselves as being one which could hardly be more satisfactory. One portion of the report particularly commended itself to their notice, and that was the reference made to the purchase of so many valuable books for the library. It had no doubt been the experience of many besides himself that if they had any special subject which they wished to study they found considerable difficulty in getting along without the right books for reference, and he could only say that he hoped the Committee would in future avail themselves of all the means within their power for purchasing the very best works on various subjects which could be procured.

Mr. Goodwin had much pleasure in seconding the report. He had heard it said that a Society never prospered until it found itself in debt, probably because when it found itself in difficulties it exerted its greatest energies, but, however that might be, he must admit that there was a feeling of comfort in finding that the balance was on the right side. He had noticed a new feature, recently introduced into another Society, which he thought they might do well to take into consideration, and that was as to the admission of ladies as members. It might be that in that Society the resolution was adopted as a tentative measure, in which case he hoped its future would be watched with a view to profiting by the experience gained. For his own part he should like te see a similar feature introduced into their own Society.

The President said he was very glad, personally, to have received the testimony of the mover of this resolution, as a non-official member of the Club, as to the action of the Committee during the past year in their endeavours to increase the efficiency of the library. They would see by the report that a large sum—scarcely less than £100—had been expended in the purchase of books of reference, many of which were of a very valuable character to the student of microscopy, and the expenditure of so large an amount had naturally caused them to feel some degree of responsibility in the matter. He was, therefore, very glad to find that their action had been so much approved by the members, and that they felt

with the Committee that what had been done had conferred a permanent benefit upon the Club. With reference to the remarks of the seconder of the motion, no doubt his reference to what had been done elsewhere was made in all good faith—but it was not everyone who had been a Queketter long enough to remember the very strong battle which they had upon this very question years ago—about the second year of the Club's existence,* when a similar proposal was made. On that occasion all the energies of the members was called out against it in a way that few who took part in the matter were likely to forget, with the result that when the proposition was put to the special meeting, convened to consider it, only one vote—that of the mover—was recorded in favour of it. He thought it was well to remind the gentleman who had just sat down that the same feeling was still in existence, and that he and others might lay the flattering unction to their hearts that if they re-introduced the subject they would have the selfsame tigers to meet who attacked and overthrew the proposition on the last occasion. They, at least, had an idea that though the establishment of their Club might have embodied some failings and some faults, it had proved to be as good as could have been desired, and, inasmuch as this was felt to be the case by those who had seen it grow and thrive from its earliest commencement, their motto was emphatically "Let well alone." They were perfectly satisfied with it as it was, and, therefore, had no desire to try any experiments, let any other chartered Society do what it might.

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

The President then read his annual Address.

Mr. Chas. Stewart said he rose with very great pleasure to move a cordial vote of thanks to the President for his Address. In past times they had had Presidents who had filled the chair with great honour to themselves and to the Club; but of all those illustrious Presidents of the past, they had none who had more efficiently carried out the duties of the office than the one they were about to lose, for he had not only conducted their meetings with an amount of ability and learning which could not fail to have been remarked, but by courtesy and tact had endeared himself to all the members of the Society.

Mr. W. J. Brown having seconded the motion, it was put to the meeting by Mr. Stewart, and carried unanimously.

The President, in rising to thank the members for the very cordial way in which this vote had been received and carried, said that it was to him a noteworthy circumstance that the most important work of a pond-hunter, and, indeed, the only work on "Fresh Water Algae," which had appeared for 40 years, had been contemporaneous with his two years of office. The first sheets were put in hand two years ago, and the last were finished only during the past week, so that the work could be said to be that of the President of the Quekett Microscopical Club. Another thing which had originated during his presidency was the establishment of a series of demonstrations, which had not only been so useful and successful that they hoped to be able to continue them, but they had redeemed the

* March 27th, 1862.

Club from the charge of becoming too theoretical and namby-pamby. Then, again, when he was congratulated upon the work of the past year, it led him to look round and see what was being done also by others, and attention was at once directed to the Journal, which, from being nearly a year behind (from causes which were both unavoidable and regrettable), was now brought nearly up to date. True, it might be said, no less than £232 had been expended upon it during the two years, but, nevertheless, it was an expense well incurred, and afforded an answer to people who said they were hoarding up their money instead of using it for the benefit of the Club. Then, as regarded their annual dinners, these had been brought under the direct control of the Committee, and recognised as one of their established institutions, whilst for their summer excursionists' dinner the change had been made, he thought with good results, from visiting a southern suburb to a district nearer home; whilst, in connection with the excursions themselves, the adoption of a plan for permanently preserving records of what had been found was a new departure, from which the best results only could be anticipated. He could only say that he desired sincerely to thank all the members for the courtesy which had always been extended to him, and the Vice-Presidents and officers for the cordial support and assistance which they had always rendered, and, not by any means least, were his thanks due to their old friend, Mr. Ingpen, for his help rendered under the most trying personal and family circumstances.

Dr. Matthews then moved "That the President be requested to allow his Address to be printed and published, and to be circulated with the report in the usual way."

Mr. Parsons having seconded the motion, it was put to the meeeting, carried unanimously, and acquiesced in by the President.

Mr. G. E. Mainland moved "A vote of thanks to the Committee and Officers of the Club for their services rendered during the past year," a resolution which he felt needed no words from him to commend it to their consideration.

Mr. A. Dean seconded the motion, which was put to the meeting, and carried unanimously.

Mr. T. C. White said he held in his hand a resolution which he had great pleasure in laying before the meeting, and that was "That the thanks of the Club be offered to the Council and Authorities of University College for the continued privilege of meeting within those walls," a privilege which they had enjoyed for many years, and the very great advantage of which he need not say a word to make apparent to anyone present.

Mr. Goodwin seconded the motion, and had additional pleasure in so doing, since it was through a member of the Council that he was first introduced to the Club. They must all feel that it was not a small thing to be allowed to hold their meetings in that splendid room, and in such a building.

The President felt sure they would carry this vote of thanks in the heartiest possible way. No one felt more than himself that it was a source of very great gratification to find that they were still to be allowed to meet where they had met together for so many years, and that their thanks still increased as years went on.

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

A vote of thanks to the Auditors and Scrutineers was then proposed by Mr. J. G. Waller, seconded by Mr. Hailes, and carried unanimously.

The President then announced that this terminated the business of the Annual Meeting, and it became his privilege once more to retire into private life.

Attention was directed to the fact of the presence amongst the visitors to the Club that evening of Mr. H. B. Chamberlain, the Secretary of the Denver Colorado Microscopical Society, to whom a cordial welcome was given by the President and members.

The meeting closed with the usual conversazione, and the following objects were exhibited :—

Larva of Vapourer moth	Mr. F. W. Andrew.
Section of scalp of child	Mr. F. A. Parsons.
Spongilla fluviatilis	Mr. J. Woollett.

Attendance—Members, 49; Visitors, 3.

August 8th, 1884.—Conversational Meeting.

The following objects were exhibited:—

Bythotrephes cederstromii	Mr. F. W. Andrew.
Eggs of parasite of grey crow	Mr. W. J. Curteis.
Hexapod larva of *Argas pipistrellæ*	Mr. H. E. Freeman.
Crystals in spermaceti, polarized	Mr. H. G. Glasspoole.
Larva and pupa of *Chironomus plumosus* ...	Mr. A. Hammond.
Coleopterous larva (aquatic)	Mr. G. E. Mainland.

Attendance—Members, 26; Visitors, 0.

August 22nd, 1884.—Ordinary Meeting.

Dr. M. C. Cooke, M.A., A.L.S., Vice-President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

Mr. T. S. Smithson was balloted for, and duly elected a member of the Club.

The following donations to the Club were announced :—

"Proceedings of the Royal Society"... ...	From the Society.
"Science Gossip"	,, ,, Publisher.
"The Microscopical News"	,, ,, Editor.
"Proceedings of the Canadian Institute" ...	,, ,, Institute.
"Quarterly Journal of Microscopical Science"	Purchased.
"Cooke's Fresh Water Algæ," part 9 ...	,,
"Annals of Natural History"	,,
"Cole's Studies in Microscopical Science" ...	,,
"Grevillea"	,,

Mr. E. M. Nelson read a paper "On a Hydrostatic Fine Adjustment for the Microscope," illustrated by sectional diagrams.

Mr. Karop inquired if this design was proposed as a really practical thing, or merely as a suggestion? To his mind it seemed to present some mecha-

nical difficulties in the way of construction, for it must be made perfectly true and tight, and would have to be made of steel, because mercury would act upon brass or gun-metal. Then if it required a large mercury chamber this would add to the weight rather inconveniently. As regarded medical students' microscopes, he thought they were already better than the use that was made of them.

Mr. Nelson did not think there was much mechanical difficulty in the matter, as the apparatus could easily be made of pieces of iron tubing, and could be drilled out so as to take steel rods fitting quite air-tight; and he thought that if the large rams could be made water-tight which carried 200 tons, this small one could be readily made mercury-tight under a pressure of a few ounces.

Mr. Parsons inquired how it was proposed to make the piston tight in this case; the pistons of hydraulic rams were packed by means of cup-leathers.

Mr. Nelson thought it would not need any packing if it were drilled out and fitted with perfect accuracy.

Mr. Karop thought that accuracy would mean made so tight as to hold the surfaces together as if they were soldered.

Mr. Hailes did not think that this necessarily followed, because they had almost the same thing in the pump of an air-gun, which was simply a steel plunger, about 2in. × $\frac{5}{8}$in., fitted without any packing, and this was capable of withstanding a very great pressure, so that he thought there would not be much difficulty on that account.

Mr. Nelson said that the pressure required need not be excessive; in fact, he should think 1lb. pressure would be quite sufficient, and that if the rod was polished in, it would be sufficiently tight for the purpose.

Dr. M. C. Cooke said that everyone who was in the habit of using the fine adjustment was well aware of the jumps with which it worked, and of the constant difficulty of getting at the exact distance required, and they would no doubt all agree that something better was wanted for use with the highest powers; but with regard to the question whether this idea was likely to answer best for all purposes, was one which could only be answered experimentally—the proof of the pudding would be in the eating.

A vote of thanks to Mr. Nelson for his communication was unanimously carried.

Mr. Karop exhibited a green caterpillar, found upon a geranium leaf, and covered with parasitic larvæ, presumably of some species of Ichneumon. The specimen was handed round for the inspection of members, and some further description of the larvæ was given by the aid of drawings on the black-board. The study of this large and interesting group of insects, of which comparatively little was known, was strongly recommended.

Announcements of meetings, &c., for the ensuing month were then made, and the proceedings terminated with the usual conversazione.

The following object was the only one exhibited:—

Ptilote elegans, in fruit ... ... Mr. F. W. Andrew.

Attendance—Members, 25; Visitor, 1.

September 12th, 1884.—Conversational Meeting.

The following objects were exhibited:—

Callithamnion granulatum, in fruit	Mr. F. W. Andrew.
Cheyletus flabellifer	Mr. H. E. Freeman.
Larva, pupa, and imago of *Chironomus plumosus*	Mr. A. Hammond.
Larva and pupa of *Simulium*	,,
Daphnia Bosmina	Mr. J. D. Hardy.
Diatoms. *Coscinodiscus excavatus*	Mr. H. Morland.
Lacinularia socialis	Mr. R. T. G. Nevins.
Fredericella sultana	,,
Double-stained sections; Vanda root, &c. ...	Mr. F. Oxley.
Docidium truncatum	Mr. F. A. Parsons.
Polyzoa, *Discoporella fimbriata*	Mr. B. W. Priest.
Shells of young *Limnæus stagnalis*	Mr. A. W. Stokes.

Attendance—Members, 41; Visitors, 4.

September 26th, 1884.—Ordinary Meeting.

Dr. M. C. Cooke, M.A., A.L.S., Vice-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. H. A. Crowhurst, and Mr. William Watson.

The following donations were announced:—

"Diseases of Field and Garden Crops," by W. G. Smith.	From Dr. Cooke.
"The American Monthly Microscopical Journal"	In Exchange.
"The American Naturalist"	,, ,,
"Proceedings of the Belgian Microscopal Society"	,, ,,
"Science Monthly"	,, ,,
"Desmids of the United States"	Purchased.
"Cole's Studies in Natural History" ...	,,
"Annals of Natural History"	,,
A Series of 24 Stained Botanical Slides ...	From Mr. Oxley.
A Series of 12 Slides of Diatoms, in Illustration of Mr. Kitton's Paper of June 27th	,, Mr. Sturt.

The thanks of the meeting were voted to the donors.

The Chairman said he had very great pleasure in announcing that they were favoured that evening by the presence of one of their transatlantic brethren—Dr. J. H. Wythe, Professor at the Cooper Medical College of San Francisco and author of "The Microscopist"—to whom, in the name of the Club, he offered a most hearty welcome. Dr. Wythe had been giving much attention lately to a new subject, which he called "Microscopic Graphiology," and upon which he had kindly consented to make some remarks.

Dr. Wythe, after briefly acknowledging the welcome accorded to him by the President and members present, said that although he had been until then personally a stranger to them, he was well acquainted with the

Society through the medium of its Journal, in which he regularly read their proceedings with great interest, and he was very pleased to have the opportunity of being with them on that occasion. He was, however, hardly ready to give them any very carefully prepared communication, as he was present almost unexpectedly, for having called upon his friend, Mr. Baker, during the day, he had been asked by him to come and bring before them what he thought was a new topic in connection with Microscopy, one upon which he had read several papers at the San Francisco Microscopical Society. He had called it "Microscopic Graphiology," and he believed it would be found to supply one answer to the question "What good was there in Microscopy?" The subject, as its name implied, was that of the examination of handwriting under the microscope, with a view of ascertaining its minute peculiarities as a means of identification. It was, of course, well known that the Microscope had long been used as a means of examining the texture of paper, erasures, differences in inks, lines crossing each other, and other features, by legal men in cases where questions arose as to the genuine character of documents; but he had gone much beyond this in endeavouring to formulate some other methods of examination in a way that could be understood by any intelligent observer. He believed that he had succeeded in so formulating the ideas that in the course of a few months they would be in print, so that anyone interested in the subject would be able to read it for themselves. When, at any time, a question arose in a court of law as to the genuineness or otherwise of handwriting, it was usual to call in ordinary experts to examine and pronounce upon it, and these people appeared to do so by mere intuition. If questioned as to their means of discrimination, they could not say why or how they came to their conclusions, only that they felt sure—they were certain—that the two specimens of writing were the same. His own attention was particularly called to the subject by an article which appeared in the "Bankers' Magazine," for July, 1878, the writer of which maintained that there was in every handwriting, as seen under the microscope, a certain rhythm or set of waves peculiar to, and distinctive of, each. These waves were, as might be expected, very small, there being several hundreds of them in a single inch, so that they were not to be seen by unassisted vision. On carefully examining the subject, he found that there were three rhythms in the handwriting of every man, each of which must be taken into consideration in connection with the others. The first of these he called the rhythm of form, by which it was meant that everyone had a certain method of forming his letters peculiar to himself, and it was upon this that ordinary experts chiefly relied. They used a hand lens or a doublet, but there was no doubt that even for this purpose a microscope would be of great use. In addition to the shape of the letters, another feature came under this head; for instance, a person in writing a letter would often make several strokes in succession exactly at the same angle, and then there would be a kind of break or change, and this would be repeated at regular intervals, so that very often it was possible to identify handwriting by this rhythm of form alone. The best description of this system which had yet come unto his hands was one published by the Hon. Mr. Thistleton, in which he gave an account of the methods of Mons. Chabot, the well known

London expert. The next kind of rhythm was the one specially referred to, and to which he had given the title of the rhythm of progress. In the examination of this he had found it best to use a binocular microscope, with Ziess's objective 3in. to 5in. and a very intense illumination by the concentration of the light of a lamp upon the paper by means of a powerful bull's-eye. The idea was that in the act of writing the co-ordination of the muscles, being the result of a nervous wave, was rhythmical, and produced an effect upon the paper of a wavy or moniliform appearance, and it was claimed by the writer of the article referred to that this varied characteristically in the handwriting of different persons. That it did so he could affirm positively. The third kind he had called the rhythm of pressure, some persons making a thick downstroke and a thin upstroke, and others not making much variety. He proposed, therefore, to formulate these three rythms—of form, progress, and pressure—and he thought it would be readily seen that when they all combined in the same manner in the specimens of handwriting under examination it amounted to a moral certainty that they were written by the same hand. He thought from this slight outline of the principles of his system the members of the Club would be able to follow it up, and he hoped they would be induced to study it. For his own part he wanted as much investigation as was possible, being much more concerned for truth than for victory, and he was also desirous that people should know that science was of some more use than merely for amusement.

The Chairman said that having heard this subject introduced by Dr. Wythe, no doubt there would be a desire to ask him some further questions upon it. To most of them it would probably be new, and would, therefore, possess some additional interest on that account. He would, therefore, invite observations upon it, for although they were promised the opportunity of some day reading the description in full, yet as they had that evening the author amongst them *in propria persona* they could question him, whereas the paper itself would be dumb.

Mr. J. J. Kern asked if it made any difference in the character of the curves when the pen was held in different ways.

Dr. Wythe said that if the pen was held very slopingly there would be a difference in the appearance of the stroke, and the lines would show a ragged edge. They could easily tell how the pen was held by the marks it made, but the rhythm would be the same notwithstanding.

Mr. Waller inquired if the texture of the paper would not make a considerable difference.

Dr. Wythe said it had been suggested that the second rhythm was produced by irregular absorption due to the nature of the material written upon. No doubt this did have some effect, but though the texture of the paper would make some difference, it did so only to a comparatively slight extent.

Mr. Karop said that from a physiological point of view one would naturally suppose that such an effect as that described by Dr. Wythe would take place. Writing was a muscular act, and, like all muscular actions, was made up of a series of impulses, or waves.

Dr. Wythe said that the first crucial test, to which he was put by the

Court of Justice in America, was one which he believed they would think certainly was so in an extreme sense. He had been examining a specimen of handwriting as compared with another, and had stated that he was satisfied as to its identity. The judge then inquired if he was willing to have a crucial test made of the value of his method. Of course, under the circumstances, he said that he was willing. The test was this: Three long foolscap sheets of paper were ruled, and the gentleman whose handwriting was the subject of inquiry filled in ten or twelve of the lines at irregular intervals, and then a skilful lithographer, accustomed to closely imitate writing, carefully filled in the other lines with what seemed to be exact copies of the gentleman's signature. The paper having then been marked at the edge as a key, this was cut off and retained by the judge, and he was handed the rest and asked to pick out the gentleman's signatures from the whole number. It was a crucial test, and one which he thought a man ought not very often to have put to him; but after a careful study of the paper he was able to pick out accurately eleven of the twelve. Physiology, as remarked by Mr. Karop, verified the principle of the method in a moment, for writing was a muscular act, and one of the most complicated kind. There would naturally, therefore, be a difference at different times, but although the rhythm would be exaggerated under the influence of stimulation, or of disease, it would be found that its characteristics remained the same.

Mr. Hind asked if the same method was found to apply to pencil marks.

Dr. Wythe said that the rhythms of form and pressure would remain, but slightly altered; that of progress it was almost impossible to trace in pencil writing. It often happened that a small, sharp particle of graphite would cut out the fibres of the paper entirely.

Dr. Matthews inquired if Dr. Wythe was cognisant of the great difference which existed between a man's writing in the morning and in the evening under certain physical conditions. He remembered a case where writer's-palsy was coming on, and the man's signature was rejected by his bankers when written in the morning, but when he wrote it in the evening they accepted it. Would it be possible to identify two such specimens as being the same handwriting?

Dr. Wythe said he had examined a number of specimens of the writing of persons afflicted with writer's-palsy, and he found that when the disease had progressed to a certain extent the writing had almost no coherence at all. In slighter cases he thought that the usual characteristics remained, although they were exaggerated, just, in fact, as they would be under the influence of a stimulant.

Dr. Matthews asked if Dr. Wythe had applied the micrometer with a view to ascertain the value of the rhythm.

Dr. Wythe said he found that it varied in different persons from 200 to 400 in an inch. The subject as yet was only in its infancy, and he was just telling them what he knew.

Mr. Buffham asked if there would be much difference between the handwriting of a person when he wrote very rapidly and when he wrote carefully and deliberately.

Dr. Wythe said that of course a rapid handwriting might vary apparently in form of letters, but there would still be, to an ordinary observer, a general similarity, but when the writing came to be examined microscopically, and the other two rhythms taken into consideration, it was not possible to entertain a doubt about it. Persons who tried, in these and other ways to disguise their handwriting would have it detected easily by this plan.

The Chairman questioned whether in rapid writing there would not necessarily be many less pulsations in a given space, seeing that they would be spread over a much greater surface of paper.

Dr. Wythe said that it had been suggested that under the stimulus of rapid action the impulses would themselves be more rapid, though he was unable to say whether this would take place in equal ratio. The best conditions were, when making an examination, to have the brain cool and clear, and to be quite quiet and undisturbed. Get a number of specimens of the known handwriting of the suspected person, and very soon it was possible to become so familiar with its peculiar rhythm as to be able to recognise it at once.

A Member asked if the same characters would be apparent in the case of italics printed with a pen?

Dr. Wythe said that of course in such a case the form would be entirely changed. He could also quite understand that a person with full knowledge might be able to disguise his writing to a very large extent.

The Chairman felt sure that all present would agree that Dr. Wythe had brought forward this subject in a very interesting way, that he had even in this age of novelties introduced yet another, and one likely to be of real use, which would rebut the charge that they played with the microscope instead of working with it.

A vote of thanks to Dr. Wythe for his communication was then put to the meeting, and carried by acclamation.

The Chairman read a communication from the Highbury Microscopical Society asking the assistance of members of the Club on the occasion of their Annual Soirée, fixed for October 9th.

Members were also invited to join in a mycological excursion to Epping Forest on the 27th.

Announcements of meetings, &c., for the ensuing month were then made, and the proceedings terminated with the usual conversazione. The following objects were exhibited:—

Rotifer, *Colurus uncinatus*	Mr. F. W. Andrew.
Palate of *Testacella Maugii*	Mr. G. Bailey.
Amœba, sp.	Mr. W. G. Cocks.
Rotifer, sp.	,,
Plumularia, mounted in glycerine jelly, with extended tentacles ...	Mr. E. Dadswell.
Section of pitchstone from Arran	Mr. A. V. Jennings.
Limnias ceratophylli	Mr. C. Rousselet.
Phtirius pubis, fem. eggs and young ...	Mr. A. W. Stokes.
Plumatella repens	Mr. A. Wildy.

Attendance—Members, 60; Visitors, 3.

On the Structure of Orbitolites.

Inaugural Address of the President, Dr. W. B. Carpenter, C.B., F.R.S. &c.

(Delivered October 24th, 1884.*)*

It having been intimated to me that a new President was rather expected to give an Address on first appearing amongst you, I have thought I could perhaps best fulfil the object of giving what encouragement I can to Microscopical workers, by a little history of my own study of the *Orbitolites.* * I began the subject nearly 40 years ago, and finished it only last year; and I propose to bring before you some of the points of general interest which have presented themselves to me during this prolonged inquiry.

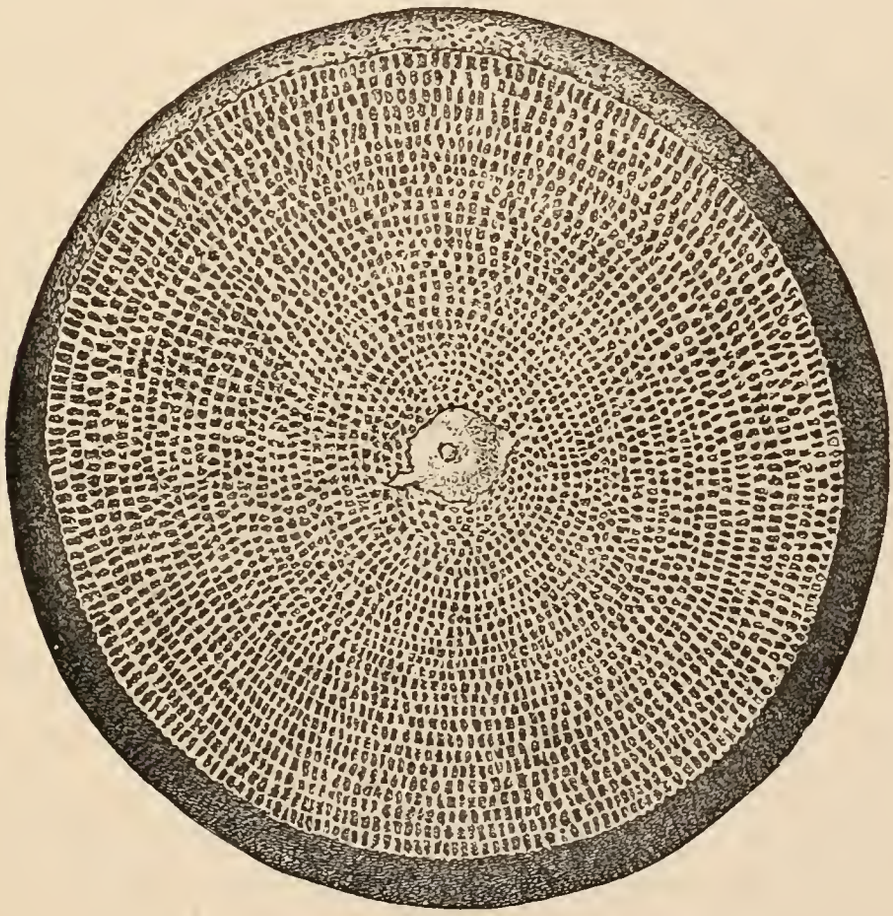


Fig. 4.

Shelly Disk of *Orbitolites complanata*, showing concentric rings of chamberlets, arranged round a central nucleus.

* A general description of this type, with illustrations, is given in "The Microscope and its Revelations." The Author's complete Monograph of the genus will be found in Vol. VII. of the *Challenger* Reports.

In the first place, the group of organisms, which includes the genus Orbitolites, had been long known as fossils, some species occurring in great numbers. Indeed, nearly all the building stone in Paris is an early Tertiary limestone composed almost entirely of Miliolines; and in the same limestone were elsewhere found a number of discs about the size of a fourpenny piece, which had attracted some notice. They were mentioned by Lamarck, who considered them as Polypi, and placed them between *Lunulites* and *Millepores*. This is not very surprising, because their surfaces are for the most part abraded and laid open ; but no suspicion seems to have arisen that they were anything else than Polypi. In the later edition of Lamarck, it was said that forms similar to these had been discovered in a living state on the west coast of Australia ; a small species was also found living in the Mediterranean, but this was of almost microscopic size. It was my good fortune to come into possession of some specimens of these recent discs about 40 years ago ; they were given to me by my friend Prof. Ed. Forbes, who obtained them from Mr. Jukes, who had dredged them up off the coast of Australia. I had at that time been examining *Nummulites*, which were the first Foraminifera to which I gave continuous attention, and of which I had received clay-embedded specimens from Dr. Bowerbank. (I found that these gave generally much better microscopic structure than Nummulites from any other bed would afford ; for when massed together in Nummulitic limestone, the percolation of water through the calcareous matrix fills up the tubes and alters the texture to such a degree that it is a matter of difficulty at times to recognise them ; whilst those from the clay give the structure with a perfection scarcely exceeded by recent specimens. This I have since found to hold good in many other cases.)

I was especially on the outlook for anything which would elucidate the structure of some small discs obtained from a mountain near Biarritz, which was described to me as almost entirely made up of them. For a long time I could not find anything like them ; but happening to ask Prof. Forbes if he could throw any light on the matter, he at once put Mr. Jukes' specimens into my hands.* This was the beginning of my study of the FORAMINIFERA ;

* The Biarritz discs subsequently proved to possess a very different internal structure, which I have described as characterizing D'Orbigny's genus *Orbitoides*.

and from this incident the whole of my subsequent researches upon that group might be dated.

I found Mr. Jukes' discs to correspond very closely with the fossil discs ; but the best-preserved amongst them had the chamberlets covered over, the only openings being at the margin. I was then able to obtain from various friends some of the small species —the recent *O. marginalis ;* and found that these also had a thin film covering the chambers, with a single row of marginal pores. After this, Mr. Cuming put his collection from the Phillipines at my disposal; and I also obtained some sand from the Red Sea, which abounded in specimens of *O. marginalis*, together with others having two rows of marginal pores, of which Prof. Ehrenberg had made a separate genus, placing both amongst his *Bryozoa.* He not only figured them (from abraded specimens) as covered with open cells like those of a *Flustra*, but put polypes with ciliated arms into these cells. Here, then, we may learn an important lesson—never to figure anything which we have not seen. Prof. Ehrenberg saw with his mind's eye only, and hence his blunder. Unless a person says explicitly, "This is only my conception of what this organism has been," he has no right to make such a drawing.

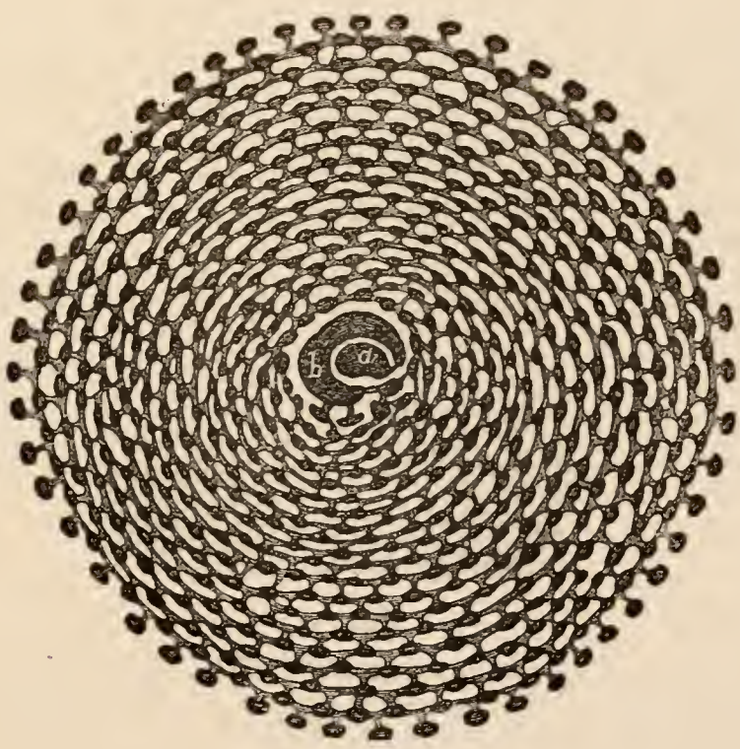


Fig. 5.

Composite sarcodic body of Simple type of *Orbitolite :—a*, primordial segment ; *b*, circumambient segment, giving off peduncle, from which arise the successive circles of sub-segments, connected by annular and radial stolons.

After this I came into possession of some specimens which had been preserved in spirit, and which showed what the animal body occupying these discs really is. Here (Fig. 5) we have its composite sarcodic body, belonging to that class to which Dujardin gave the name of *Rhizopoda.* In the first place there is a primordial segment, *a*, surrounded by one turn of a large segment, *b*, forming an imperfect spiral; this giving off a sort of root-stock, or stolon, from which are budded off rows of sub-segments, that enclose the primordial chambers. Each circle of sub-segments, connected by its annular stolon, corresponds with the segment of an ordinary Foraminifer; it is connected by radial stolons with the next annulus; and the radial stolons of the last-formed annulus issued as *pseudopodia* from the marginal pores of the shelly disk. The *simple* disposition of sub-segments in one plane, occupying the single layer of chamberlets in the minute *O. marginalis,* undergoes a very curious modification in the *complex* structure of the large *O. complanata*, recent and fossil. In this there are two rows of surface-planes, separated by an intermediate plane, the chamberlets of which have a columnar structure (Fig. 6). The successive rows communicate

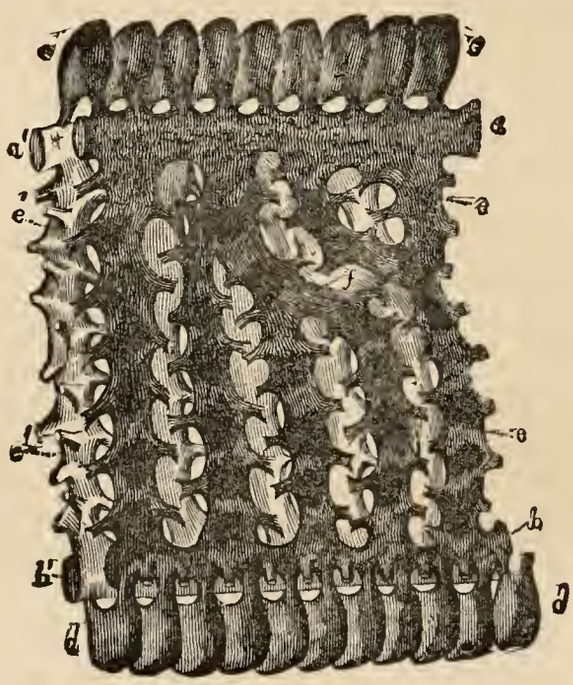


Fig. 6.

Portion of Sarcodic body of Complex *Orbitolite*:—*a a′*, *b b′*, upper and lower annular cords of two concentric zones; *c c*, upper layer of superficial sub-segments; *d d*, the lower layer; *e e* and *e′ e′*, intermediate columnar sub-segments of the two zones, giving off oblique stolon-processes.

by a number of oblique threads; and it is through the threads which issue from the marginal pores of the outermost ring, that the body receives its nourishment. In the living condition

the sarcodic substance is almost liquid, and there is a continual circulation or interchange taking place; but there is no differentiation of function that I can find. The Red Sea specimens having two rows of marginal pores, furnish a curious intermediate condition (Fig. 9); having a single annular stolon in each ring, but

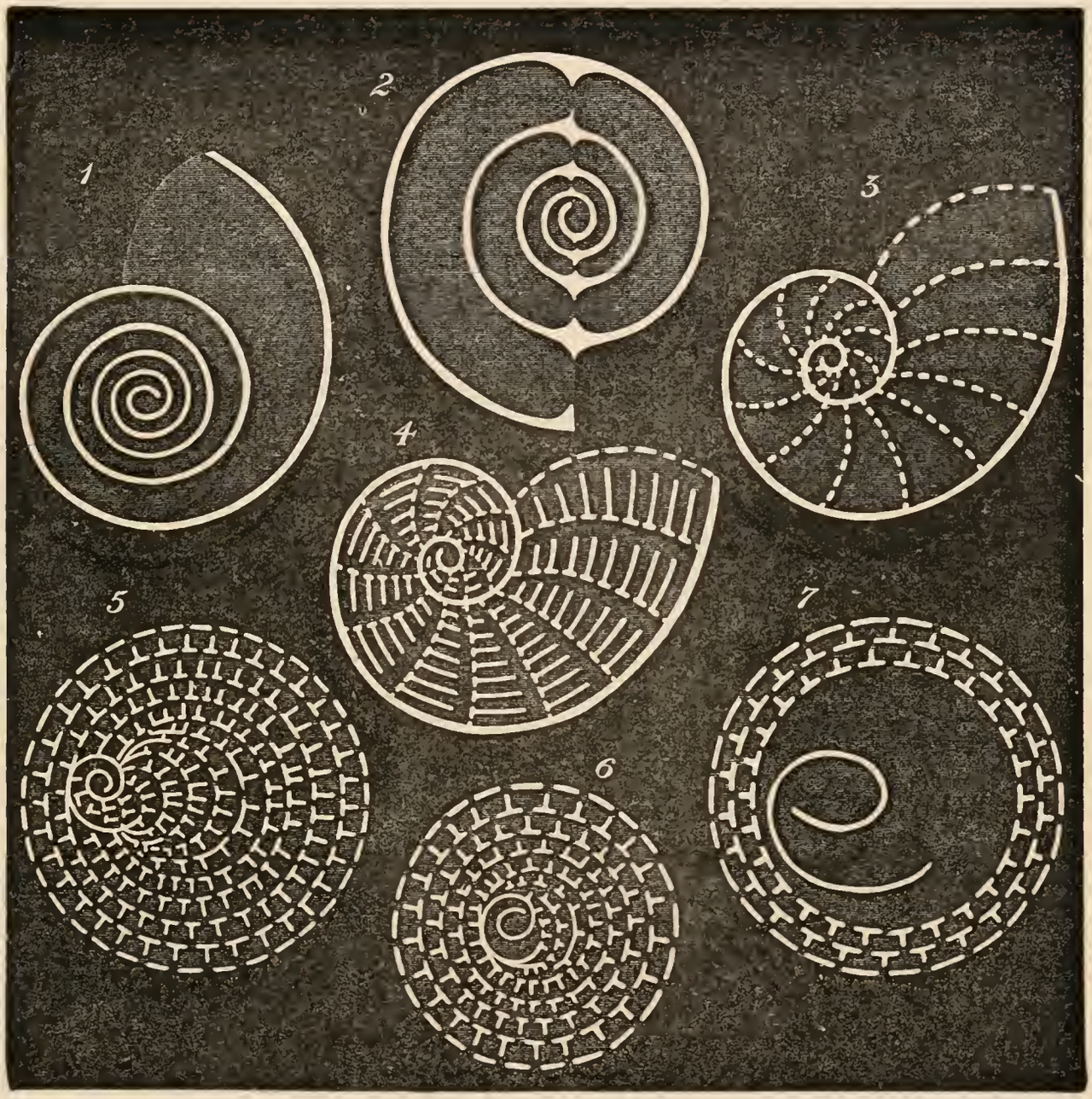


FIG. 7.

Diagram illustrating the Pedigree of the Complex type of *Orbitolite*.

1. Simple undivided spire of *Cornuspira*.
2. Partially interrupted spire of *Spiroloculina*.
3. Spire of *Peneroplis*, divided by partitions into chambers.
4. Spire of *Orbiculina*, its chambers divided into rows of chamberlets.
5. Disk of "simple" *Orbitolite*, showing first-formed spire, surrounded by concentric rings.
6. Disk of "duplex" *Orbitolite*, showing earlier passage from spiral to cyclical plan of growth.
7. Central portion of disk of "complex" *Orbitolite*, in which the chambered nucleus alone shows an abbreviated spire, the very first row of chamberlets forming a complete ring.

each ring being connected with the next by two rows of radial stolons, instead of one. Now, seeing that the most highly developed form often begins life in the simplest form, then passes through the intermediate form, and then undergoes this separation of the superficial plane by an intermediate plane—the next stage being that the annular canal is split (as it were) into two—I came to the conclusion that there was no actual specific distinction between the simple and the complex types, but that they were merely stages of development of the same organism, which in tropical seas undergoes a higher development than in colder regions.

Having investigated this subject very carefully, I made it, in 1856, the basis of a disquisition on the Range of Variation of

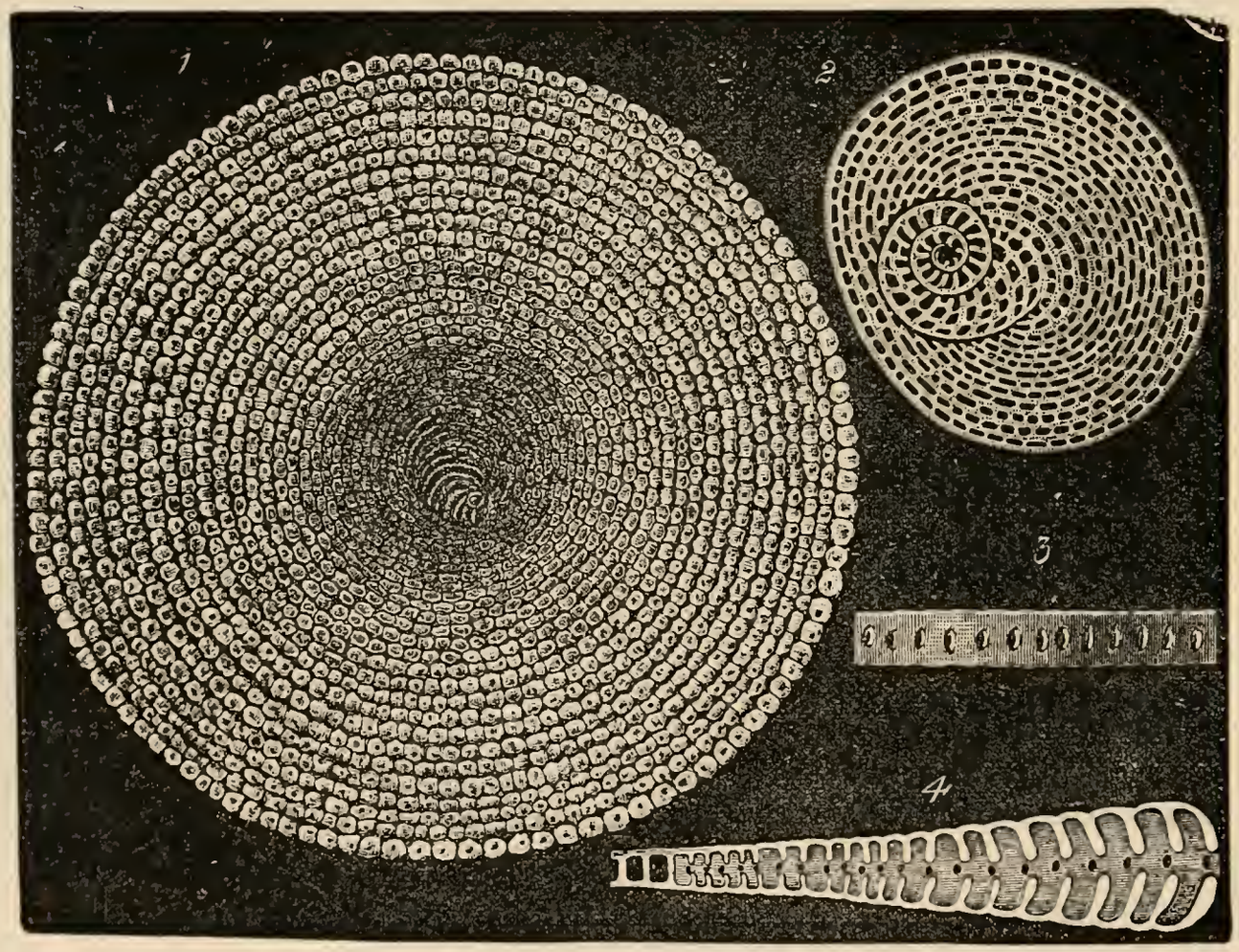


FIG. 8.

Disk of Simple Type of *Orbitolite* (*O. marginalis*).

1. Surface of disk, showing later growth of concentric rings of chamberlets around a first-formed spire.
2. Central portion enlarged.
3. Edge of disk, showing single row of marginal pores.
4. Vertical section, showing succession of chamberlets communicating with each other radially by single passages in the annular partitions, and laterally by the annular canals, whose sections are seen as dark spots.

Species. Mr. Darwin had not at that time given his views to the world; but when he read the conclusions I had arrived at, he said that he not only agreed with them, but was disposed to go a good deal further. It was by this previous enquiry that I found myself prepared, when the "Origin of Species" was published, to accept all its main positions as scientifically tenable.

The next stage was made in the course of the Porcupine expedition in 1869, when, from 1,200 fathoms' depth off the west coast

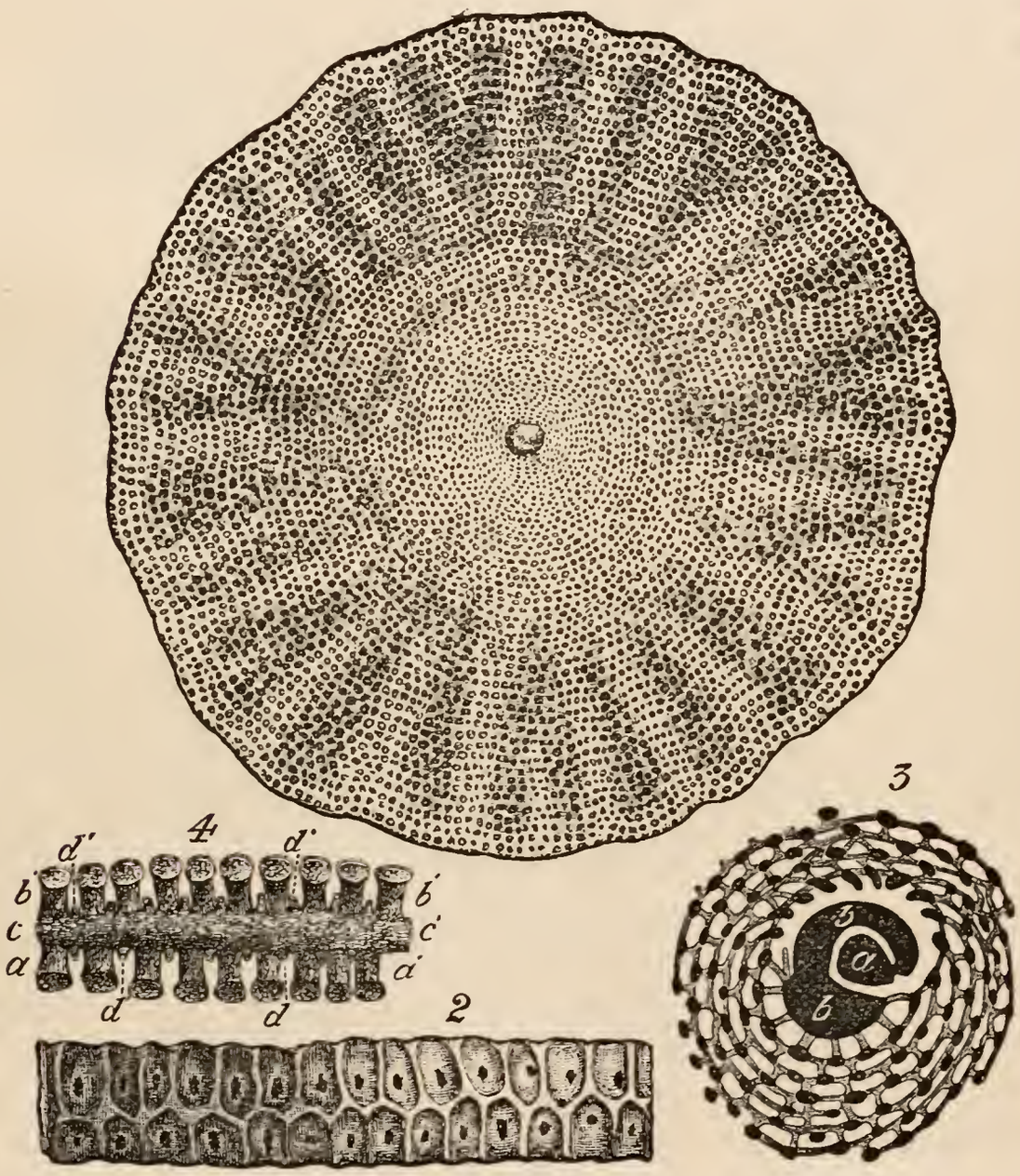


Fig. 9.

1. Disk of Duplex Type of *Orbitolite* (*O. duplex*).
2. Edge of disk, showing double row of marginal pores.
3. Central portion of sarcode body:—*a*, primordial segment; *b*, circumambient segment, budding off a half-ring of sub-segments, from which complete rings are afterwards formed.
4. Portion of the sarcodic body of one ring; *a a'* and *b b'*, the two halves of the columnar sub-segments in connection with *c c'*, the annular cord; from this are given off the pairs of stolon-processes *d d'*, *d d'*, which connect it with the sub-segments of the next annulus.

of Ireland, some extremely thin Orbitoline disks were obtained, about the size of a fourpenny piece. Although they were nearly all broken, it was very interesting to find them presenting unmistakable evidence of a Milioline origin. I have thus been able to trace the development of the Orbitoline type along a series of forms, beginning with the simple undivided *Cornuspira*, a flat shell very like a *Peneroplis*, but without any division into chambers; the

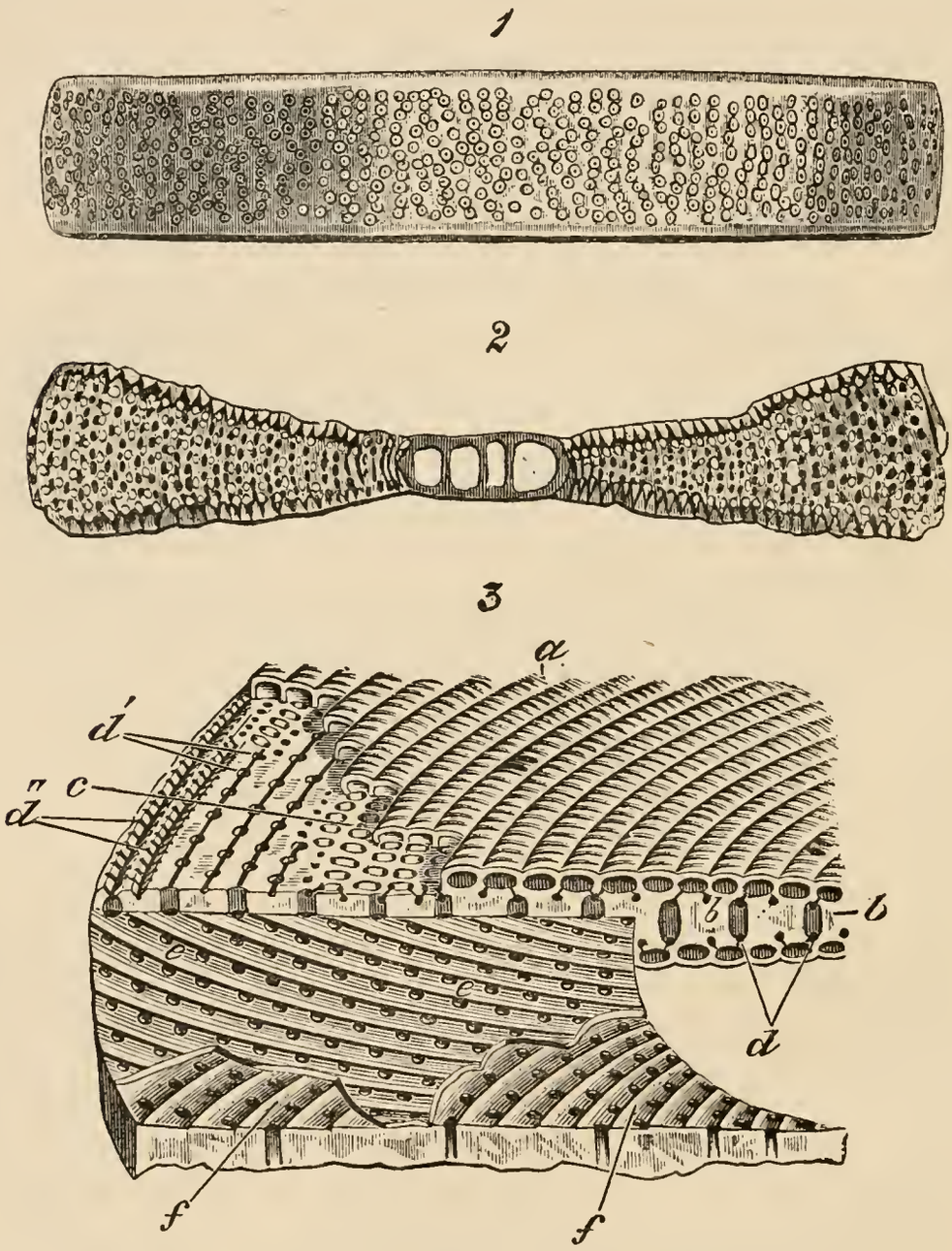


FIG. 10.

Structure of Shelly Disk of *Orbitolites complanata*.

1. Edge of disk, showing multiple series of marginal pores.
2. Vertical section, showing two superficial planes of chamberlets, separated by intermediate columnar structure.
3. Internal Structure:—*a*, superficial chamberlets; *b b*, columnar chamberlets of intermediate layer; *c*, floors of superficial chamberlets, showing the opening at each end into the annular gallery beneath; *d*, annular galleries cut transversely; *d' d''*, annular galleries laid open longitudinally; *e e*, *f f*, oblique stolon passages intermediate layer.

next stage corresponds with the Milioline *Spiroloculina*, the spire being constricted at intervals by imperfect partitions ; and this passes into the *Peneropline* stage, in which the partitions are numerous and complete (Fig. 7). The next stage is that of the *Orbiculina*, found in tropical seas so abundantly that nearly every handful of sand contains them ; in which the principal chambers are divided into chamberlets, and the spiral plan of growth gives place to the cyclical. This brings us to the *Orbitolite* itself ; and of my previous strong impression that it was developed from the simpler Miliolines, I had a complete confirmation in the beautiful deep sea form *O. tenuissima*.

When the *Challenger* expedition brought home its results, Sir Wyville Thomson placed in my hands a jar of *Orbitolites* from the reefs of Fiji ; and I undertook to work out this collection, thinking that so large a gathering from one locality might enable me to throw some more light on a good many questions of development. . . . (The specimens exhibited upon the table form a complete series in illustration of Orbitolite structure ; the largest of them showing a remarkable exuberance, in the shape of a number of curious outgrowths.) I found that this collection, when sorted out, fell naturally into very distinct groups. First there was a remarkable series of specimens as *simple* in their plan of structure as the Mediterranean *O. marginalis*, but very much larger (Fig. 8) ; then of the *duplex* Red Sea form (Fig. 9) ; and then of the large *O. complanata* (Figs. 4, 10). The question of species then came up again ; and with this large collection I saw at once that each of these types had its own size, plan of growth, and general aspect, so that it was very easy to distinguish between them ; and yet a most *complex* form might show that it had passed through the grades of the simple and the duplex (Fig. 11). Both these show a survival, in their early growth, of the original *spiral* plan (Fig. $7,^{5,6}$) ; but in the most typical specimens of the large *O. complanata*, the plan is circular from the very commencement (Fig. $7,^{7}$). Another point of interest was that the fossil forms stopped in an incomplete stage ; for it was easy to see in vertical sections of fossil forms, that the continuity of the superficial and the intermediate chamberlets was maintained throughout (Fig. 11, *e, e*) ; while in the large recent type they are disconnected by a shifting to half the breadth of a ring ($f, f^1, f^2 f^3$). In recent specimens from other localities I have found the earlier condition shown in the fossil

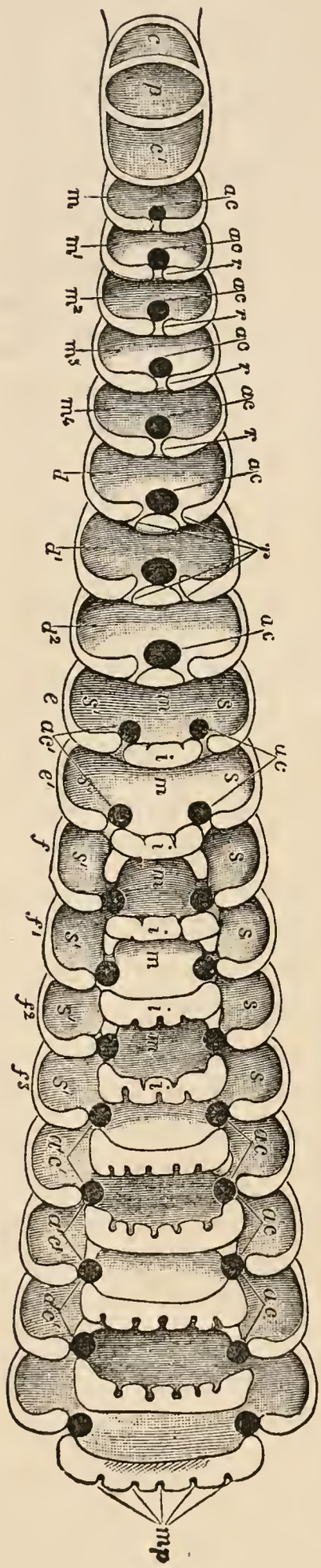


Fig. 11.

Diagrammatic representation of the transition from the "simple" to the "complex" plan of growth, as shown in vertical section, from the primordial and circumambient chambers (*c p c'*) of the centre, to the margin, whose pores are shown at *mp*. The chambers *m*, m^1, m^2, m^3, m^4, are all formed upon the *simple* type (as in Fig. 8, 4); and show at *ac*, *ac*, the cross sections of the annular canals, which connect all the chamberlets of one ring, and at *r*, *r*, *r*, the radial passages connecting the successive annuli. The chambers *d*, d^1, d^2, are formed upon the *duplex* type; the annular cannls *ac*, *ac*, being single, but the radial passages *r* being double. The chambers *e*, e^1, show two annular canals *ac*, *ac'*, between which is interposed a columnar chamberlet, continuous with the two superficial chamberlets *s s'*. In the chambers *f*, f^1, f^2, f^3, to the margin, which are all formed on the fully-developed *complex* type, the upper and under superficial chamberlets *s s*, *s' s'*, are completely cut off from the intermediate columnar portion, and, by a shifting of their position, each is made to communicate with *two* annular canals.

forms to be still preserved. And thus we have in this group an illustration of the principle, that if all genetic series were preserved, we should find no fixed boundary lines between species, but that every form would be connected with other forms by gradational transitions.

Another lesson now comes in. I have always been one of those who could not accept the doctrine of "natural selection" as a *vera causa.* It is based on the idea of aimless or casual variations, of which some prove more suited than others to become established permanently. I never could feel that this gave any scientific account of the "origin of species," because it offered no explanation of the causes of the variations by which the "fittest" came into existence. Now here is a case in which we have at the present time the entire series surviving, and this under the same conditions and in the same dredging; and since, to the eye of anyone but a skilled Foraminiferalist, a specimen of the smaller type would not be distinguishable from a young specimen of the larger, I cannot think that the creatures that prey upon them would know them apart.

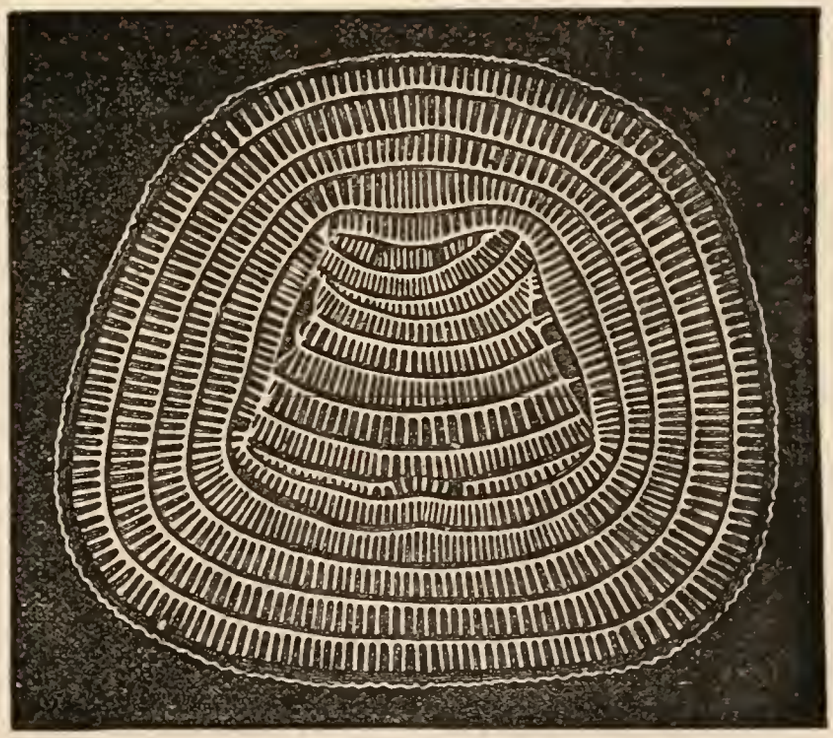


Fig. 12.
New disk of *Orbitolite* formed round fragment of previous disk.

There is here, therefore, no room for "natural selection." To my mind everything is indicative of development upon a determinate *plan*, from the spiral to the excentric, then to the less excentric, and then to the concentric form; with a uniformly increasing complication of the internal structure.

One more point is the very remarkable reparation which takes place when these disks are injured. Sometimes they may be nibbled by Fishes, Crustaceans, or Echinoderms; or they get broken by the dashing of the waves: and when this occurs, there is always a curious tendency towards the restoration of the circular form by an exudation of protoplasm, which forms a complete ring round the broken edge, and subsequently becomes surrounded by more regular annuli. A mere marginal fragment is quite sufficient to be the centre of such a new growth, reproducing a perfect disc (Fig. 12); this reparation always taking place on the perfected type, just as Sir James Paget has observed that repair always takes place in accordance with the existing state of the animal. I cannot think it is possible to resist the conviction that this reparation takes place on a plan, and is not the result of mere casualty.

These *Orbitolites* seem to be the culmination of the Porcellaneous series of FORAMINIFERA, not leading up to anything else. It is my belief that they form the top story of these simple sarcodic forms.

The results of this inquiry, I think, will show you the value of taking up a subject, and working it out thoroughly; and I hope this lesson will not be lost on many now present. Before entering upon such a special inquiry, however, everyone should go through a general course of instruction. It is now admitted that in every profession requiring the exercise of mental power, general training is of great importance to begin with; and in the case of anyone desiring to follow up some special object of microscopic study, I would recommend such a general preliminary course. Having made himself acquainted with the microscopic characters of any group as a whole (using for the purpose, when suitable, the binocular as well as the monocular), I would then recommend the student to take up some special subject, the detailed pursuit of which will be found to open out lines of thought and inquiry of far more value to himself and to science than the sort of dilettante work which is still so often indulged in. Thirty years ago, when Schleiden brought out his great work on Botany, he supposed that there were no good microscopes in England, because so little had been done in this country for the elucidation of vegetable structure and life-history; but the fact was, we had here the best microscopes of the day, the fault lying with the workers. I rejoice,

however, to know that there is now rising up among us a great body of earnest workers; and that especially at Cambridge, under Professor Michael Foster, and at Oxford, under Professor Moseley, many young men are proving most successful searchers in these fields of inquiry. One of the most beautiful results attained hitherto, has been the demonstration of the continuity of protoplasm through the walls of Vegetable cells. Several observers are now taking up the study of Algæ,; and I would suggest to them the special study of a stage in the life-history of *Volvox*, in which I have no doubt that this continuity will be distinctly traceable. I specially bring this before you, to show that there are subjects within the reach of each one, which are of the very greatest importance in Biological science. It used to be held that there is a separate life in each vegetable cell distinct from that of every other; but Prof. Burdon Sanderson, in the course of his experimental study of the Sensitive plant, was led to the conclusion that there is some kind of physiological continuity; and you may now look upon these connecting protoplasmic threads as the equivalent of nerve-fibres, each of which contains an intensified protoplasmic thread passing through it from one end to the other. Sir William Thomson, in his Presidential Address to the British Association, speaking of Comets in their relations to Meteorites, remarked that such inquiries were the life-blood of Physical science; and in the same spirit I may also say that these microscopic discoveries are the life-blood of Biology. I venture, therefore, to hope that there are many members of this Club who will devote their time and ability to inquiries of similar interest.

On Sexuality in the Zygnemaceæ.

By F. Bates.

(*Read, November 28th*, 1884.)

Mr. A. W. Bennett, in an article recently contributed to the Linnæan Society,* seeks to maintain that there are well-marked and certain characters whereby the sexual nature of the filaments in the *Zygnemaceæ* may be determined. The chief points on which he relies to prove his case are—1. The difference in size of the cell; in the *Zygnemeæ*, the so-considered germ cells being the largest ; whilst in the *Mesocarpeæ* the contrary is the case. 2. That the portion of the conjugating canal contributed by the germ cell is shorter and wider than that contributed by the sperm cell. 3. That the protoplasmic contents of the cells always travel in one direction :—that is, that in scalariform conjugation the contents of the cells of one thread invariably pass over into the cells of the other thread with which it is conjugating; and 4. That in *Mesocarpus* the spore, which is formed in the conjugating canal, never occupies its centre, except in such cases where the spore is large enough to occupy the whole of that space. He also regards this production of the spore in the conjugating canal as exhibiting a more rudimentary differentiation of the sexual elements.

Many distinguished cryptogamists have, before Mr. Bennett, devoted much attention to this question of the sexuality of the threads in these Algæ (when such obvious facts as difference in the size of the cells, position of the spores, &c., must have come under their notice, but were doubtless set aside as being inconstant and therefore unreliable), and although none have positively asserted that sexuality may not exist, with scarcely an exception it has been concluded that no safe, constant, and reliable, sexual characters, which will enable one to say which is a male and which is a female thread, or cell, are discernible.

Mr. Bennett states that his observations have extended over

* On "Reproduction of the Zygnemaceæ: a contribution towards the solution of the question, 'Is it of a sexual character?'" "Journal of the Linnæan Society," April, 1884, Vol. xx, No. 130, pp. 430-9.

several years. To prove this he concludes his article by saying, "If the mode of '*lateral*' conjugation described by De Bary, Wood, and others as taking place between adjacent cells of the same filament in *Zygnema* and *Spirogyra* be founded on correct observation, all idea of sexuality of the filaments must be abandoned in these cases." Now, to my mind, and according to my experience, this concluding remark effectually disposes both of Mr. Bennett's conclusions, and his experiences extending over several years, for I will venture to affirm that if anyone will seriously commence the collecting of these plants on the 2nd day of April, he will be the most unfortunate of Spirogyra hunters if he does not meet with at least two species, in which *lateral* conjugation is going on abundantly, before the ensuing May-day. By the light of my own experience I will now examine Mr. Bennett's points seriatim.

Firstly, as to differences in the sizes of the cells. If anyone will take up a descriptive work on the *Zygnemaceæ*, he will find such entries as :—Sp. cells ·05 to ·065 mm. by $2\frac{1}{2}$ to 10 times longer ; sp. ·032 to ·05 mm. by 2 to 4 times longer ; sp. ·024 to ·03 mm. by 3 to 8 times longer ; ·012 to ·015 mm. by 8 to 16 times longer. And in *Mesocarpus* sp. ·012 to ·018 mm. by 5 to 10 times longer ; sp. ·007 to ·015 mm. by 7 to 12 times longer ; and so on. Here is variation enough in all conscience ! Moreover, it has to be admitted that conjugation must have *commenced before* even a guess can be made as to which is a male and which a female thread or cell. Now, when we consider the many curious changes which take place in the form, &c., of cells at the time of conjugation, we must needs be careful how we draw conclusions from them on which to base a theory of sexuality. Again, one may find mixed in the same gathering, of one and the same species, threads having the spore cells cylindrical and longer than the spores, or swollen and more or less wider than the spores ; or so abbreviated that the spores are crowded together and placed sideways, being longer than their cells ; these are of very common occurrence in *Spirogyra longata*, *porticalis*, and *condensata*. Considering all these things, then, how can we place any value or reliance on conclusions based on an infinitesimal increase in the diameter of one cell over another ? I may further state that I have carefully examined the conjugated cells of *Spirogyra porticalis* (the species chiefly operated upon by Mr. Bennett) and, where the cells have preserved their cylindrical form, I have not found any appreciable difference of

diameter; as a rule the two conjugated threads are equal, or may vary to a slight extent on either side. As to the second point, that the portion of the conjugating canal contributed by the so-considered germ cell is shorter and wider than that contributed by the sperm cell; the suture marking their point of union will consequently show nearest the spore-containing cell. This conclusion has evidently been arrived at from observations made at the early stage of conjugation, and before the commencement of the passage of the contents of the one cell into the other. At this stage it is true that the tubular protuberance put forth by the so-considered sperm cell does, when it comes into contact with the opposing protuberance, force slightly inward the opposing face; but this I take to be but transitory, for afterwards there is doubtless resorption of the opposing membranes with fusion of the tubular walls, so that a perfectly open channel of communication is formed. When this is effected, and not till then, in my experience, does any passage of the contents of the one cell to the other begin to take place. Then also it will be seen that the shortening and widening of the so-considered germ-tube was only due to the temporary pressure exercised upon it by the sperm-tube; for, when all is completed, the suture resulting from the fusion of the two portions will be found, *as a rule*, in the middle; although, as might reasonably be expected, it is sometimes met with nearer the one cell, and at others nearer to the other.*

On point 3. That the protoplasmic contents of the cells in conjugating always travel in one direction. It is doubtless the *rule* that in scalariform conjugation, the one thread parts with, and the other receives the contents of the cells; but this fact is so overborne by others as to be deprived of all its significance as a test for sexuality. *Spirogyra orbicularis, longata, insignis, Weberi,* and *tenuissima*, I have found in *both* scalariform and lateral conjugation; whilst it is also a fact that *both* forms of conjugation may be *going on together in different parts of the same threads.* To my mind *this* settles the question; for it must not be forgotten that Mr. Bennett abandons all idea of sexuality in threads conjugating laterally; and yet, really, this form of conjugating is nearly as common as the scalariform. It is strange that Mr.

* The appearance produced when *looking down through the* conjugating tube (when fractured at the suture) is due, in my opinion, to its *unequal diameter;* it is rarely perfectly cylindrical: similar to what is seen in the "*bordered pits*" in the woody tissues of the Pines.

Bennett has not been able to meet with it during his observations. Lastly, on point 4. as to that form of conjugation in which the Zygospore is formed in the conjugating canal. Mr. Bennett states that the spore *never occupies the middle* of this canal, except in cases where, from its large size, it fills the whole of that space; otherwise it is always formed at one side, and at that side nearest the so-considered female cell, which he also states to be constantly shorter than the supposed male cell. I am prepared to admit (and to give him credit for this observation) that the spore is *mostly* situated at one side of the conjugating canal; but it is so frequently otherwise—or situated at the centre—as to destroy any value the observation might seem to have, in helping to determine the sexuality of the cells. As to the spore *when lateral* being always adjacent to a short female cell, this is still less to be depended upon. I find it subject to great variability. It is not easy to ascertain the exact position of the spore, and to accurately measure the mother-cells in these delicate plants; the conjugated threads being so involved that it is only here and there one can get a view of the two cells, and the spore, accurately in focus at the same time. Out of a number of such that presented themselves in a position to be accurately viewed and measured, I selected seven in which the spore was lateral, and seven in which it was central, and measured all the cells. I found that in the former case the cells were, in a majority of cases, longest in those considered by Mr. Bennett to be males, these varying in length from ·091 to ·13 mm.; whilst the so-considered female cells varied in length from ·078 to ·104 mm. But I also met with so-considered female cells which were *longer* than their attached male cells in the proportion of from 5 to 6 given spaces to 4, or an average difference of ·04 mm., the female cells being *longest* by those figures. In those cases where the spore was central, I found a great, or even greater, difference in the comparative length of the two attached cells. In one case a cell was exactly double the length of the other cell to which it was yoked. So here again we are met with such an utter want of uniformity as to baffle all attempts to determine the sexuality of the cells. A figure is given by the author of a spore of a *Spirogyra* germinating in a direction totally opposed to all previous experience. I do not deny that he may have seen a spore germinating after the fashion figured, but it must most certainly be regarded as most exceptional and abnormal.

Mr. Bennett further has made the remarkable discovery that the

form of conjugation, as it exists typically in the genus *Mesocarpus*, exhibits a more rudimentary differentiation of the sexual elements than exists in the *Zygnemeæ*. This seems to me most astounding, for he cannot be ignorant of the fact that De Bary, Pringsheim, Wittrock, and others who have closely and patiently observed all the phenomena of conjugation in these forms, have been led to separate *Mesocarpus* and the allied genera from the *Zygnemeæ*, and to elevate them into a distinct sub-family—the *Mesocarpeæ*, owing to the more advanced type of sexual development they exhibit.

Notes on a Slide, showing Ten Sections of the Oral disc and Tentacles of Cerianthus Solitarius.

By Arthur Pennington.

(*Read November 28th*, 1884.)

Upon the slide accompanying these notes is a series of longitudinal sections of the oral disc of *C. solitarius*, carried down so as to show the septa and a portion of the body-wall. The sections are cut at right angles to the diameter of the animal, a mode of cutting which possesses the advantage of showing more than would a longitudinal section cut in any other manner.

Recent observers have separated the *Cerianthidæ* from the other anemones and made them into a distinct family or tribe, in consequence, mainly, of the fact that the septa or mesenteries, which are such important features in the organisation of the *Zoanthariæ*, are not paired or arranged in cycles as in the *Actiniæ*, nor confined to the limited number of eight as in the *Edwardsiæ*.

There are only three defined species of the genus *Cerianthus*, one of which, *C. Lloydii*, is found in England. The specimen of *C. Solitarius*, from which the sections on this side were cut, I obtained from the Naples Zoological Station.

The specimen was stained with hæmatoxylin, and mounted, after the sections were cut, in Canada balsam. Before cutting the sections the animal was imbedded in paraffin.

The sections on the slide exhibit clearly the division of the body structure of the anemones into the three layers, ectoderm, mesoderm, and endoderm. The deeply coloured central layer is the mesoderm. The layer exterior to this, and evidently of more complicated structure, is the ectoderm, and the internal layer is the endoderm. The septa will be seen to possess only two of these layers, namely, the central mesoderm lined on each side with endodermal cells ; the tentacles possess all the layers.

The ectoderm may be clearly made out to contain three distinct layers, namely, epithelial, nervous, and muscular. The epithelial cells form the broadest layer ; next the nervous layer may be seen as a fine band of lighter cells, and deeper still lies the muscular layer,

which, in the oral disc, is not well developed, but which in the body-wall forms a broad, well defined, powerful muscular system.

The epithelial cells contain three series of elements—ciliated, stinging, and glandular. In the tentacles the stinging cells, or *cnidæ*, may be easily seen, as they are both large and numerous. They are oval in shape, and each contains a spirally coiled ecthoræum. The gland cells are very numerous in the body-wall, where they are often filled with granular or colouring matter.

The nervous layer consists of an interlacing network of fibrillæ, with here and there ganglion cells.

The muscular layer is the most important layer in the *Cerianthidæ*. In the tentacles the elements are isolated, but in the oral disc it forms a distinct stratum, which, in the body-wall, becomes, as stated above, broad and well defined. The longitudinal fibres composing the stratum in the body-wall may be distinctly seen in the slide. These longitudinal muscular fibres are supported by a thin membrane, which springs from the mesoderm.

The *Cerianthi* are able to secrete, or rather to form, an external sheath or protective case of mucus mud, nematocysts, spicules, &c., into which, when alarmed, they can retire. The powerful arrangement of longitudinal muscles in the ectoderm of the body-wall is necessary for this purpose.

The mesoderm may be distinctly seen below the muscular layer, and it will be seen to form, as it were, the basis or skeleton of the body, as it runs through body-wall, oral disc, tentacles, septa, and œsophagus.

The endoderm contains two series of elements—muscular and epithelial.

Amongst the anemones generally the muscular layer of the endoderm is well developed; the extraordinary breadth of *ectodermal* longitudinal muscles, as seen in the slide, being peculiar to the *Cerianthidæ*.

The muscular layer of the endoderm will be seen in the slide, lying immediately below the mesoderm.

The endodermal epithelial layer may be clearly made out, lining the whole of the interior of the body. The separate cells, if isolated, would be found furnished with a tuft of delicate cilia.

In the accompanying slide the layers above described can all be seen, and, in addition to the sections of the oral disc, a number of sections of the tentacles will be found, some cut transversely and others longitudinally.

On the Larva of an Ascidian found at the Land's End.

By A. D. Michael.

(*Read November 28th*, 1884.)

PLATE V.

Gentlemen,—I am going to ask you to bear with me to-night, as you have often done before, while I occupy a few minutes of your time with some remarks which do not contain any new or original matter whatever ; but when I find some object in microscopical biology which I think interesting, it usually strikes me that others who have similar tastes may be of the same opinion ; and, therefore, if I succeed in securing what seem to me to be fairly good preparations of it, and if similar slides are not often before the Club, I like to show them to you. I think that merely placing them on the stage of a microscope on the table is, after all, a poor mode of exhibition, as the points of interest are most likely to be missed, unless a few words be said calling attention to them.

Last autumn, whilst searching for marine life in my favourite hunting-ground at the Land's End, I came across several groups of compound-Ascidians which appeared to me worthy of notice, from the fact that there were eggs and larvæ in all stages of development, as well as adults. I mounted some of these for microscopical examination, and three preparations are under the microscopes to-night, viz. :—

No. 1. An egg with the larva fully developed and ready to hatch. Stained with hæmatoxalin.

No. 2. A mature larva stained with hæmatoxalin.

No. 3. A mature larva slightly stained with picro-carmine.

The specimens belong to the genus *Leptoclinum*, and the species is, I think, either *gelatinosum* or *maculosum*. The *Tunicata* of this genus form thin films coating stones, lammariæ, &c., the individuals being imbedded in a jelly-like mass as in *Botryllus*, but they have not the beautiful stellate arrangement round a common anus, with which we are all familiar in that genus, but are irregularly scattered,

We are not without ample information on the subject I am speaking of. The anatomy and life history of the larvæ of compound-Ascidians has been well worked out by a number of eminent biologists, and the literature on the subject is copious. I will only mention two works, viz., Milne-Edwards' "Observations sur les Ascidies-composées des côtes de la Manche" (1844); and Reichert's memoir, "Zur Anatomie des Schwanzes der Ascidien-Larven *Botryllus violaceus*") in "Abhandl. d. K. Akad. der Wiss. Berlin," 1875. The first-named is a classical work forming the ground-work of much of our present knowledge of the subject, and illustrated by numerous figures, one of which is so like the specimen of the fully developed egg with its larva ready to escape, which is now on the club-microscope, that anyone might suppose that Milne-Edwards had made his drawing from the specimen now before you. The second is an exhaustive treatise on a more special subject, and is illustrated by magnificent plates, which leave nothing to be desired.

The larval Ascidian is a somewhat tadpole-shaped, free-swimming creature, having a nearly globular body, somewhat truncated in front, and having three conspicuous suckers, mostly cupuliform, at its anterior edge; behind these there is usually a circle of outgrowths, possibly tentacular. Further back again is the opening of the branchial sac, and at one side is a large and conspicuous eye-spot. Behind the body comes a long tail, many times the length of the body, and very singular in formation. It is enveloped externally in a colourless and structureless cuticular test, which surrounds the more or less circular central portion, and is produced so as to form two broad flat bands set on edge, one on the upper and the other on the under-side of the tail, which run all along it like the fins of a sole, but are much broader in proportion. This test also extends behind the muscular portion of the tail and there expands a little, and is marked with diverging rays, so that it has a certain resemblance in form to the tail of the sole. Within the test is a layer composed of clearly-marked longitudinal rows of large nucleated cells. There are usually eight rows of these cells in *Botryllus*, but in the species I am now showing to you there seem to me to be only six. The central portion of the tail is a cellular, rod-like body.

The larva swims with a rapid, somewhat wriggling motion, by means of quick lateral strokes and undulations of the tail, but its free-swimming life is short, usually only a few hours. It then

attaches itself by its anterior suckers to some solid object, and becomes permanently fixed. The muscular portion of the tail and of the anterior projections becomes absorbed into the general body-substance, as a tadpole's tail does; the structureless test of the tail becomes detached, either whole or in pieces; and the body develops into a mature Ascidian.

I may remind you that the special interest of the Ascidian-larva lies in the tail, as many biologists of the greatest eminence have considered that the central axial rod of which I have spoken is neither more nor less than the lowest representative of the *chorda dorsalis* of Vertebrates. It has been stated to resemble the notochord in giving insertion by its sheath to muscles, which are said to hold a position with regard to the nervous system similar to those of the *Vertebrata*. The nervous system has been stated to be developed in a dorsal cavity, as in Vertebrates, and to be divided by the axial rod from the viceral canal below. The radiating structure of the terminal portion of the caudal test has been compared to the rays in the tails of young fishes, and the perforated branchial sac to the perforated and dilated pharynx of *Amphioxus*. These views have been strongly held by Kowalewsky * and Kupffer, † and for these reasons among others, they, and many able naturalists and anatomists have held that the Ascidians are more closely allied to the Vertebrata than any of the remaining forms of invertebrate animals. These views have been denied, either in whole or in part, by men of such attainments as Mecznikow, Giard, ‡ Von Baer § and others, and the points must probably be considered unsettled, and I do not wish to express any opinion upon them; but certainly the fact that many of the highest authorities have considered the Ascidian-larvæ as the allies of the lower Vertebrates lends great additional interest to those minute creatures, and the peculiarities of structure which have been thought worthy of prolonged and

* "Die Entwickelungsgeschichte der einfachen Ascidien," "Mém, de l'Acad. Imp. des sci. de St. Petersbourg." 1866.

† "Die Stammverwandschaft zwischen Ascidien und Wirbelthiere." "Schultze's Archiv für Mic. Anat." 1870.

‡ "Etude critique des travaux d'embryogénie relatifs à la parenté des Vertébrés et des Tuniciers." "Lacaze-Duthier's Archives de Zoologie." 1872.

§ "Entwickelt sich die Larve der einfachen Ascidien in der ersten Zeit nach dem Typus der Wirbelthiere?" "Mém. de l'Akad. Imp. des sci. de St. Petersbourg." 1873.

earnest investigation by many of the best observers on record will, I hope, be sufficient excuse for my calling your attention to the subject to-night.

EXPLANATION OF THE DIAGRAM.

Rough diagrammatic representation of the larva of *Leptoclinum*.

Figures 1 and 2 are drawn from actual preparations, but figures 2 to 4 inclusive are more or less adapted from, or suggested by, Reichart's figures of the larva of *Botryllus violaceous*.

FIG 1.—Egg containing a fully developed larva ready to escape.

FIG 2.—Larva. The fin-like membranous expansions of the test of the tail, being directed towards the eye or downward, are not seen.

FIG 3.—Transverse section of the tail.

FIG 4.—Longitudinal section of a portion of the tail cut in a plane at right-angles to the fin-like expansions.

A.—Body.

B.—Tail.

a. External tunic and vitelline membrane of the egg.

b. External structureless test of the body.

b'. ,, ,, ,, of the tail.

c.c.c. Anterior cupuliform suckers.

d. Circlet of cellular outgrowths.

e. Eye-spot.

f. Opening of the branchial chamber.

g. Cells of the body-wall.

h. Large nucleated cells of the contractile and muscular portion of the tail, forming a sheath round the central axis.

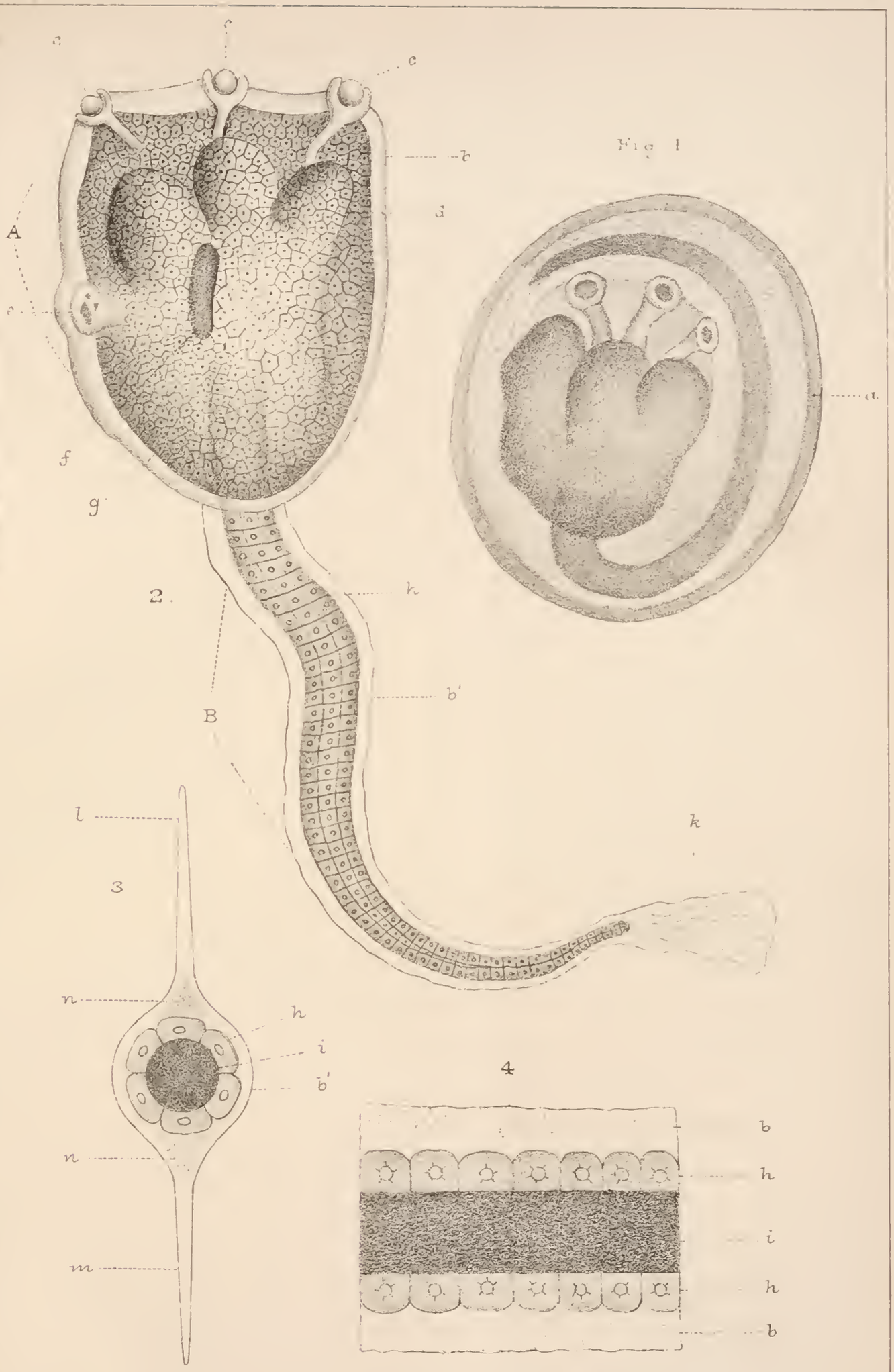
i. Central axis of the tail. (Supposed *chorda dorsalis*).

k. Terminal fin-like portion of the test of the tail showing the ray-like striæ.

l. Upper fin-like longitudinal expansion of the test of the tail.

m. Lower ditto.

n. Gelatinous substance of the fin-like expansion.



A. D. Michael del. W. Rhein sc

West, Newman & Co. imp.

Diagrammatic representation of the larva of LEPTOCLINUM.

PROCEEDINGS.

October 10th, 1884.—Conversational Meeting.

The following objects were exhibited:—

Brachionis urceolaris	Mr. F. W. Andrew.
Heliopelta metii	Mr. H. A. Crowhurst.
Silk glands of *Epeira diadema*...	Mr. T. Curties.
Anguinaria spathulata	Mr. W. I. Curties.
Camptoptera papaveris	Mr. F. Enock.
Living mite *Bdella* sp.	Mr. H. E. Freeman.
Head of Wasp	Mr. G. Hind.
Daphnia	" "
Larva of May Fly	" "
Spine of Echinus *Heterocentrotus mammillatus*	Mr. W. M. Holmes.
Anther and pollen, *Scabiosa columbaria* ...	Mr. G. E. Mainland.
A large specimen of *Eschara foliacea* from the Coast of Cornwall...	Mr. A. D. Michael.
Section of Jutland Slate, showing diatoms ...	Mr. H. Morland.
Navicula Lyra with a $\frac{1}{6}$ O. G. and diatomescope	Mr. E. M. Nelson.
Living *Physa-fontinalis*...	Mr. F. A. Parsons.
Diatoms n. s. *Rhoicosigma antillarum*... ...	Mr. G. Sturt.
" grouped	Mr. W. Watson.
T. S. Leaf of *Pinus Sylvestris* double stained	Mr. G. Williams.

Attendance—Members, 52; Visitors, 4.

October 24th, 1884.—Ordinary Meeting.

Dr. M. C. Cooke, A.M., A.L.S., Vice-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. A. Allen, Mr. Wilson Wiley, Mr. Thomas Petty, Mr. Fredk. Litchfield, Mr. Charles Fowler.

The following donations to the Club were announced:—

"Science Monthly"	In Exchange.
"The American Naturalist"	"
"Proceedings, &c., of the Royal Dublin Society"	From the Society.
"Annals of Natural History"	Purchased.
"Cooke's Fresh Water Algæ"	"

"Science Gossip" ... ... From the Publisher.
"Journal of the Royal Microscopical Society" „ „ Society.

The thanks of the meeting were voted to the donors.

The Secretary read a letter from Mr. Clark, stating that he had forwarded therewith, some specimens of Spongilla for distribution amongst the members.

Mr. Hailes called attention to some slides of the tongue of *Helix aspersa* mounted in gum styrax, one of which he had placed under a microscope on one of the side tables. There had been a good deal "floating in the air" of late with respect to gum styrax as a mounting medium, but there appeared to be some obscurity as to where this material could be obtained, in the condition best adapted to microscopic mounting. In a note communicated to the "Société Belge de Microscopie," and published in their journal, Dr. Van Heurck pointed out some of the difficulties attending the procuration and the purification of the crude gum, and stated, that he had imported some which he had sent to a French firm of chemists for preparation. On pointing this out to Mr. Curteis, he, with his usual kindness, wrote at once to the Paris house and obtained some samples, which he (Mr. Hailes) had experimented with, in order to ascertain what would be the best solvent for it, and also to test its applicability to other objects. He found that the gum, which was of a dark colour and almost solid, dissolved readily in sulphuric æther, in benzol, and in chloroform; but the æther did not dissolve all the oil, which is used in considerable quantity in the preparation of the crude gum. Benzol dissolved all the oil, but made a somewhat muddy solution. Chloroform, he found, gave the most satisfactory results. The solution was a little cloudy, but the cloudiness disappeared under the influence of a slight heat in the process of mounting. As to its applicability to other objects than diatoms, members would be able to form their own opinion at the close of the meeting, and if any desired to experiment for themselves, no doubt Mr. Curteis would be able to let them have a sample of the gum.

Dr. M. C. Cooke said that he had very great pleasure in introducing to the Club their newly-elected President, Dr. W. B. Carpenter, F.R.S., to whom, in their name, he offered a most hearty welcome.

Dr. Carpenter having taken the chair, amidst great applause on the part of the members, said that his first duty, on that occasion, was to thank them very cordially for the honour done to him in electing him as their President. It was not the first time that they had made the request that he would occupy the position, but on former occasions it had happened that there were circumstances which precluded him from doing so. On the last occasion, however, he had no excuse to make, except that as he was getting rather old he might not always be able to come out to attend the meetings. He would, however, do the best he could in that respect, and would try to attend as often as possible. He then proceeded to deliver an inaugural address, "On the Structure of the Orbitolites."

Mr. A. D. Michael said that though not strictly in order in moving a vote of thanks at that time, he felt he should be neglecting a duty if he did not,

in the name of the Club, thank Dr. Carpenter for the address which he had just given them. They had all found the subject of the greatest interest; indeed, he thought that no more interesting subject could have been brought before a Club like theirs, and when a man like Dr. Carpenter came down there and in his lucid manner taught them lessons of such practical value, he thought all present would agree with him that their thanks were due to the Doctor, not only for his address, but for his presence amongst them on that occasion as their President.

The vote of thanks was put and carried by acclamation.

Announcements of meetings for the ensuing month were then made, and the proceedings terminated with the usual conversazione, the following objects being exhibited:—

Rotifer. *Asplanchna priodonta*	Mr. F. W. Andrew.
Shell of Orbitolite	Mr. W. J. Brown.
Plumose antenna of *Volucella bombylans* ...	Mr. F. Enock.
Egg of Parasite of Squirrel, with embryo ...	Mr. H. E. Freeman.
Acineta Ehrenbergii	Mr. W. Goodwin.
Palate of *Helix Aspersa* mounted in gum styrax	Mr. H. F. Hailes.
Stentor Müllerí	Mr. G. E. Mainland.
Cladosporium herbarum	Mr. T. S. Morten.
Pleurosigma fasciola	Mr. E. M. Nelson.
A. Neuropterous larva from Walton	Mr. F. A. Parsons.
Section of Jaw of Kitten, showing displacement of temporary, and development of permanent teeth	Mr. W. Watson.

Attendance—Members, 83; Visitors, 4.

November 14th, 1884.—Conversational Meeting.

The following objects were exhibited in the Library:—

Hydrozoa, *Syncoryne pusila*	Mr. F. W. Andrews.
Spicules of sponge, *Hyalonema mirabilis* ...	Mr. F. Coles.
„ „ gorgonia	Mr. A. L. Corbett.
Paramecium aurelia	Mr. C. G. Dunning.
Cynips, sp.	Mr. F. Enock.
Parasite of Black Wallaby, N. S. Wales ...	Mr. H. E. Freeman.
Larva of *Simulium*	Mr. A. Hammond.
Crystals of *Zeolite*	Mr. G. E. Mainland.
Terebraria Kerguelensis...	Mr. H. Morland.
Hydra Viridis	Mr. T. S. Morten.
Carchesium polypinum	Mr. R. T. G. Nevins.
Foraminifera, *Carpenteria monticularis* ...	Mr. B. W. Priest.
Diatom, *Auliscus speciosus*	Mr. G. Sturt.
T.S. Finger of monkey	Mr. W. Watson.
Head of house-fly	Mr. J. Woollett.

In the mathematical theatre Mr. Lewis Wright exhibited some slides by

means of an improved construction of lantern microscope, which had been constructed for him by Messrs Newton and Co., of Fleet Street.

Mr. Wright said that he had devoted considerable time and attention to the perfecting of the gas microscope, his part of the task being so to arrange matters that adequate illumination could be passed through both the objects and the lenses, and in such a way as not to impair the definition of the latter. He had found considerable difficulty in obtaining suitable object glasses, especially those of the higher powers, as many of those which were perfectly satisfactory when used with the ordinary microscope would not stand the amplification to which they were submitted in the lantern.

The object glasses used on the present occasion were a half-inch of Powell and Lealand's, lent by Mr. Frank Crisp; a half-inch of Gundlach's, lent by Mr. Curties; and an eight-tenth of Messrs. Newton's.

The most important consideration was, however, the arrangement for the management of the lime light, and this, which could only be carried out by those thoroughly conversant with the peculiar conditions attending the use of that mode of illumination, had been most effectually and satisfactorily done by Mr. Herbert Newton, from his (Mr. Wright's) designs.

Mr. Wright then showed various objects upon the screen, including a beautiful section of the eye of a fly, magnified 1,400 diameters, and the cornea of the same, 2,500 diameters; sections of human skin, wood, and echinus spines, the tongue of the blow-fly, from six to fourteen feet long, the circulation in a living frog's foot, &c., &c., the sharpness and clearness of definition, as well as the penetration, being in all cases remarkably good. He also exhibited a number of polariscope slides, rock sections, salicine, &c., with great beauty.

Dr. Carpenter, who was present, expressed his satisfaction with the progress Mr. Wright had made in this direction, and pointed out the immense advantages in the use, for educational purposes, of such an apparatus.

Attendance—Members, 63; visitors, 9.

November 28th, 1884.—Ordinary Meeting.

Dr. W. B. Carpenter, C.B., F.R.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. Fredk. Bates, Mr. F. O. Snell, Mr. P. G. Sanford, and Mr C. Crisp.

The following donations to the Club were announced:—

"Proceedings of the Royal Society"... ...	From the Society.
"13th Annual Report of the South London Natural History Society and Field Club"	" " "
"Transactions of the Essex Field Club" ...	" " "
"Transactions of the Norfolk and Norwich Natural History Society"	" " "

"Transactions of the Brighton and Sussex Natural History Society"	From the Society
"Transactions of the Hampstead Natural History Society"	" " "
"American Monthly Microscopical Journal"...	In Exchange.
"Proceedings of the Royal Society of New South Wales"	" "
"Proceedings of the Canadian Institute" ...	" "
"Science Gossip"	" "
"Science Monthly"	" "
"The American Naturalist"	" "
"Annals of Natural History"	Purchased.
"Quarterly Journal of Microscopical Science"	"
"Challenger Reports" (new volume)	"

The thanks of the meeting were voted to the donors.

The Secretary read a letter from Mr. T. B. Rossiter, of Canterbury, with reference to a number of specimens of *Stephanoceros* which he had that day forwarded for distribution amongst the members.

The President said that there were four tubes sent containing a large number of specimens, which would no doubt be appreciated by the members.

The Secretary said there was one other donation to which special attention should be called, and that was a collection of 300 slides contained in twelve boxes, and presented by Mr. E. M. Nelson. They consisted of a set of Van Heurck's type slides of diatomaceæ, which for purposes of comparison would be of great value.

The President proposed that a special vote of thanks should be given to both these gentlemen for their donations; and he thought that a very special vote of thanks should be given to the gentleman who had presented this very valuable series of slides. These were type specimens, and would assist the members in naming and identifying slides.

Special votes of thanks were then put to the meeting and carried unanimously.

Mr. A. D. Michael described and figured on the black board a specimen of an Ascidian found at the Land's End.

The President said he had never chanced to come across it in the tadpole state, but he was perfectly familiar with the form mentioned. He took a very early interest in this class, because he had the opportunity of studying them just after the publication of Milne Edwards' book had directed attention to them, and that book seemed to be the starting point. He was about that time staying at Tenby, and found there nearly every species described by Milne Edwards. He was sorry to say, however, that on visiting Tenby about two years ago he found the whole of this fauna was gone, the place having been so entirely altered during the interval. The new interest which the ascidians had at the present time arose from the fact that there was just now a very strong leaning towards the belief that they were the root stock of the vertebrate animals, especially as modern embryology was found to entirely confirm this view. Those who had studied Mr.

Balfour's work would no doubt have noticed that there was nothing whatever about the ascidians in the first volume, but in the second volume they were placed at the beginning of the embryology of the vertebrates. He fully sanctioned the idea that they led up to the vertebrates, and not the mollusca as was formerly supposed.

Mr. Bates' paper "On the supposed sexual nature of the threads of the Zygnemaceæ," being a criticism upon a paper by Mr. A. W. Bennett, M.A., B.Sc., F.R.M.S., &c.

Dr. M. C. Cooke said it was a source of great satisfaction to him to find that they had acquired a member who would write papers, and who was at the same time an indefatigable worker in fresh water algæ. He thoroughly endorsed the opinions expressed.

The President said that this was no doubt a very remarkable group, and having early paid some attention to it at the instance of Mr. Thwaites, of Bristol, they were the first to make out that this conjugation was a sort of anticipation of the sexual process in plants. In the Diatomaceæ they found a perfect equality; and in the Zygnemaceæ, taking the simplest forms, there was no distinction of form, but as they went higher they came to cases in which there was a difference, but it seemed to be a gradual differentiation. This, at least, was his own old opinion. He would venture, however, to suggest that there should be some modification of the language employed by the author of this paper with reference to Mr. Bennett, who had been personally known to him for many years, and who was a very excellent man. He was glad to find that the feeling of the meeting was with him in expressing himself on this matter; there could be no reason why one scientific man should in this manner impute motives to another. No good ever came of it, and he was quite sure that their Journal would be better without it.

Mr. Pennington's note "On a slide presented to the Club, being a series of sections (10 on one slide) of the oral Disc of *Cerianthus solitarius*" was read by the Secretary.

The President said that these were very beautiful illustrations of the superiority of the new method of section cutting over the old. The specimens were beautifully mounted.

A vote of thanks to Mr. Pennington was unanimously passed.

Mr. E. M. Nelson announced that he had recently been successful in detecting a flagellum on the cholera bacillus. He also suggested that it would obviate much inconvenience where immersion condensers were used if a standard thickness of glass slips was adopted. At present there were so many thicknesses in use that it was sometimes very troublesome to adjust the focus properly with high powers, as if too thin the drop would not adhere, and if too thick it got squeezed out. He should propose that a thickness of $\frac{1}{20}$in. be adopted as the best for a standard, and if every person would buy slides of that gauge only, the thing might easily be done. He also exhibited a new microscope, which he regarded as a marvel of cheapness, the instrument, with two eye-pieces and two objectives, being offered at £3 12s.

Mr. Michael said he thought he should find a standard gauge for glass slips a great nuisance, especially for such objects as required the use of

high powers. Certainly for his particular class of work he should naturally object to abolish thin slips.

The President said they were much obliged to Mr. Nelson for bringing these subjects forward. As regarded the microscopic glass, he quite agreed that it might be well to have a standard thin glass, but for ordinary work he always used glass of about twice the thickness mentioned. He never measured the slips, as he found his own fingers to be very good guides in that respect; but now that the oil immersion lenses were coming more into use, he thought it might be well to try to get some uniform slip for use with them.

The President announced that Mr. Charlesworth had brought to the meeting (through a mistake as to the night of meeting of the Geologists' Association) a very interesting series of bones of the gorilla, which were displayed on the table at the end of the room. Also that as the date of their next ordinary meeting fell on Bank Holiday, December 26th, it had been determined to omit the meeting. Notice of this alteration would be given on the Demonstration Cards about to be issued.

The proceedings then terminated with the usual conversazione, and the following objects were exhibited :—

Lophopus crystallinus	Mr. F. W. Andrew.
First leg of the Honey Bee showing comb for cleaning antennæ	Mr. F. Enock.
Minute Hymenopteron from Ceylon to illustrate Mr. Green's paper read April 27th, 1883	Mr. T. Curties.
Section of Oolite with Foraminifera	Mr. W. M. Holmes.
Lecythea Rosa, and *Aregma mucronatum* ...	Mr. G. E. Mainland.
Larval compound ascidian, *Leptoclinum* showing condition in the egg ...	Mr. A. D. Michael.
" " in the three anterior suckers, &c. ...	" " "
" " in structure of caudal appendage ...	Dr. Matthews.
Lima hians and nest made up of *melabesia calcaria* and fragments of shell ...	Mr. S. H. Needham.
Portion of nest of same, showing the lining of byssus spun by the mollusc ..	" " "

Attendance—Members, 68; Visitors, 3.

December 12th, 1884.—Conversational Meeting.

The first demonstration of the third series, "On Bacteria and the methods of staining them," was given this evening by Mr. E. Thurston, L.R.C.P., Curator of the Anatomical Museum, King's College.

The following is a *resumé* of his lecture :—

In the microscopical investigation of micro-organisms it is necessary for most purposes, that they should be stained with anilin dyes, in order that they may be rendered distinctly apparent. Nevertheless I strongly advo-

cate the examination of the organisms, whenever it is possible, in their natural state, so that their appearances and characteristics may be observed when they have not been subjected to the action of heat or chemical reagents. It will be found, in many instances, that species, which are undistinguishable one from the other microscopically, can be easily recognised by their appearance (colour, consistence, &c.) and mode of growth in cultivating media, and, for this reason, microscopical examination should always be combined with artificial cultivation. The cultivation medium which is generally employed is clear sterilised meat jelly, which is made by adding to a meat infusion neutralised with sodium carbonate, and sodium phosphate, 5 per cent. of gelatine, or 1-2 per cent. of agar, (Japanese isinglass). The advantage of employing the latter is that the jelly remains solid when heated to 40°, whereas jelly made with ordinary gelatine liquifies at 20-25°. A very good cultivation soil is afforded by the outer surface of a cooked potato. If a potato is cleansed by washing it with a solution of corrosive sublimate (1-2,000), boiled, and cut in two with a heated knife, and exposed on a plate beneath a bell jar, the air in which is kept moist by blotting-paper steeped in water, within 1-2 days minute colonies of various coloured organisms, together with moulds *penicillium*, *aspergillus*, &c., will appear on the surface of the potato, and increase in size day by day. Each of these coloured colonies consists of a pure cultivation of a chromogenous *bacterium* or *torula*, of which many varieties—white, yellow, orange, buff, red, &c.—exist. Many of these are microscopically undistinguishable from each other as regards their shape and size, but they are easily recognised microscopically by their colour and mode of growth.

The investigation of *bacteria* is required under various conditions, according as they occur:—1. In fluids, *e.g.*, milk, water, blood, &c.; or on solid media, *e.g.*, bread, meat, potatoes, meat jelly, &c. 2. In the organs and tissues of the animal body. In the former case a minute portion of the fluid, or of a colony of the *bacteria*, is placed on the centre of each of two cover glasses, which are superimposed one over the other, and rubbed together between the fingers, so as to distribute the organisms evenly over their surfaces, and then separated and left to dry. They are then passed several times through the flame of a spirit lamp, so as to fix the *bacteria* to the surface of the glass. Cover glasses so prepared can be kept for an indefinite time for future investigation, and if an interesting organism is met with it is a good plan to preserve some in this manner. It is very easy to obtain a thin, evenly-diffused specimen of *bacteria* on the cover glass when they are present in fluids, but more difficult when they occur in the form of solid colonies. To obviate this difficulty a minute portion of mucilage or glycerine may be placed on the cover glasses, which will help the diffusion of the *bacteria* when the glasses are rubbed together between the fingers. It will often be found that the *bacteria* form very fantastic patterns on the cover glass, which are artificially produced, and must not be considered as typical modes of growth.

To stain *bacteria* mounted on cover glasses they should be floated, with the bacterial surface downwards, or a saturated watery solution of methyl

blue, methyl violet, gentian violet, fuchsin, vesuvin or bismarck brown* The time which is required for the completion of the staining process will vary according to the nature of the dyes. Roughly speaking, 10-15 minutes suffices in every case except that of vesuvin or bismarck brown, on which the cover glasses should be left for at least an hour. When the staining process is completed the glasses should be washed with distilled water, and, if the stain is too deep, in a ½-1 per cent. solution of acetic acid, then allowed to dry, and mounted in Canada balsam. The best form of balsam is balsam in Xylol, in which the dye does not fade.

If time is an object, the drying of the cover glasses may be effected by pressing them between folds of blotting paper and then brushing their surfaces with a camel's hair brush.

It will be found that, in solutions of anilin dyes which have been made up some time, various fungi, *torula* and *bacteria*, are prone to develop, and their presence, especially on the surface of stained sections, might give rise to an erroneous observation. Their development may be prevented by the addition to the solutions of some antiseptic, *e.g.*, crystals of camphor. In every case the solution should be filtered before it is used.

For photo-micrographic purposes *bacteria* are best stained with vesuvin or bismarck brown.

In the investigation of *bacteria* in the tissues and organs of the animal body, sections must be made after the specimen has been hardened by one of the numerous hardening processes. A great number of staining reagents have been recommended, of which I shall describe only three, which I find most useful for general purposes.

1. *Bismarck brown.*—The sections are allowed to remain in a saturated watery solution of the dye for about one hour, washed in distilled water, and then in a ½-1 per cent. solution of acetic acid, dehydrated in absolute alcohol, clarified in oil of cloves or pure anilin, and mounted in Canada balsam.

2. *Alkaline blue.*—The formula for the making of this solution is as follows:—To 100 parts of a solution of caustic potash (1-10,000) in distilled water, add 30 parts of a saturated alcoholic solution of methylen blue. The sections should remain in this fluid for about an hour, are then washed in distilled water, and afterwards in a ½-1 per cent. solution of acetic acid, dehydrated in alcohol, clarified in oil of cedar, and mounted in Canada balsam. If they are clarified in oil of cloves it will frequently happen that much of the dye runs out of them, whereas the colour is retained when they are left in the oil of cedar, even for a long time.

3. *Gram's Method.*—In this staining process three solutions are used and are as follows:—

Solution A.—Saturated alcoholic solution of gentian violet, 11 parts. Saturated watery solution of anilin, 100 parts.

[The anilin solution is made by shaking up pure anilin with distilled water, until no more is dissolved, and filtering.]

* The best dyes, as far as I know, are those which are supplied by Grübler, of Leipzig, for whom Mr. Baker, 244, High Holborn, is the London agent.

Solution B.—Iodine, 1 part. Potassium Iodide, 3 parts. Distilled water, 300 parts.

Solution C.—Saturated watery solution of vesuvin or bismarck brown.

The sections are immersed in absolute alcohol for a few minutes, and then placed in Solution A for 1-3 minutes; washed for a few moments in absolute alcohol, and transferred to Solution B, in which they remain for 1-3 minutes. They are then again washed in alcohol, and placed in Solution C for several minutes; washed in distilled water, dehydrated in alcohol, clarified in several changes of oil of cloves, and mounted in Canada balsam.

This method is by far the best for staining *bacteria* with which I am acquainted, and if the various steps are properly carried out the *bacteria* should be stained of a dark violet colour, and stand out in striking contrast with the tissue elements, which are stained light brown.

If tubercle *bacilli* are to be stained by this method, the sections should be left in Solution A for 24 hours instead of a few minutes, and the other steps carried out in the manner which I have just described. The result is far superior to that which was obtained by the method of staining the sections in a fuchsin-anilin solution, treating them with nitric acid, and contrast staining them with methyl blue.

Let me in conclusion remind you that *bacteria* are not of interest solely to the pathologist, but that, entirely apart from pathology, much remains yet to be learned of their life history, and development, and the precise nature of the fermentative processes to which they give rise. Why do *micrococci* generally grow in a solid mass in meat jelly, while many *bacilli* liquify the same medium? What is the nature of the pigment in the chromogenous *bacteria?* What changes occur in the blood under the influence of the *bacillus anthracis?* Such are a few of the many questions which still remain to be solved by patient and untiring chemical investigation.

The various processes illustrative of the lecture were carried out by Mr. Thurston, assisted by Mr. J. W. Groves, and, on the conclusion of the demonstration, a hearty vote of thanks was accorded to these gentlemen, on the motion of Mr. A. D. Michael.

The following objects were exhibited in the Library:—

Fairy shrimp *Chirocephalus diaphanus* ...	Mr. F. W. Andrew.
Web of house spider *Amaurobius similis* ...	Mr. F. Enock.
Lophopus crystalinus	Mr. J. D. Hardy.
Gamasus coleoptratorum	Mr. G. E. Mainland.
Disparipes Bombi	" " "
Asteromphalus Humboldtii	Mr. H. Morland.
Condylostoma stagnale	Mr. R. T. G. Nevins.
Cuticle of Fuschia	Mr. C. Le Pelley.
Bacillus of splenic fever	Mr. E. Thurston.
Type slide of 100 species of diatoms... ...	Mr W. Watson.

Attendance—Members, 68; Visitors, 11.

Notes on a New Hydroid Polyp.

By F. A. Parsons, F.R.M.S.

(*Read January 23rd,* 1885.)

PLATE VI.

Before describing the curious little polyp to which I wish to draw your attention this evening, I will give a short account of its discovery.

At the excursion to the gardens of the Royal Botanic Society of London, on the 19th of April last, I took a gathering from a tank in the house for Medicinal and Economic plants. On an iron pipe in this tank there was growing some fresh-water sponge, I obtained a piece of this which I placed in the bottle containing my collection.

I am in the habit of keeping the gatherings made during excursions as long as circumstances will permit, and this practice I venture to recommend members generally to follow, as it frequently happens that many interesting objects make their appearance, after a time, that would be lost if the gatherings were thrown away soon after they were made. The discovery of this polyp is a case in point.

The sponge I have alluded to went the way of all sponges, and nothing but its skeleton remained. This cohered, partly from the way in which the spicules were matted together, and partly by reason of a film of rust which had adhered to the side of the sponge and by which it had been cemented to the pipe.

Some weeks after the excursion I happened to look at the contents of the bottle, and on the rusty side of the sponge skeleton I saw what at first appeared to me to be a polyzoon, but so different from anything I had ever seen that I was at once induced to examine it more closely with a pocket-lens, when the seeming resemblance vanished. I should perhaps explain that the fancied similitude arose from the fact that there were a number of these polyps in close proximity to each other. I took an early oppor-

tunity of making a microscopical examination, but was unable to get beyond the fact that it was a hydroid polyp which I had never before seen. I described it to several persons whom I thought might be able to give me some clue to its identification, but I was unable to obtain any information about it.

Owing to the flimsy structure of the sponge skeleton, which had began to disintegrate, I hesitated about bringing it here, but finally determined to make an attempt to exhibit it in this room, and I brought it down to the meeting in July last. Being anxious to show it under a quarter-inch objective I endeavoured to transfer it to a very shallow trough, but the sponge skeleton had become so fragile that the whole thing collapsed in the attempt, completely obscuring all the specimens, which I thought were annihilated, but, however, they subsequently reappeared stronger than ever. It was my intention to exhibit a rather fine specimen, at the November meeting, in the hope that our President might be able to throw some light upon the matter, but, when I looked for this particular specimen, which I had carefully isolated in a small tube, I was unable to find it; neither could I find any of the others. They had all, I suppose, died from want of food.

I paid another visit to the tank at the end of November, and was much gratified on reaching home to find that I had obtained a fresh supply of these singular little creatures.

In the following week a letter from Professor E. Ray Lankester appeared in the *Times* stating that Mr. Bourne had discovered, in the Victoria regia tank, at the Royal Botanic Gardens, a hydroid polyp, which was supposed to be the polyp stage of the Medusa *Limnocodium Sowerbii*.

Without having the slightest idea that this polyp was the same that I had found in the Economic house, I determined to make another pilgrimage to the Gardens and endeavour to find the polyp referred to by Professor Lankester. I went to the Victoria regia house, and searched there in vain for anything like a polyp, but took away with me some rootlets of the *Pontederia*. The first piece I examined of this under the microscope revealed my old acquaintance of the Economic house, and it immediately flashed across my mind that this was probably the same polyp which had rewarded the search of Mr. Bourne.

It was suggested to me by a friend, that I should exhibit it at the December meeting of the Royal Microscopical Society, and

as there was no meeting of this Club last month, except the Gossip night which I was unable to attend, I acted upon the suggestion, and I am very glad that I did so, as it brought me a letter from Mr. Bourne, in which he says:—"I am told by Mr. Charles Stewart that you exhibited to the Microscopical Society a Hydroid polyp, which Mr. Stewart informs me is the same as the one I have lately described from the tank at Regent's Park. Mr. Stewart further informed me that you had been for some time acquainted with this form, and had found it in other localities than in the Lily tank at the Botanic Gardens—if this is the case it cannot be *Limnocodium*. I should feel greatly obliged if you would let me have a line from you about it. I naturally considered it in the highest degree probable that the thing was connected with *Limnocodium*, but if it is not, and if it never developes further than the condition in which we now see it, I regard it as an even more interesting form, and should, of course, consider it as your discovery."

In reply to this letter I gave Mr. Bourne some information about the polyp, and ventured to suggest that before coming to the conclusion that it had no relationship to *Limnocodium*, it would be well that the latter should be looked for in the tank in the house for Medicinal and Economic plants, where it might have easily escaped observation.

I remarked just now that the polyps made their appearance on the side of the sponge which had been in contact with the pipe. This fact leads me to the inference that the polyps were developed from germs contained in the water which I brought away with me, for I do not see how they could have got there while the sponge was alive; moreover they were in different stages of development, the earliest stage seen by me being a little mound of fuscous coloured sarcode. Other specimens more advanced were similar, but longer, the length varying, no doubt, in proportion to the age of the individuals. When the polyp has attained its full length, or perhaps a little earlier, its free end presents a warty appearance due to a number of receptacles containing the urticating thread cells. These thread-cells are very minute, the shape of them being that of a very short cylinder with hemispherical ends. The spines on the filament are not sufficiently distinct to be counted under a quarter-inch objective—at least I was unable to count them when I had them under examination with that power—but I was

just able to detect the threads coiled up in the little papilla-like receptacles on the head of the polyp.

Besides the simple form I found three other forms; these were evidently further developments, but how brought about I have not been able to determine, for I have not discovered any intermediate stages, though I hope I may yet be able to find them. If I may be allowed to speculate—though it is unsafe to do so—I should think it probable that the second polyp is developed from the base of the first, thus causing the erect position to be changed to a recumbent one. The tripartite and quadripartite forms are probably developed in the same manner as the bipartite form.*

The method of attachment of the polyps I have not been able to make out; they do not appear to have anything like the adherent disc or foot of the hydra, though there is probably some approach to that organ; neither have I been able to discover that it has any powers of locomotion, though after the collapse of the sponge skeleton I found a polyp attached to some rootlets. The only motion I have observed is a sluggish one, the animal occasionally bending its body sideways as if searching for food, remaining motionless for a considerable period, and presenting altogether a harmless appearance. This appearance is, however, utterly deceptive, for its powers of paralysing its prey equal, if they do not surpass, those of the hydra, though it has not its activity, otherwise it would be impossible, in the absence of tentacles, for it to obtain food; any small animalcule coming in contact with the head must be instantly paralysed, else, on finding itself hurt it would dart away out of reach. As regards its method of feeding I was for some time in doubt; I could not detect any mouth, and as I found little worms lying dead about the heads of the polyps, I was at first inclined to think that they lived by some process of absorption. I have, however, since had ocular demonstration of their powers of deglutition. I saw a polyp swallow a rotifer which was quite as large in diameter as itself. How the rotifer was caught I did not see, as it was done at a moment when my eye was away from the microscope. From

* Since writing these remarks I have found an intermediate stage, where one member of a trifid form was developing a fourth polyp, in the form of a bud, near the base of that particular member. This bud consisted simply of what I would term a perfect head, projecting beyond and clear of the body of the parent. The body of the new polyp would doubtless be developed in due course.

the position of the rotifer I should think that it had probably collided head first with the polyp and had been instantly paralysed. The head of the polyp was bent over nearly at a right angle to its body, but was presently moved round to its normal position, the rotifer being taken with it; by this time the head of the latter had disappeared, and the rotifer was motionless, the gizzard only working slowly. The polyp continued to swallow its unfortunate prey, but the operation was so slow that I could not detect the motion, and it was only by mentally comparing the relative positions from time to time that I could tell what was going on. Eventually the rotifer disappeared from view, but its position in its downward course within the polyp could readily be discerned by the corpulence of the latter at the spot to which the rotifer had arrived.

I afterwards witnessed a still more extraordinary display of the polyp's capacity for swallowing comparatively large objects. In this instance one member of a twin arrangement was discovered in the act of swallowing a little *chydorus sphæricus*, which was quite double the diameter of the glutton to which it was the victim. When I first observed it the *chydorus* was already about two-thirds of its diameter within the body of the polyp, whose mouth was fearfully distended, and I doubted whether it would succeed in the task it had undertaken; however, presently it accomplished the feat, but by converting itself into a bloated deformity.

Although I have had this creature under observation for a long time, I have seen no indications of any reproductive process other than that already described; but I think it is probable that if search were to be made shortly before the period at which the *limnocodium* usually appears, evidence might be obtained which would show whether or no this polyp has the relation to *limnocodium* which it has been supposed to have. I would mention here, as having some possible bearing on this point, that a change does appear to take place in the structure of the animal; in the earlier stages the body seems to consist of granular sarcode, in general appearance similar to that of the common hydra, but in later stages there is a decided cellular appearance, the cells being comparatively large and the polyp more nearly transparent.

The polyps seem extremely hardy, for though taken from a tank kept at a temperature of 90° or more, they lived and flourished with me in a room at the ordinary indoor temperature; all they seemed to require being plenty of food. Whether keeping them at so

low a temperature would interfere with the development of medusæ I cannot say, but should think it probable.

There is one point which I omitted when speaking of its powers of offence. I am inclined to believe that it has defensive powers also. This idea occurred to me from seeing a rotifer blunder head first against the trunk of one of these polyps. The rotifer backed off instantly with its rotary organs retracted, and had every appearance of being seriously hurt; in fact, I thought it had received a death blow. I watched it for some time, but it ultimately recovered and swam off as though nothing had happened.

In concluding these remarks I must apologise for the very rough form in which they are presented, and for the absence of more solid information than I have been able to give. I have kept no notes, and my remarks are given entirely from memory; some of the sketches are also made from recollection of the objects. I may therefore not have been quite so precise on some points as could be desired; my excuse is that I have not had the leisure necessary for working out the matter in a more satisfactory manner; but I thought the members might like to know something concerning the polyp, the first discovery of which is due to the Club Excursions. I shall continue my observations, and if I discover anything fresh of sufficient interest I may on a future occasion trespass on your patience.

DESCRIPTION OF PLATE VI.

Figures 1 to 9 may be considered as diagrams only, having been drawn entirely from memory. With the exception of Fig. 5 they approximately represent the appearance under the inch objective and B eye-piece.

Figs. 1, 2, 3, 4, represent the early stages in the development of the polyp.

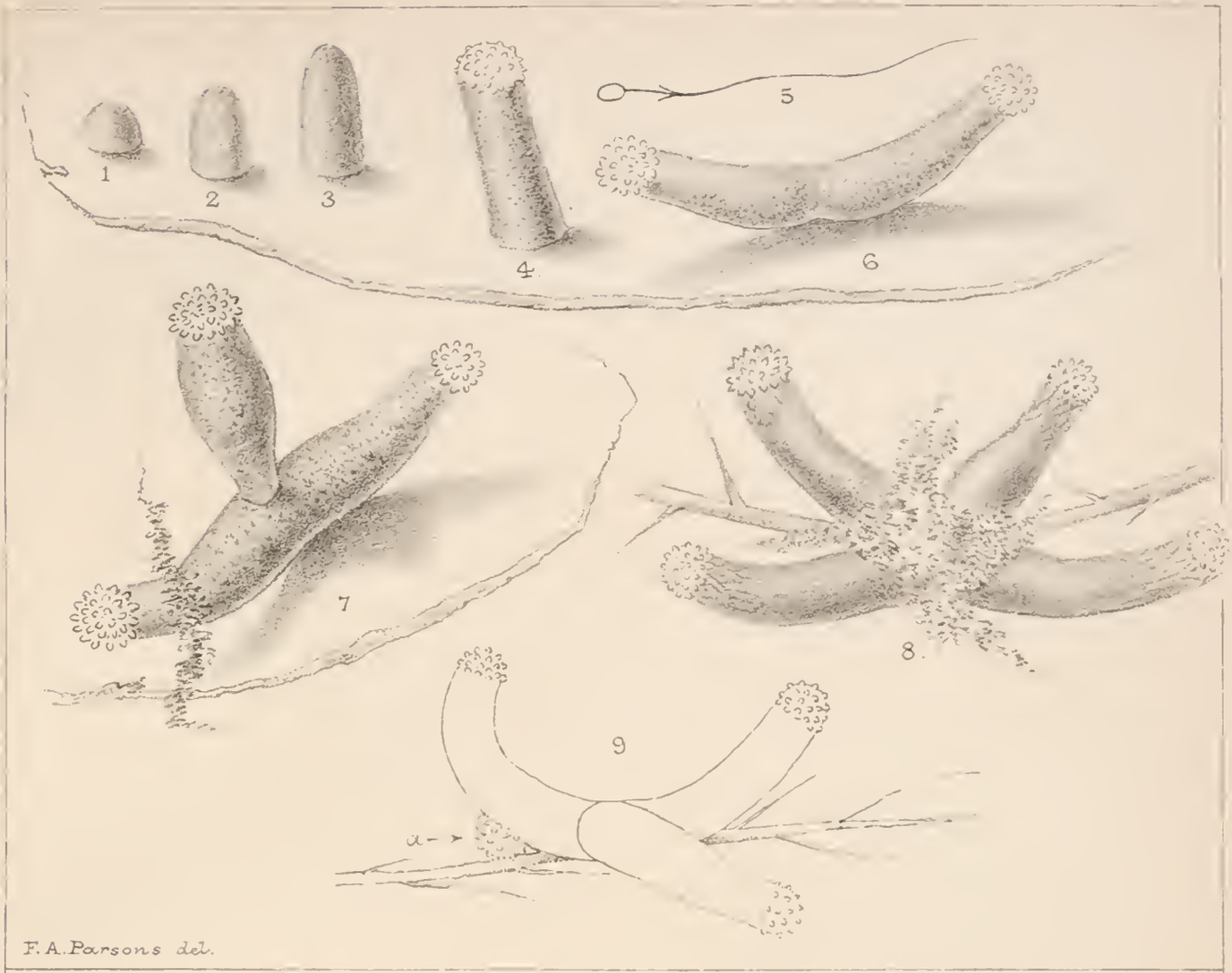
Fig. 5 is an enlarged sketch of a nematocyst or thread-cell, as seen under the quarter-inch objective and B eye-piece.

Figs. 6, 7, and 8 show various other forms referred to in the paper.

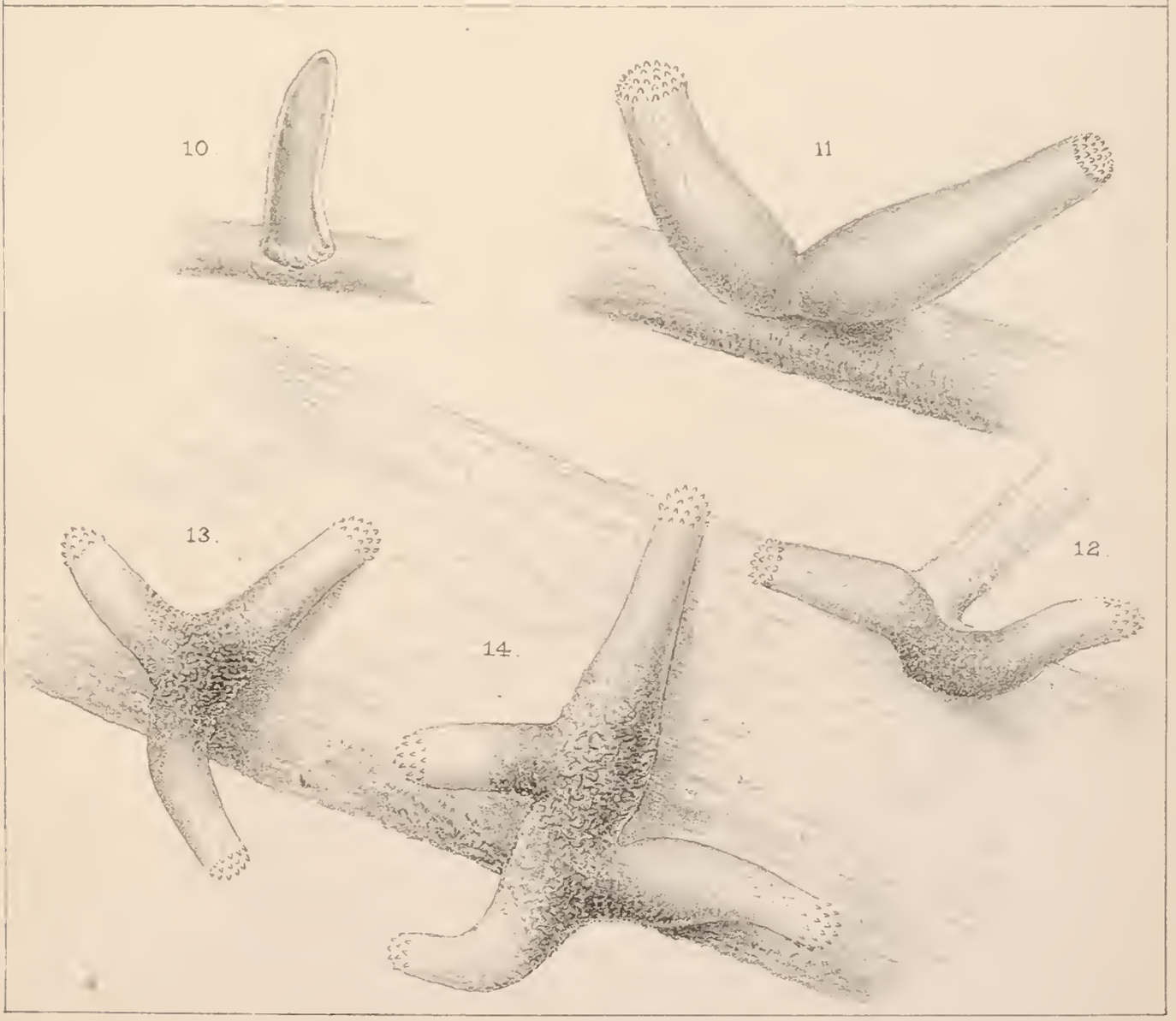
Fig. 9 is a trifid form with a fourth polyp budding out at *a*.

Fig. 10 shows a form similar to that shown at Fig. 3, and

Figs. 12, 13, and 14 three different stages, bipartite, tripartite, and quadripartite in close proximity; also variation in form from Figs. 5, 7, 8, and 11.



F. A. Parsons del.



J. Badcock Jr. del ad nat. W. Rhein lith.

West Newman & Co imp

Newly-Observed Phenomena in the Conjugation of the Diatom *Rhabdonema arcuatum*.

By T. H. Buffham.

(*Read February 27th*, 1885.)

PLATES VII. & VIII.

Before entering upon a description of the phenomena noticed in the process of conjugation of this diatom, it will be instructive to understand the peculiar structure of the frustule and habits of the plant, for they undoubtedly govern the mode and circumstances of that process which it is the purpose of the present paper to describe.

Rhabdonema arcuatum grows in filaments which are attached to marine algæ. The filaments are of constant thickness, have parallel sides, but differ from each other in breadth, being 3 to 9 times the thickness, so that the appearance is that of a number of ribands. These filaments are found to contain from 2 to 60 frustules, but the frustules themselves are not of equal breadth (using this term now as extending along the direction of the filament). Moreover, the breadths of the frustules are usually different in the same filament. On taking the "front view" (as it is called) of a frustule (*i.e.*, in this instance the flatter side) the two valves—one at each extremity—are seen to be separated by a considerable distance from each other, the intervening space being filled up by a number of annuli of the same length as the valves, and equally siliceous. These will bear boiling in nitric acid without, in many cases, separating. A few will, however, be found together with free valves. A "side view" of a valve is shown on Plate VII., Fig. 1, × 600. In Fig. 2 is drawn the same aspect (also × 600) of an annulus. An extremely thin plate of silex is projected from each extremity, but only from one side. It resembles, in fact, the elliptical lid of a cardboard box with all the top removed excepting a crescent at each end. To revert, then, to the frustule it will be perceived that there are as many narrow chambers as annuli, all freely communicating with the central large space, only that in

this composite frustule the granular contents are somewhat restricted when moving in the chambers.

The mode of self-division is similar to that of diatoms with simple frustules excepting that the "connecting membrane" (or "hoop") may be formed at other parts of the widened frustule than the middle. Nor must we overlook the gelatinous cushions or "isthmi" which connect the four corners of adjoining frustules.

To come now to the process of conjugation. Prof. W. Smith, in his invaluable "Synopsis of British Diatomaceæ" (Intro. Vol. ii., p. 13.) says: "From a single frustule two sporangia are produced in the process of conjugation: this takes place in *Achnanthes* and *Rhabdonema*." How far I am compelled to consider this description inadequate will presently appear.

In March, 1883, I collected at Folkestone, *Rhab. arcuatum* growing on *Cladophora*, *Polysiphonia*, and *Ceramium* in rich profusion. After carefully washing in sea-water I placed them in glycerine to await examination. This was done after mounting in the same medium, but chiefly in Deane's gelatine. As objection might be taken to results obtained from preserved and no longer living specimens I may here remark that the only effects of glycerine, as far as I can see, are to make the endochrome more transparent and slightly greener, and but very little to alter the disposition of the granules. And Deane's gelatine, after glycerine, very well preserves the same appearance. At all events it will not be argued that these media will differentiate substances that are identical in structure and condition. Relying to a large extent on this principle I am not wholly dependent on it.

It would be of no interest to relate here the various attempts made to reconcile one's earlier observations with the statements of Prof. Smith, and I therefore proceed at once to give the results of the examination of many thousands of filaments, continued at intervals since collecting the specimens, with here and there an instance of conjugation, accumulating, however, in the aggregate, to a considerable number, and exhibiting almost every possible stage. In this examination I have been assisted by my friend Mr. W. H. Gilburt, to whom I am indebted for several important suggestions.

I. There are filaments which differ from the ordinary kind in consisting chiefly of frustules whose breadth (reckoned along the axis of the filament) is usually about equal to the length, and the terminal half-dozen or so are connected only by one angle to each

other, and thus form a zigzag chain (like *Grammatophora*) which is frequently somewhat twisted. (See Fig. 3, × 200.)

The frustules themselves are noticeable for —

1. Their small size. They are the smallest observed,—the length of valves or annuli being usually but ·00156 inch, though occasionally reaching ·002.

2. Their delicate appearance. This is partly owing to the divisions between the annuli being less marked than in ordinary frustules, but also through the pale colour of the endochrome.

3. The absence of one isthmus and the small size of the other.

4. But chiefly the paucity and arrangement of the endochrome. In all vegetating frustules there is much variety in this respect, no regular figure being generally found. In these, however, there is always a central pale circle or disc, this being the nucleus, and the remaining endochrome forms wavy curved lines, radiating in a roughly-stellate manner, with a few small granules. (See Fig. 4, × 600.)

These are undoubtedly the *male frustules*, as will presently be seen.

II. There are other filaments nearly as small, generally about ·00188 inch, but a few as wide as ·00225. These may be distinguished from ordinary filaments by the large number of annuli in a frustule. Near the middle of a frustule is a "hoop," but much wider than the "hoops" of a self-dividing ordinary filament. The endochrome is usually of a darker green, and the granules denser. The nucleus is frequently obscured by the aggregating granules, but when detected is found to be altered, and there is no distinct central mass as in the smallest frustules described in I.

These we shall find are the *female frustules*.

III. We have, then, two clearly-distinguishable kinds of frustules which are concerned in the act of conjugation, but the mode is so curious, and as I believe it has hitherto been unrecorded, I would specially draw attention to it.

Most frequently the conjugation takes place with a female frustule at or near the free end of a filament. At the earliest stage a number of male frustules have attached themselves by an isthmus to each of the half-frustules divided by the wide hoop or band. They do so at any part of the annuli indifferently, either on their flatter sides or ends. The number varies : it is never less than two, and sometimes as many as eight crowd round it. Of 21 I have counted, the average on each half-frustule was four. In

one case there were five, besides a zigzag chain of ten—one only of this chain being attached to the female. It would be impossible to understand the various positions where many are crowded on excepting by the use of the binocular. The appearance with a $\frac{1}{2}$-inch objective and paraboloid $\times 120$ is extremely curious as the whole can be seen nearly in focus at once. In Fig 5 ($\times 200$) is seen the earliest stage of conjugation, only that for clearness the male frustules on the under side are not drawn.

An interesting point now suggests itself. One cannot yet foresee whether one or two sporangia will be developed. Prof. Smith only knew of the latter result, but the instances are about equal. What, then, is the determining cause? As far as I have seen there is no case where conjugation occurs excepting when the female frustule is greatly widened and presents the broad band mentioned above. This may be a stage in self-division, yet there is no trace of new valves, and the band is noticeably wider than in those vegetating frustules which go on self-dividing. Prof. Smith says (*loc. cit.*, p. xiv): "Self-division occurring during the progress of conjugation the endochrome becomes segregated in the very act of intermingling, and a single frustule whose contents have been already differentiated gives rise to two sporangia as in *Achnanthes* and *Rhabdonema*." It will already have seemed probable that this description does not include the true process of conjugation, but I gladly note that it suggests the explanation we want. It is a fact that in about half the cases only *that* half of the frustule which is nearer the base of the filament produces a sporangium, as shown in Figs. 6 and 7. The terminal half—although having males attached—falls away. We can only infer that its vitality was not enough, probably from the nucleus not having divided, to carry on to its completion the production of a sporangium. If, however, the nucleus *has* divided—or in whatever way the necessary vitality of the upper half has been obtained—there will result two sporangia, as in Plate VIII., Figs. 1 and 2.

Returning from this digression to the course of development of a *single* sporangium following the earliest stage shown in Fig. 5 we have already noted that the terminal half of the female frustule falls away. The isthmi attaching the male frustules enlarge, the endochrome contracts, and the central pale nucleus is lost. The endochrome of the female moves towards the band, and the now open end of the latter secretes a gelatinous portion which closes

it, and one of the isthmi connecting the female with the frustule below it gives way, leaving it cohering by one angle.

Later still the males lose all their green colour, and the contents are still further contracted, so that only amorphous minute specks are left that look like the denser remnants of the original granules, and the frustules break in two,—either near the middle, or lose one valve: having fulfilled their office their vitality is quite lost. The stimulus they have exerted upon the contents of the female cell has passed through the thin (possibly unsilicified) spot near the end of the valve, and has undoubtedly been conveyed by the isthmi which connect them with the annuli of the female, and, I think, must have made its way through the sutures of these annuli. The endochrome of the males appears mainly to pass into solution to effect the stimulus: there is obviously no transfer of the granules as such. The female has developed—projecting from the band—a globose gelatinous sporangium, in which there is a distinct small portion that contains most of the endochrome. (Fig. 6, × 250.)

Succeeding this the whole of the endochrome passes into this space, and then appears completely separated from the cavity of the frustule, and is gradually elongated, and has formed round it a sheath or membrane.

Finally, the elongated mass secretes silex, and a new frustule is formed. The gelatinous investment has grown with the requirements of the contained body. The new frustule consists of two valves and what seems a kind of hoop,—there are no annuli,—and it contains larger, denser, and more deeply-coloured granules. Some of the male frustules still hang attached although it is evident, by the still further diminution of their opaque contents, that it is only by the persistence of their isthmi. (See Fig. 7, × 300.)

With regard to the double sporangia a substantially similar course of development is followed. In some cases, however, one sporangium appears to be more advanced than the other. In Plate VIII., Fig. 1, × 200, the lower one was either started earlier, or has developed more rapidly. In this specimen the female frustule was *not* terminal—a frustule being beyond it. In Fig. 2—showing two mature sporangial frustules (× 300)—it *was* terminal. It is now rare to find the female frustule of the upper sporangium. Very frequently it gets rubbed off, even by the time the stage in Fig. 1 (preceding) has been reached, and only fragments of the band are left, but this is probably of no consequence, the developing poten-

tiality being then in the endochrome contained in the sporangium. The curious and invariable loss of one of the isthmi at the base of the lower female frustule, noticed already, may be intended to give freer play to the sporangia, which undergo a great deal of friction from the surrounding filaments; indeed, they occasionally show a somewhat battered appearance.

There is considerable elasticity in these isthmi. I have seen a long filament doubled up while mounting in Deane's gelatine, and then gradually unbend itself, and this after eighteen months' preservation in glycerine. The male frustules are, in a very few instances absent, but the scars of their attachments can always be detected with a high power.

I regret I cannot contribute anything towards a settlement of the question as to whether the sporangial or "zygospore-frustule" contains a number of gonidia which Dr. Carpenter ("Microscope," 6th ed., p. 337) thinks may originate the new generation. Some observations of Prof. Smith seem to point to this, and there is a short note by Mr. G. C. Karop—now our Secretary—in our own Journal (Vol. vi., p. 191), in which the writer describes what may have been immature forms possibly developed from such gonidia. I have seen double sporangia where one of the new frustules had evidently been discharged, but this would prove nothing either way. The length of several mature zygospore-frustules I found to be constant at ·0059 inch, and the widest filament I found to be but ·0051. If the zygospore-frustule at once increased by ordinary self-division, it seems strange that no filaments were found of a width equal to the length of the initial frustule.

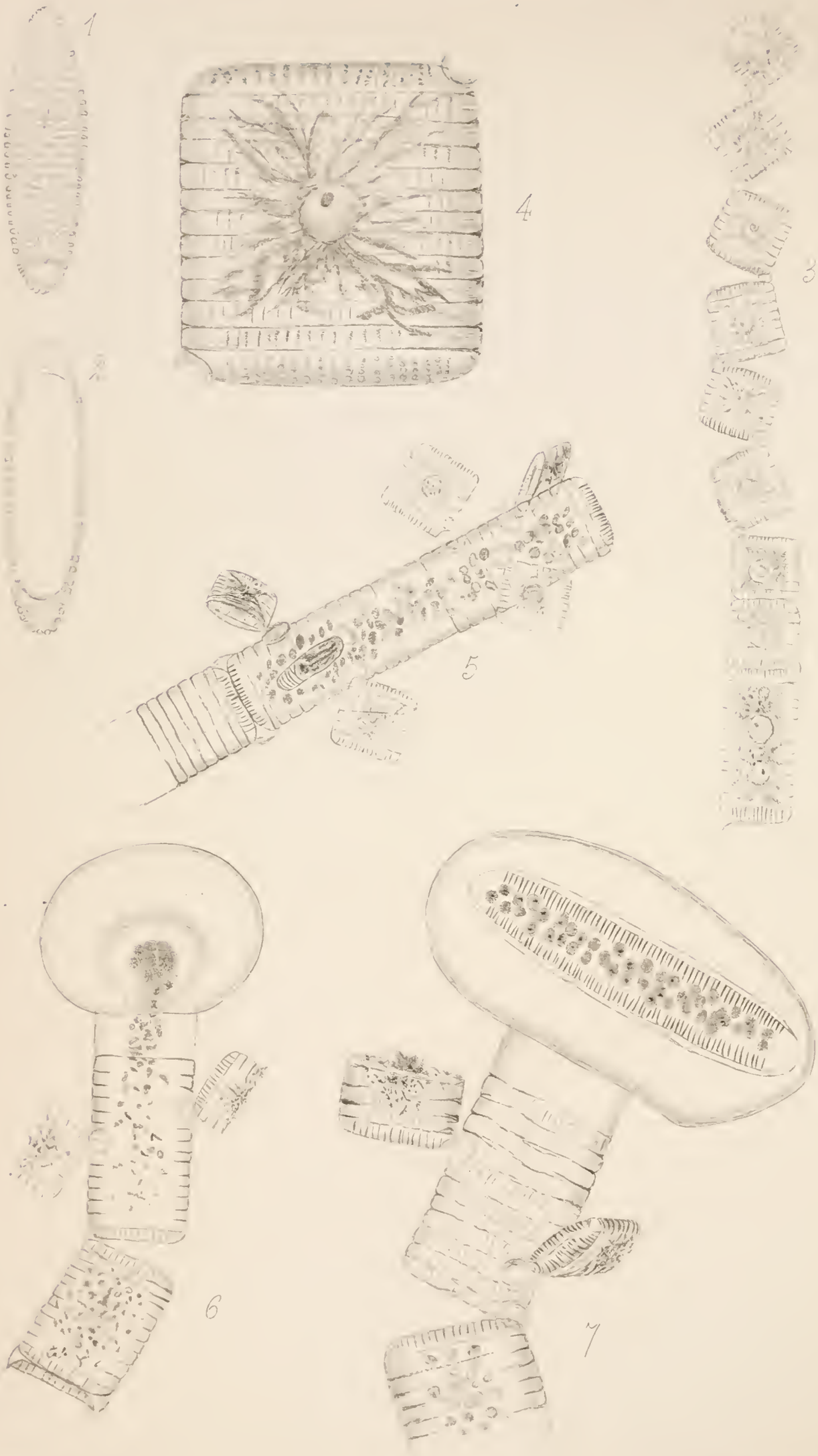
To sum up, then, the salient features of conjugation in *Rhabdonema arcuatum* we find :

1. The male frustules are the smallest in size, have the most definite arrangement of endochrome, and are the most readily detached.

2. The female frustules have slightly longer valves, more numerous annuli, and have always a wide band near the middle.

3. Conjugation is always polyandrous, and is effected by the male frustules attaching themselves indifferently to any part of the annuli of the female frustule.

4. The result of such conjugation is the production of one sporangial or zygospore-frustule if only the basal half of a female frustule persist; but, if both halves persist, each will produce a sporangium—the two sporangia being in close opposition.


1
2
3
4
5
6
7


1
2

5. The sporangial or zygospore-frustule consists of two valves, without annuli, which have a length about thrice that of the valves of the female.

With regard to the inducing causes of conjugation it would appear that in the present species self-division, which gradually reduces the size of the bounding valves, has gone on so long that a new generation becomes necessary to maintain the size. It can scarcely be induced by any extraneous influence, for the examples of conjugation occur amidst a profusion of vigorously-growing filaments. I have failed to discover any visible cause of the selective adhesion of the conjugating individuals. If there were any viscous coating on the female frustules the accidental appulse of a male frustule might fix it sufficiently to destroy its slight cohesion to its fellows by its one isthmus. I have generally seen the male filaments in the close neighbourhood of a conjugated specimen, and it may be that fortuitously touching the female the attachment is thus induced.

In conclusion, permit me to remind you that the *Diatomaceæ* have been classed as the highest division of the *Conjugateæ* in which no sexual difference has been perceptible. In *Rhabdonema*, with its composite frustule, we have seen that the conjugating process is also (so to speak) composite as well as distinctly sexual. We seem to have here a step towards—hardly a connecting link with —the sexual process in those *Algæ* which produce antherozoids.

DESCRIPTION OF THE PLATES.

Plate VII.

Fig. 1.—Free valve of *Rhabdonema arcuatum*, × 600.

2.—Side view of an annulus with its projecting plates, × 600.

3.—Free end of a male filament, the last 6 frustules being semi-detached, × 200.

4.—Male frustule, × 600.

5.—Female frustule with 6 male frustules attached: the earliest stage of conjugation, × 200.

6.—Young single sporangium, × 250.

7.—Mature ditto ditto with new frustule, × 300.

Plate VIII.

Fig. 1.—Double sporangium shewing different degrees of development, × 200.

2.—Mature ditto ditto with 2 new frustules, × 300.

Some Remarkable Moulds.

By Dr. M. C. Cooke, M.A., A.L.S., &c.

(*Read March 27th*, 1885.)

PLATES IX. & X.

It may be of some interest to the botanical members if I take this opportunity of placing before them figures and descriptions of some remarkable moulds which have come within my recent experience. It need not be premised that one great difficulty in the determination of these minute and fragile fungi lies in ascertaining the mode of attachment of the spores, whether singly or in chains, whether solitary or in clusters. This applies with strongest force to specimens sent from a distance, or when examined some months after death and dessication. Whenever the spores can be induced to germinate on rice paste, or other suitable matrix, and a cultivation of the mould artificially is successful, this great difficulty vanishes, but it is by no means an easy task to conduct such an artificial cultivation to a successful termination.

Basidiella sphærocarpa, *Cooke, in "Grevillea,"* vi., 118.

This is the first mould to which I would refer you. It was found growing in black woolly patches on dead and decayed roots of *Gloriosa superba*, from Madras. The roots were packed in a closely-stoppered bottle, in a damp state, and putrefied in that condition. When opened the mould was found on some of the still wet and rotten portions. The structure of this mould was so peculiar, that I felt obliged to constitute a new, if only a temporary, genus for its reception. The larger patches were composed of numerous small tufts or fascicles, of club-shaped brown hyphæ, not more than one-tenth of a millemetre in length, the clubs themselves being about ·03 m. (or 30 micromillemetres) in thickness above, attenuated to about 5 micromill. at the base, where they were attached to the creeping brown mycelium. Each tuft consisted of five or six, sometimes

more and sometimes less, of these club-shaped stems, which showed no septa, but were covered at their apices with slender short spicules, each of which was surmounted by a solitary globose, dark-brown spore, some 4 micromill. in diameter, with a minutely roughened external coat, or epispore.

The structure and habit of this mould differs wholly from any of the genera noted by Saccardo in his "Conspectus." From *Zygodesmus* in the clavate hyphæ, and the capitate manner in which the spores are produced, and, indeed, from all other genera in the capitate spores, except only *Stachybotrys*, *Periconia*, *Fuckelina*, *Camptoum*, and *Acrotheca*. Of these five genera only three have globose spores, namely, the first three just mentioned. *Stachybotrys* has branched slender hyphæ. In *Periconia* the hyphæ are slender, and solitary. *Fuckelina* is to me a genus unknown, beyond the description, but does not appear to be the same. There was therefore no other alternative but to give it a new station and name.

Sterigmatocystis Ferruginea, *Cooke*, "*Grevillea*," viii., 95.

About the year 1878 I received from my friend, Mr. F. Moore, the pupa of an Erie silk moth, from Cachar, which, had covering the greater part of its exterior, a bright rust-coloured mould, to which I have applied the above name. The woolly effused patches of the mould had just such an appearance as the common *Aspergillus glaucus* might be expected to have if it were dyed of a bright rust-colour. The long, slender, septate threads, or stems, were about one-hundredth of a millemetre in thickness, terminated by a globose head of rusty-brown spores, the stem itself being transparent and almost colourless. The base of the threads was effused in a matted intricate mycelium, penetrating through the joints into the pupa. The most interesting part of the structure, however, was the capitulum, or head of spores. By a little careful manipulation it soon became evident that the supporting hypha was expanded at its apex into a globose knob, nearly three times the diameter of the thread. This was surrounded on all sides by a compact stratum of wedge-shaped bodies, four times as long as broad, and each of these bearing on its summit three or four elliptical cells, which cells were individually crowned by three or four short papillæ. To each one of these papillæ belonged a globose, rough spore, nearly one-hundredth of a millemetre in diameter, or about the thickness of the

primary thread or stem. Evidently it was impossible to demonstrate with certainty whether the spores were produced solitary at the tips of the papillæ, or whether in chains. No evidence could be found that the spores were ever concatenate. The mould would not be cultivated, and hence uncertainty must attach to it until found again, and examined under more favourable conditions.

The first doubt which naturally presents itself is—whether this species belongs to either *Aspergillus* or *Sterigmatocystis*, since it is uncertain whether the spores were ever concatenate, and *that* is an essential feature in these two genera. It can only be permitted to remain with a note of interrogation. The rough spores would only be a secondary consideration. This mould is of interest as being probably one confined to animal substances for its matrix, but even that cannot be affirmed with confidence. Hitherto it has only been seen on the dead pupæ of *Lepidoptera*.

Aspergillus nigricans (*Auct.*), *Cooke*, "*Grevillea*," vi., 127.

The third mould to which I would refer has also a special interest of its own, from having been found on the human subject. It was given to me by one of our ex-presidents, Mr. Arthur Durham, now some years ago, and was found inhabiting the meatus auditorius of the human ear. I am uncertain whether it is the same as one mentioned in the "Chicago Medical Journal," xxxiii., p. 913, but it does not seem to be the same as the *A. nigrescens* of Robin. The hyaline, uncoloured supporting hyphæ were from one to two millemetres in length, and about one-hundredth of a millemetre in thickness, seemingly continuous throughout their length, for no septum could be detected. The apex was swollen, in a globose manner, to about three times the diameter of the support, surrounded on all sides with closely-packed, radiating, cylindrical cells, about six times as long as broad, and with a diameter equal to that of the spores. To each of these radiating cells was attached at its outward extremity, a chain of globose, smooth, sooty-coloured spores, which seemed black when massed, and 5 micromillemetres in diameter. The entire globose heads, including spores, measured about one-tenth of a millemetre.

It is only the specific identity of this mould which is in question, but I did not feel disposed, with the doubts in my own mind, to describe it as a new species. Nevertheless it cannot fail to be interesting as a human parasite.

POLYACTIS DEPRÆDANS, *Cooke, MSS.**

Some six or seven years ago I noticed, when in Norfolk, that several young trees of *Acer pseudo-platanus*, growing in a damp plantation, presented an unusual appearance, from the flabbiness and decoloration of the leaves, which induced me to collect some for examination, the results of which I will now endeavour to describe. The green leaves had become flaccid and rotten whilst still attached to the tree; the whole surface blotched with greyish spots, which were in many cases confluent over a great portion of the leaf. The under surface, under a pocket lens, was spotted with minute white points, like the head of a small pin. These points were most numerous on, and almost confined to, the veins of the leaf. Under the microscope, these minute points were found to be the globose capituli, or heads, of a small parasitic mould, scattered over the under-surface of the leaf, with its delicate mycelium penetrating into the substance. The heads were loosely scattered, and not collected in tufts, almost wholly confined to the venation. The hyphæ, or threads, short, slender, flexuous, and septate, swollen at the apex, where one, or three to four larger cells formed the basis, of the globular head; around these large cells were clustered a number of smaller, elliptical cells, which again were surmounted by somewhat triangular, obtuse-cornered cells, and these divided at the apex in a furcate manner, each fork divided off as a globose hyaline spore. Each capitulum was, in its entirety, about one-tenth of a millemetre in diameter, and the spores 12 micromillemetres.

Some of these leaves were placed under glass and kept moist for weeks, when a very peculiar phenomenon was presented, the formation of small black round sclerotia on the spots occupied previously by the mould. This took place several times, and was reported as a curious circumstance to my friend the Rev. M. J. Berkeley. It would not be surprising for a *Polyactis* to be developed from a *Sclerotium*, because this already was known to have taken place, but for a *Sclerotium* to be developed from a *Polyactis* seemed to be a reversal of the order of nature. Pressure of other

* Maculis griseis, determinatis vel confluentibus. Hyphis assurgentibus septatis, flexuosis, simplicibus, ad apicem cellulis ellipticis, basidiiformibus coronatis, capitulo globoso sub-compacto, conidiis globosis hyalinis, ·012 mm. Toto albo.

On under surface of leaves of *Acer pseudo-platanus*, which it destroys.

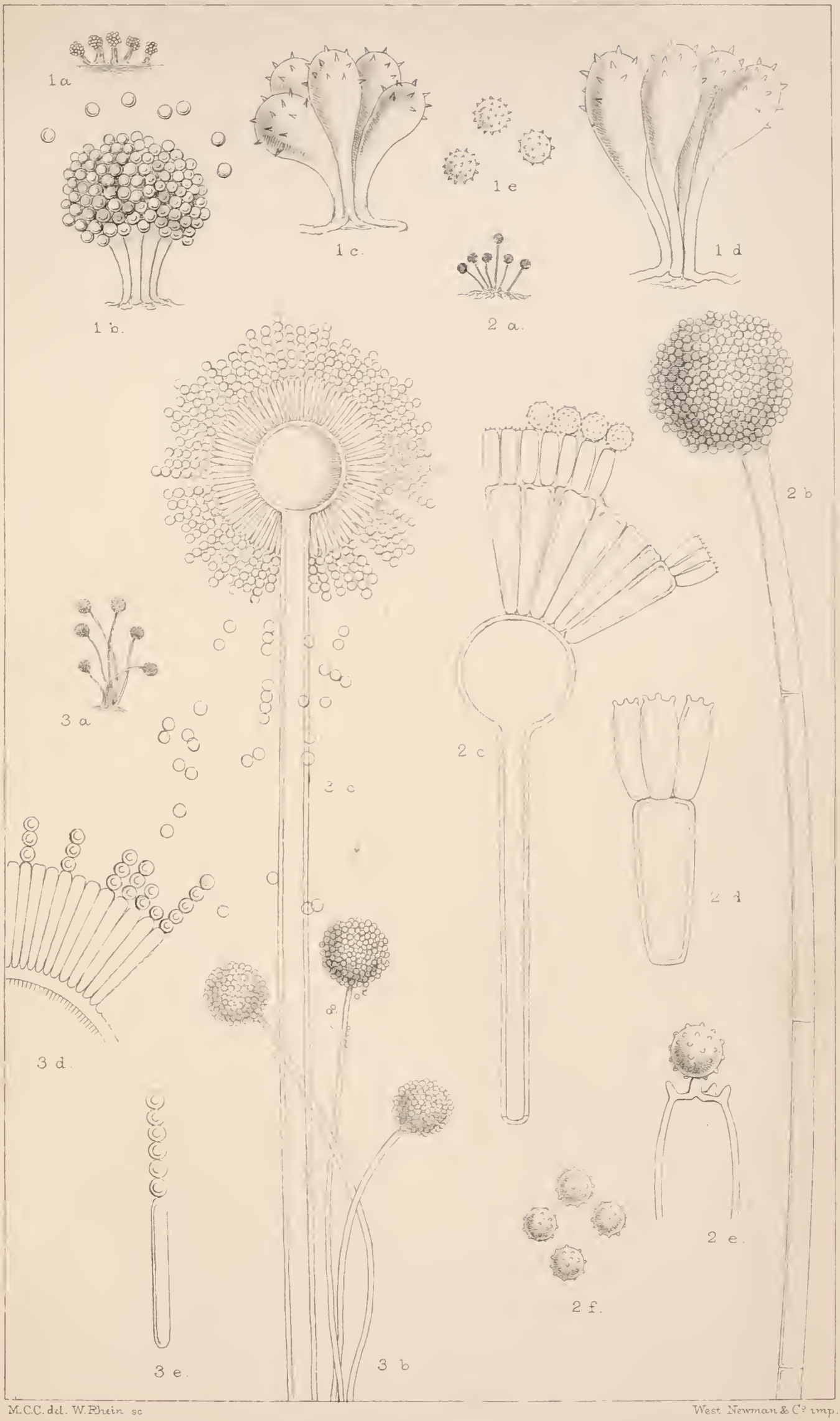
matters prevented my pursuing the cultivation any further, and I never attempted to learn what was the ultimate destination of the sclerotia.

There are some points in which the capituli of this mould differ in their composition from those usual in *Polyactis*, but this is merely a systematic question which the systematizers must settle for themselves. The parasite is undoubtedly an injurious one, extending speedily to every leaf on young trees, and as such is worthy of its name.

POLYACTIS TRUNCATA, *Cooke, in Bommer's "Champignons de Bruxelles,"* p. 137.

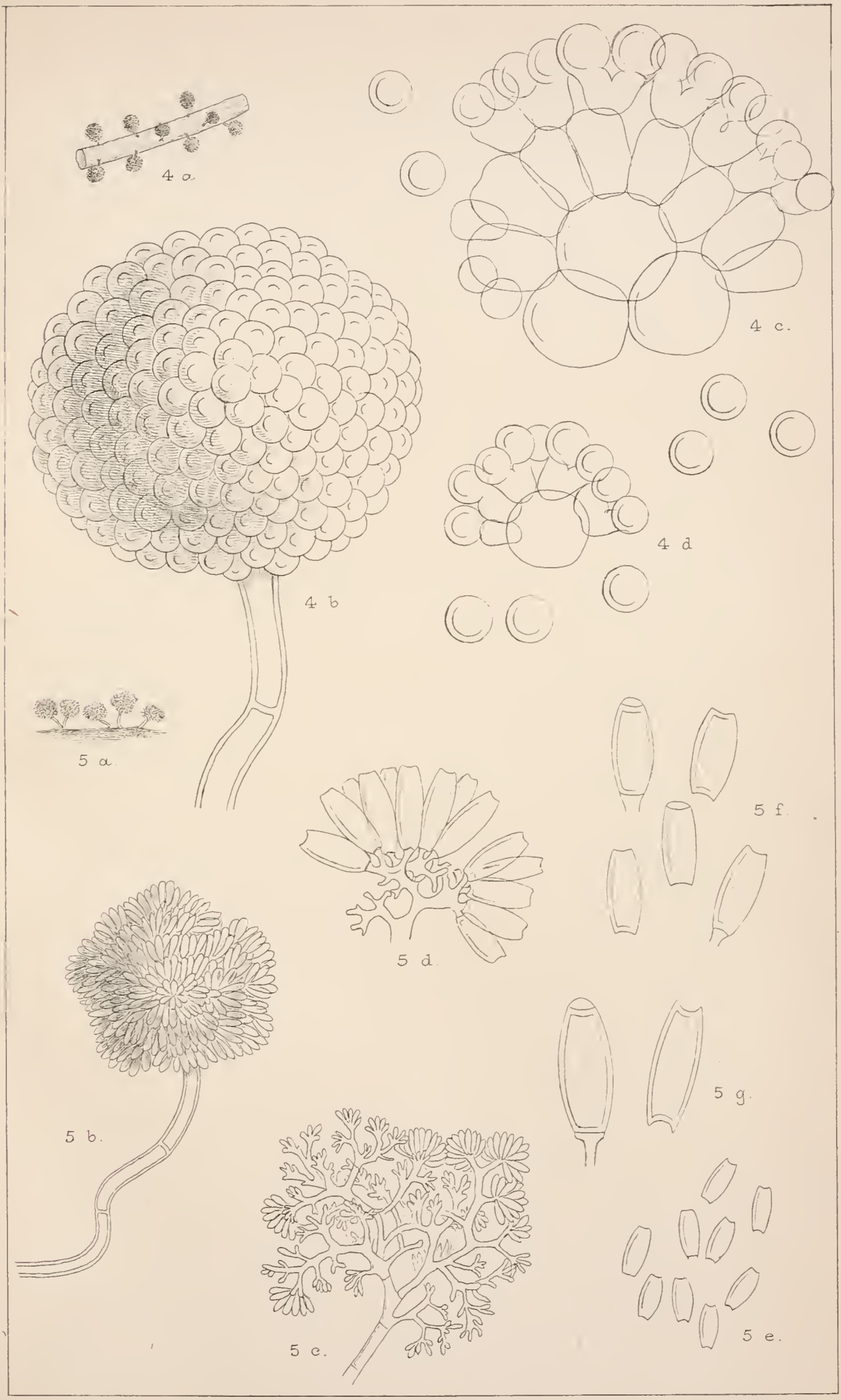
Advantage may be taken of this opportunity to give details of a white mould on the fronds of ferns, which was communicated to me from Belgium by Madame Bommer. Although placed in the same genus, it differs in many particulars from the one to which I have just alluded. The tufts were small, and consisted of but a few fertile threads. The hyphæ slender, flexuous and septate, surmounted by a rather irregular subglobose head. When the spores were removed the upper portion of the thread which formed the capitulum was found to be repeatedly branched, in a somewhat furcate manner, each branch being very short; the ultimate ramuli being fastigiate, or digitate. Each minute branchlet bore at its extremity an elongated elliptical, but abruptly truncate spore (·02 mm. long × ·007 mm. broad). When the spores became free each end was truncate. When the specimens were examined I was under the impression that the truncate, sometimes concave, ends of the spores might be caused by the falling in, or collapse, of the thinner extremities of the epispore, but of this I could not be assured.

Although there is a determination in some quarters to suppress the genus *Polyactis* altogether, for the sake of a change, I have still retained these names. It is one of my many failings, which some friends seldom fail in reminding me of, that I am persistently heterodox, inasmuch as I will not shift and veer in all directions, as the weathercock has done with us every day during this blustering month of March. Such mycological veering of the mycological weathercock being determined by the explosion of some windbag in some corner of Continental Europe. These incidental words lead me still further to protest that alterations in genera, whether



M.C.C. del. W. Rhein sc West Newman & Co. imp.

REMARKABLE MOULDS. I.



M.C.C. del. W. Rhein sc West Newman & Co imp.

REMARKABLE MOULDS. II.

in the orthography, or in its constituent elements, are *not* an advancement of science, but a hindrance; and all needless multiplication of synonyms instead of a blessing is nothing less than a curse.

DESCRIPTION OF THE PLATES.

PLATE IX.

FIG. 1.—*Basidiella sphærocarpa.*—*a*, Compound heads, slightly magnified. *b*, One cluster, magnified about 300 diam. *c*, *d*, Clavate threads denuded of spores × 400 diam. *e*, Spores × 800 diam.

FIG. 2.—*Sterigmatocystis ferruginea.*—*a*, Fertile heads slightly magnified. *b*, Head and upper portion of stem × 200 diam. *c*, Portion of section of head × 600 diam. *d*, *e*, Supporting cells × 800 diam. *f*, Spores × 600 diam.

FIG. 3.—*Aspergillus nigricans.*—*a*, Fertile heads slightly magnified. *b*, Three heads × about 200 diam. *c*, Section of head × 500. *d*, Portion of section showing supporting cells × 800. *e*, A supporting cell with chain of spores, isolated.

PLATE X.

FIG. 4.—*Polyactis deprœdans.*—*a*, Scattered heads on nerve of leaf, slightly magnified. *b*, Fertile head, magnified 400 diam. *c*, *d*, Supporting cells and spores × 500 diam.

FIG. 5.—*Polyactis truncata.*—*a*, Fertile heads slightly magnified. *b*, Head with spores *in situ* magnified about 250 diam. *c*, Ramifications of the head, with most of the spores removed. *d*, Portion with spores attached × 500. *e*, Free spores × 400. *f*, Free spores × 500. *g*, Two spores further magnified.

PROCEEDINGS.

January 9th, 1885.—Conversational Meeting.

The second of the third series of demonstrations was given this evening by Mr. B. T. Lowne, F.R.C.S., F.L.S., &c., "On the Structure of the Eyes of Arthropoda."

After explaining the manner in which optical images are formed, Mr. Lowne described the structure of the compound eye in insects, and gave a *resumé* of the mosaic theory of compound vision, as expounded in the classical work of Johannes Müller. The lecturer pointed out the optical difficulties resulting from this theory, as it is received by Grenacher and others, and then proceeded to explain his own views.

He regarded the whole of the great rods and the structures between them and the cornea as *dioptric* in function.

This view was founded on microscopical observations and physical considerations. The chief new points he insisted upon were the existence of a true bacillary layer, rods comparable with those of the vertebrate eye beneath the great rods. These, with the optic nerve were, according to his observations, frequently separated from the optical portion of the eye by a continuous non-perforated membrane. The great rods consisted of tubes, which the lecturer considered as very thick lenses of short focal length. He stated that during life these tubes were filled with an oil-like fluid, which escaped, leaving the empty, shrivelled tubes when the eye was injured; hence the very various appearances described by different authors. According to Mr. Lowne's view, the great rod magnifies and erects the sub-corneal image, and has its posterior focus on a true retina comparable with that of a vertebrate. In the course of the discussion which followed, the lecturer stated that the nervous structures of the insect's eye are apparently developed, like the retina of a vertebrate, from the nervous ganglia as an outgrowth, whilst the optical structures, including the great rods, arise as a modification of the sub-corneal epithelium; and he explained the manner in which the focal length of the lenses formed by the great rods could be calculated, and the close correspondence of the actual and calculated distance of the retina from the sub-corneal image.

For further details Mr. Lowne referred his hearers to the "Trans. Linn. Soc.," Vol. ii., pt. 11., New Series

The following objects were exhibited in the library:—

Circulation in the egg of trout	Mr. F. W. Andrew.
Crenulated antenna of a moth, *Pygæra bucephala*, retaining natural form and colour	Mr. F. Enock.
Parasite of seal, *H. stronglyformes*	Mr. H. E. Freeman.
Acarus, sp.	Mr. W. Goodwin.
Zoophytes, from Cape Good Hope	Mr. J. D. Hardy.

Sections of a leech...	Mr. W. M. Holmes.
Diatoms, *Navicula mormonorum*	Mr. H. Morland.
Head of tape-worm, *Tænia medio-canaliculata* ...	Mr. W. Watson.

Attendance—Members, 63; Visitors, 5.

January 23rd, 1885.—Ordinary Meeting.

Dr. W. B. Carpenter, C.B., F.R.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 H. Garner and Mr. Edward C. Bousfield.

The following donations to the Club were announced:—

"Proceedings of the Royal Society"	From the Society.
"Science Gossip"...	,, ,, Publisher.
"Science Monthly"	,, ,, Editor.
"Proceedings of the Royal Microscopical Society"	,, ,, Society.
"American Monthly Microscopical Journal"...	In Exchange.
"American Naturalist"	,, ,,
"Pamphlet on Law and Species," by E. Poulson	From the Author.
"Transactions of the Northumberland and Durham Natural History Society" ...	,, ,, Society.
Nine numbers "Linnean Society's Journal" ...	Mr. Scholefield.
Forty-three Type Slides of *Oribatidæ* ...	Mr. A. D. Michael.

The thanks of the Club were voted to the donors, and a special vote of thanks to Mr. Michael for his valuable contribution to the cabinet was unanimously passed.

Dr. G. C. Wallich exhibited and described his condenser, remarking, however, that everything depended upon getting a proper light, and that the gas lamps in the room were not the best for the purpose.

The President thought it would be better to reserve a critical examination of the apparatus until the end of the meeting, when the large lamp on the table before him would be available for the purpose. He was sure that every worker with the microscope must feel the value of anything which would give an increase in focal depth, as hitherto they had only been able to get it by reducing the aperture of their objectives; but there was one very curious thing about the Binocular Microscope, that it did increase very greatly the focal depth. He had tried this under every condition, and had always found it to be so. It was to be explained to a certain extent by the binocular prism halving the aperature of the objective. That, however, did not explain it altogether; because having asked a friend to look through the binocular with one eye only, the prism being in its place, and to focus the objective for what he considered to be a medial distance, on then asking him to open the other eye, the difference in the depth of focus had been at once observed; indeed, it was considered that the increase amounted to at least five times. He had talked the matter over with his friend, Sir Charles

Wheatstone, but they could never come to any satisfactory conclusion. Dr. Wallich had made a condenser to produce a certain arrangement of the illuminating rays; and if it proved that by the use of this they could employ lenses of larger aperture and still get the same depth of focus, it would be of very great value.

Mr. F. Parsons read a paper "On a Hydroid Polyp found in the tank at the Royal Botanic Society's Gardens, at the Excursion of the Club in April, 1884," the subject being illustrated by drawings and by enlargements from the same on the black board.

The President said the drawings would give a better idea of the organism than what was on the board; there did not seem to be any appearance of tentacles.

Mr. Hardy enquired if Mr. Bourne had seen the drawings? If not, how did he know the polyps were the same?

Mr. Michael asked for what length of time any individual polyp had been watched? because it was quite a usual thing to find that the first form had only the rudiments of tentacles, which came afterwards by a process of growth, and unless the specimens were kept under observation it was not possible to know that they might not have tentacles at some later period of their lives.

Mr. Parsons said he had only looked at one polyp during one evening and had not isolated it for continued observation, but although he had looked at a great many he had never seen such a thing as a tentacle. Still it was quite possible that they might subsequently develop.

Mr. Michael said it was of course quite possible that they might not do so, but it would, he thought, be a little premature to say they never would. It was often very easy to get these organisms to grow to a certain extent, and then from want of favourable conditions nothing further could be got. He should be inclined to say that as far as their information went at present they did not know what might be the ultimate form, and therefore it would be premature to say it never would have tentacles.

Mr. Parsons said he should be very glad to be able to ascertain the facts and would keep a look out with that idea. It was, however, a very difficult matter to carry out.

A Member enquired if Mr. Parsons had found that each arm of the bifid or trifid form was distinct from the others, or was there any connection between them?

Mr. Parsons could not say, but he rather imagined that there would be a constriction formed, and after that they would separate. He could not say if there was a canal between them.

The President proposed a vote of thanks to Mr. Parsons for his communication. It was known to all that this matter was one of very great interest to naturalists, because the discovery of a fresh water medusa caused at the time a very great sensation, and it was always felt that a hydroid polyp ought to be found. It was no more than a surmise on the parts of Mr. Bourne and Professor Lancaster at present, and therefore Mr. Parsons had the credit of having seen it first. It was a curious thing that it should be found in another tank beside that at the Victoria Regia house,

and he thought it might be a question worth asking whether the germs might have come from a common water supply.

Mr. Parsons said the plants in this tank were sometimes changed.

Mr. Michael said that no new plant had been put into the Victoria Regia tank for some years, but whether plants had been transferred from it was of course another matter.

The President said he had a short communication to make, which he thought would be of interest, relating to the discovery by his friend Professor Moseley of eyes embedded in the actual shell of a Mollusk. He had himself during some investigations made 40 years ago found some peculiar canals in the shells of *Chitons;* he had only the dry shells to work upon, and thought at the time that some organs might pass into them, but had no idea as to their remarkable character. Mr. Moseley having had the opportunity of examining a specimen of Chiton preserved in spirit, had made this remarkable discovery. The animal was very like the common Limpet in its anatomy; but instead of having a simple conical or oblong univalve shell, it had a multivalve shell. The small Chitons found on our coasts had much the same kind of shell as the common woodlouse, its overlapping valves being jointed so that the animal could roll itself up. It was found that in certain Chitons the shells had two sets of perforations, one large and the other small. The large orifices contained very perfect simple eyes, of a rather prolonged form; each having a calcareous cornea, behind which there was a crystalline lens with an iris, and then a vitreous humor and a retina. The mouths of the small passages were filled with small plugs of tissue, probably constituting organs of touch; and it was found that the nerves of these eyes and the nerves of the small tactile organs came off from the same plexus. These organs did not occur in all Chitons, but only in those of tropical seas; no English species had them. Their number was most extraordinary, 3,000 having been counted on a single anterior valve, while there were at least 8,500 eyes on the remainder. This multiplication of eyes was certainly a most remarkable phenomenon, and was not a little puzzling to understand. The Limpet, which, as we commonly see it, remained firmly fixed to the rock on which it lived, was known to move about when the tide was up, and to go in search of food, and then to come back again to its place. This had been frequently observed; but how it was that these creatures found their way back to the same holes again, had never been satisfactorily explained. Perhaps Dr. Buckland's observations on certain Snails which make hollows in limestone rocks, might apply also to Limpets. He thought they secreted an acid; and to detect this he made one walk over a blue ribbon stained with litmus, and he found that in doing so it left a red stain. His idea about it was that the track of acid mucus which was left behind them formed the means by which they guided themselves back again. But if Limpets and eyeless Chitons are thus guided, it is difficult to find a use for the multiple eyes of the species that possess them. The President thought it was a matter of some little historical interest that 40 years ago he had detected these passages in the shell, of which the use was only now found. He would illustrate the matter by placing under the microscope in the room some of the shell-sections which

he made 40 years ago, and also some of Professor Moseley's preparations showing the nerve trunks passing along to the eyes, which looked almost like pears upon their foot-stalks. It had long been an idea amongst naturalists that the Chiton, on account of its peculiarities, had some relation to the Articulata; and in this discovery there occurred another curious point of analogy. The plates in illustration of Professor Moseley's paper would be printed in the next number of the "Quarterly Journal of Microscopical Science."

Mr. E. M. Nelson said he wished to bring a small "brass and glass" matter before the notice of the meeting, and that was a stop for an Abbé Achromatic Condenser. It gave 1·25 numerical aperture, or 1·3 with a Powell Condenser. He was exhibiting it that evening, and the results were most satisfactory. The highest resolving power, he found, was obtained just before the field began to get dark.

Another matter he wished to notice, was the fact that the cholera bacillus was found to be a beaded structure, the same as observed in the case of the tubercle bacillus. Mr. Watson Cheyne had found this to be so, and he (Mr. Nelson) had also carefully examined it with the dark ground illumination and found it to be most remarkably distinct.

The President said that finding that Nachet's small Portable Microscope had not been exhibited at the Club, he had brought it down to the meeting, and would exhibit his specimens under it. He then exhibited and described the instrument, showing the method of setting it up and of changing the compound body for the simple arm for dissecting purposes, and also the method adopted for quickly changing the objectives.

Announcements of meetings, &c., for the ensuing month were then made, and the proceedings terminated with the usual conversazione, and the following objects were exhibited, in addition to those shown by the President :—

Condylostoma patens	Mr. F. W. Andrew.
Spine of Skate	Mr. W. M. Holmes.
Pollen, *Lilium longifolium*	Mr. G. E. Mainland.
Section of Shell of *Haliotis*	Mr. C. Le Pelley.
Diatoms from Campeachy Bay	Mr. W. Watson.
A new Condenser	Dr. Wallich.

Attendance—Members, 60 ; Visitors, 5.

February 13th, 1885.—Conversational Meeting.

The third demonstration of the series was given by Dr. M. C. Cooke, M.A., A.L.S., &c., the subject being, "Collecting, Examining, and Preserving Fresh Water Algæ."

Dr. Cooke premised that he should group his observations and illustrations under seven heads, in order to facilitate their impression upon the memory.

I. Definition.—"Fresh Water Algæ" was a purely artificial arrangement made solely for the convenience of those who desired to study the inland to the exclusion of Marine Algæ. This group was held to include such as were found in fresh and brackish water, as well as those inhabiting the face of

moist rocks, damp soil, or the bark of trees. He then proceeded to give the best general description available of what were the principal attributes of Algæ, as distinguished from Fungi and other of the cellular Cryptogams, at the same time intimating that no brief definition would be absolutely perfect and without exception.

II. Distribution.—The places in which to find Fresh Water Algæ were stated to be those in which a constant state of moisture was present, such as the dripping face of rocks, damp walls; flower-pots, benches, and walls in conservatories and hot-houses; water-tanks and cisterns; small streams of waste warm water from factories and steam engines; ground often inundated, or subject to the overflow of tides; little pools and ponds; stagnant or slowly-flowing ditches and streamlets; dead submerged plants, branches, timber and stones; and amongst moss and sphagnum in bogs. It was little better than waste of time to seek for Algæ in swift streams or torrents, save on the rocks in their vicinity which were subject to the spray, or steady dripping.

III. Collection.—But little preparation and but few implements were required for their collection. Those on the face of rocks or walls could be best removed by a flexible palette-knife, such as used by artists. An iron spoon was very useful in skimming floating Algæ from small pools amongst sphagnum, particularly such as Desmids. The ordinary collecting bottle and stick would be often useful for dipping amongst the vegetation in ponds, and a small net of muslin, stretched over a metal ring of some six inches diameter, and mounted on a collecting-rod, would assist in collecting the floating scum and filamentous Algæ on the surface of ponds. Hooks and drags were of little use, as the majority of the filamentous Algæ are only attached in the early part of their history, becoming detached and floating previous to fructification, when only they could be satisfactorily determined. In addition to collecting tubes, in which each gathering should be kept by itself, he recommended small squares of thin gutta percha tissue, to be obtained at any indiarubber or gutta percha shop, and cut to about six inches square, as exceedingly useful both for collection and transmission by post. When folded the contents would remain moist and fresh for several days, Failing this, even squares of firm writing paper would answer admirably, but the specimens should be taken out and transferred to water on reaching home.

IV. Examination.—Small white artists' saucers were recommended to receive each "gathering" at the close of the day. Algæ collected from soil or rocks should be cleared as much as possible from fragments of sand. Filamentous Algæ could be transferred successively to clean waters to remove all extraneous matter. A bunch of Sphagnum shaken in a bottle of water, and then removed, would often leave behind a good collection of minute floating species. Large species may be picked out from a saucer, with a clean camel-hair pencil, by using a pocket lens. Only clear water requisite to examine provisionally the gatherings under a microscope. Recommended to use first a 2-inch or 1-inch objective, and then $\frac{1}{4}$-inch. The demonstrator always had two small working microscopes beside him, with these powers, and had only to pass from the one instrument to the other,

without the inconvenience of nose-pieces and readjustment. A fixed camera was a great advantage, so that a drawing or rough sketch could be made at once. Sketches strongly recommended, and taking measurements accurately either by means of an eyepiece micrometer, or a camera lucida sketch of known proportions.

V. Determination.—In order to determine the names of collected Algæ no royal road could be indicated. The only method, safe and sure, was by a scientific process, and not empirically. The fructification by all means essential. The genus must be determined, through the fructification, combined with the vegetative characters, and after that there would be comparatively little difficulty, with the aid of a manual. The great difficulty usually was occasioned by the imperfect condition of the specimens. Reagents often useful in very hyaline objects before the outline can be distinctly made out. The aniline dyes readily available for this purpose.

VI. Preservation.—Two kinds of preparation in vogue, the preservation of portions for the microscope, and the preservation of entire plants for the herbarium. Thin filaments of mica, most to be commended for preserving the more minute species for the herbarium. Large filamentous algæ to be washed clean and floated out on squares of paper and dried, in the manner adopted for marine algæ. The majority of species are gelatinous enough to adhere of themselves to the paper when dry. For microscopic preparations the chief difficulty is the fluid medium. Too dense a medium will at once cause the endochrome to collapse, and the cell-walls to be distorted. Most persons are content with the water in which the specimens were growing, with just a tinge of creosote. He had seen specimens mounted in this manner, after twelve years in the cabinet, as fresh-looking as though collected the day previously. Calcium chloride has also been recommended, and in many cases, where no green colour has to be kept, may be used with advantage. Glycerine, by its density, distorts most forms of Algæ. In all cases mounted Algæ must not be exposed to the light of day, or the colour will vanish.

VII. Cultivation.—These organisms are most interesting for cultivation. Small aquaria may be extemporized of glass tumblers, placed at different elevations. Connected to each other by thinly twisted cotton threads as syphons, a constant change of water can be kept up from the highest to the lowest tumbler, and the whole life-history of species watched at home. Growing slides of various forms have been devised, each with some special advantage. Terrestrial species will for a long time retain their freshness on damp sand or wet flannel, under small bell glasses or inverted tumblers. No objects in the whole round of animated nature are so capable of being placed in natural conditions, and submitting to artificial cultivation.

The implements and instruments necessary were exhibited, and alluded to in conjunction with their application in the above sections.

The following objects were exhibited in the Library :—

Difflugia pyriformis	Mr. F. W. Andrew.
T. S. Whisker of Cat	Mr. E. C. Bousfield.
Isinglass, polarized...	Mr. A. L. Corbett.
Podophyra, sp.	Mr. C. J. Dunning.

Head of *Andrena*, showing parts of the mouth, in their natural form and colour ...	Mr. F. Enock.
Algæ. *Drapernaldia plumosa*	Mr. H. E. Freeman.
Chironomus prasinus	Mr. H. Hammond.
Argulus foliaceus	Mr. T. J. McManis.
Diatoms. *Surirella clementis*	Mr. H. Morland.
Parasite of Crane	Mr. A. C. Tipple.
Foraminifera...	Mr. W. Watson.

Attendance—Members, 27 ; Visitors, 16.

February 27th, 1885.—Ordinary Meeting.

Dr. W. B. Carpenter, C.B., F.R.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:—Revd. W. W. Fowler, Mr. J. W. Stevenson, Mr. A. H. Ward, Mr. J. C. Warwick, Mr. B. H. Woodward, Mr. P. W. Wall, Mr. E. K. Jaques, and Mr. C. Upton.

The following donations to the Club were announced:—

"Journal of the Royal Microscopical Society"	From the Society.
"Proceedings of the Geologists' Association"	,, ,, ,,
"Proceedings of the Hertfordshire Natural History Society"	,, ,, ,,
"The American Monthly Microscopical Journal"	In exchange.
"Proceedings of the Belgian Microscopical Society"	,, ,,
"The American Naturalist"	,, ,,
Vol. XI. "Challenger Reports"	Purchased.
One Slide of *Surirella Clementis*...	From Mr H. Morland.
Six Slides of Foraminifera	,, Mr. Tipple.
60 Slides of Diatomaceæ	,, Mr. G. Sturt.

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

The Secretary having called special attention to the very beautiful series of slides of Foraminifera presented by Mr. Tipple, and also to those of Diatomaceæ—prepared from the material of Professor Smith, and therefore illustrative of his work on the subject—presented by Mr. Sturt, special votes of thanks were passed, on the motion of the President.

Mr. Buffham read a paper "On the Conjugation of *Rhabdonema arcuatum*," the subject being illustrated by numerous coloured diagrams, and also by pasteboard models of the compound frustules.

Mr. W. H. Gilburt said he had been extremely pleased to be allowed to go through this subject with his friend Mr. Buffham, and he quite agreed with him as to his earlier remarks, especially as to the distinctive filaments—which he had called the male filaments or frustules —he had seen not only single ones attached, but also a chain of them. He could, however, scarcely agree that the fertilizing matter was

conveyed to the female filaments in the manner suggested; he thought that the case was more likely to be a parallel one to that of plants, where the pollen of the male flowers was produced in great quantity because it was most likely that some of it would get lost, and therefore a large supply was provided. He thought it was quite likely that a similar arrangement held good in the case before them, only that as the fertilizing element was thrown out into the water many frustules were provided in order that some of them at least might get some of it. In all the male frustules it would be found that after fertilization a division into two parts took place, the upper half falling away—and it would also appear that after contact there was an opening through which the fertilizing medium might escape. He had little doubt that the fertilizing medium being quite free came into contact with the non-silicious band and passed through it.

The President said he had never made diatoms a special study himself, but Mr. Thwaites was an early friend and pupil of his, and it was very much in consequence of his earnest recommendation that he should take up the study of the unicellular plants, that the observations were commenced which led to the discovery of conjugation—and during the interval of 45 years very little beyond this seemed to have been done. He had always said that if one-tenth part of the time had been given to the life history of these forms which had been spent in trying to make out the striæ on their valves, very much better results would no doubt have followed. He did not recollect anything at all approaching to the description which Mr. Buffham had given of these males attaching themselves to the female forms. The nearest thing seemed to be what was seen in the case of the conjugatæ, where in one group the endochromes of both discharge themselves into the intermediate space; or, on the other hand, in those cases where the endochrome of one filament passed over into the cells of the other filament. He thought, however, that there had been something lately recorded in the "Journal of the Royal Microscopical Society" which tended to show that this was not quite correct, and this had rather sent them adrift again upon the question. If the observations which had been described that evening should prove to be the first indication of sexuality it would be of the greatest importance. What was now wanted was some information as to the existence of a distinct opening being formed, so that it could be affirmed that there was an actual passage. Mr. Buffham inferred that there was, because of the effects which took place; but he should very much like to know that it had been proved by observation. He hoped that Mr. Buffham would devote further attention to this point, which he regarded as one of the very highest interest; if proved it would form one of the pregnant facts of biology; and such being the case, it was worth any amount of attention which it was possible to bestow upon it. He could only express the very highest sense of the value of such an observation.

Mr. Buffham said with regard to the point on which Dr. Carpenter had some doubt, he could only ask, how was it possible to account for the facts except by taking his view of the attached frustules? And why should they lose their vitality in the way he had described? Absolutely without exception they had never observed the formation of sporangia unless they

could find either the male frustules, or the scars left by them. With regard, also, to Mr. Gilburt's remark, he did not wish to deny that if the male frustules had not been present they would not have gone on dividing.

Mr. Gilburt said it would of course be of great interest to see the passage if possible, though he did not think that the mode of fertilization would be disproved even if the passage was non-existent, because it should be remembered that in its earlier growth the band did not contain silex.

Mr. Buffham said this was so, and the idea therefore was that the process might be carried on through the sutures.

Mr. Michael enquired how the exact form of the partition, as shown in the model, was ascertained. The shape was very remarkable, and he should like to know whether it could be seen, or if not, how it was found to be so shaped ?

Mr. Buffham said he had a slide under a microscope in the room which contained a number of the frustules, some of which were attached, others lying loose ; by careful focussing on the loose ones, it was quite possible to see this shape. He might add that Professor Smith was quite in accordance with him as to the observation.

Mr. E. M. Nelson exhibited and described a rotating nose-piece, and also a condenser. With regard to the former, he said he had frequently thought that an object glass performed differently as an object was presented to it in different azimuths. It had, however, occurred to him that this might be due to the objective itself rather than to the altered position of the object as regarded the light. Wishing, therefore, to test this, he had devised a rotating nose-piece, by means of which, without shifting the object, the objective could be turned upon its axis and used in different sectors. On trying the effect of this with a glass which was believed to be of first-rate quality, he found that whilst in one position it would resolve *amphipleura* perfectly, it altogether failed to do so at another angle, showing clearly that there was a difference in different azimuths. He thought this might account for the fact that there seemed to be so much difference of opinion as to the performance of certain objectives when used upon different microscopes, and he suggested the desirability of being provided with a simple contrivance such as he exhibited, in order to test objectives in all azimuths, especially when about to purchase an expensive one—say at £40. He also exhibited a simple form of stage condenser, designed for small cheap microscopes. It consisted of a meniscus lens, and a bi-convex lens, put into a tube which was made to slide in another tube by means of a spiral slit, so that it worked up and down quite smoothly in the same way as a common pencil-case. The great increase in the amount of light was remarkable.

The President said there could be no question about the great improvement in the light. The form of lenses was that of Herschell's doublet, which he might say he had used himself for that purpose nearly 50 years ago, long before achromatic condensers were thought of. He had had it applied to his Chevallier microscope as a condenser, having felt the want of more light—its efficiency for the purpose was so great that he should recommend it to everyone.

Mr. C. Beck, in reply to the President, said that their objectives were always tested by focussing upon a podura scale, and altering the position of the scale so as to examine it in all directions. It was very easy to get an objective which would show the scale very well in one position, but not in others also.

Mr. Nelson said that perfect accuracy could not be obtained in that way, because as the light did not proceed from a point, the cone of light was not really a cone, as they would find if they tried the image of the flame of a lamp end-ways or flat-way; if in the former case the definition was good they would find that there would be in the latter case a loss of intensity which would spoil the definition.

Mr. Beck said that they endeavoured to get it true for central light by having a cone of light accurately centred.

Mr. Michael said it was clear to him that Mr. Nelson was right in saying that turning the podure scala was not by any means the same thing as turning the objective; to make it so it would be necessary to turn the light also, otherwise the test-object would be viewed under different conditions in different positions. Though they might have central light to the objective all the time, it might not be also central light to the object.

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

Mr. C. Beck exhibited and described a new serial section cutting machine, designed to meet the want of some reliable instrument which would cut any number of consecutive sections of a specimen and preserve them in exactly the same order in which they were cut. The importance of being able to do this was very great in many kinds of investigation, and the instrument exhibited was designed to do all the work of the Cambridge machine, but at considerably less cost. It was not yet perfect, but still it did its work so well as to merit attention. Sections could be cut of various thicknesses, and accessories for freezing were supplied with it.

Announcements of meetings, &c., for the ensuing month were then made, and the proceedings terminated in the usual manner by a Conversazione, at which the following objects were exhibited:—

Ichneumon fly	Mr. F. W. Andrew.
V. S. cochlea of a kitten	Mr. E. C. Bousfield.
Diatoms, *Rhabdonema arcuatum* (in conjugation)	Mr. T. H. Buffham.
Scale of Lady-fish from Bombay	Mr. H. Epps.
Section of Coniferous Wood (fossil)	Mr. W. M. Holmes.
Epidermis of mistletoe	Mr. G. E. Mainland.
Diaptomus Westwoodii	Mr. R. T. G. Nevins.
Chelifer museorum	Mr. A. C. Tipple.

Attendance—Members, 64; Visitors, 6.

March 13th, 1885.—Conversational Meeting.

The fourth of the series of demonstrations was given by Dr. T. Spencer Cobbold, F.R.S., F.L.S.. &c., late President of the Quekett Microscopical Club, "On Lung Parasites." The following is the substance of his remarks:—

I have chosen the subject of lung parasites for our demonstration this evening because it possesses both practical and scientific bearings.

Beyond the generally recognised fact that the so-called bronchial filariæ are destructive to our flocks and herds, and that strongyloid worms belonging to the genus *Syngamus* prove fatal to our fowls and game-birds, there are few persons who possess any adequate conception of the variety and multitude of entozoa that give rise to lung disease.

I do not speak of microbes, bacteria, and other microphytic organisms, though, like other observers, I constantly encounter them in a casual way. Neither with these, nor with the more highly organised gregarines and psorosperms, have I anything to do at present.

All the great groups of the higher forms of entozoa, including the Helminths proper, have, with one exception, their lung-infesting representatives, so to speak.

If time permitted, I could show you flukes that produce blood-spitting (hæmoptysis) in man, and there are other fluke-species that are constantly present and productive of mischief amongst animals. These lung-parasites represent the order *Trematoda*. Similarly, I could also present various bladder-worms (Hydatids, Cœnuri, Cysticerci, &c.) that have been removed from the lungs of man and animals. These, as tapeworm larvæ, represent the order *Cestoda*.

Again, another singular group of parasites, the Pentastomes, are in certain of the lower vertebrata constant occupants of the lungs and air passages, not unfrequently proving fatal to their bearers. These represent the order *Acanthotheca*.

In the production of lung disease, however, it is the filaria-like roundworms, the *Strongyles* especially, that are far and away the most numerous and important. It is to these, therefore, as representing the order *Nematoda*, that I now more particularly invite your attention. It would take a long time to enumerate all the species of pulmonary nematodes. Suffice it to say, that they abound in cattle and sheep, in antelopes, camels, and deer, in horses and other solipeds, and notably in the cetacea. They are frequent in the smaller carnivora, especially in cats; rarely producing lung affections in the dog, except in cases where the left side of the heart and pulmonary vessels are involved.

From amongst all the species I select one parasite only for special consideration, namely, *Olulanus tricuspis*. Every now and then we hear of epidemics affecting our house-cats. Some of these outbreaks are due to parasites, some to other causes. At least four distinct kinds of parasitic epizoöty are known to me as affecting cats. One of these outbreaks which occurred in Sweden some years back was described in the public journals as due to *Trichinosis*. A large number of cats perished.

Here I may remark, that when young microscopists stumble upon little worms coiled up in cysts and occupying the tissues of any animal, they are very apt to jump to the conclusion that they have discovered instances of the trichina disease. At least a score of such fancied discoveries, affecting widely differing classes of animals, have been published as genuine examples of Trichinosis. Perhaps the most stupid and foolish announcement that was ever made on this subject is that which concerned the alleged "Outbreak of Trichinosis on board the training-ship 'Cornwall.'" This ridiculous "out-put" by the Local Government Board—this genuine mare's-nest, as we may call it—occupied the attention of the wise-acres of both Houses of Parliament; nevertheless, about three months before the Board published their "Report," I stated in the *Times* newspaper, and also publicly in St. George's Hall, that the so-called Trichinæ (detected in the exhumed body of the lad who died) were neither more nor less than rhabditiform nematoids, probably accidentally introduced. This conclusion proved to be substantially correct.

My first acquaintance with the larvæ of *Olulanus tricuspis* dates some 35 years back; that is to say, long before the publication of Leuckart's description of the adult worm.

Whilst at work in the Anatomical Museum of the University of Edinburgh, as curator, a young cat in my room suddenly rushed about and finally fell dead, asphyxiated. Whilst it was yet warm I dissected its body, and never from that day to this have I seen so remarkable a display of lung-parasites. Tens of thousands of embryonic nematoids lay coiled in cysts occupying every part of both lungs. The parasites were moving freely within the cysts, and the tissues were so fully infested that those air-cells which were not actually invaded were so compressed as to produce general obstruction (hepatisation). Drawings were made at the time, but I retain no specimens from that particular case.

However, from another instance of the same disease I am enabled, through the kindness of Mr. J. W. Groves, F.R.M.S., to show you some beautiful stained sections of a lung infested by these little entozoa. If you compare Mr. Grove's sections with the illustration suspended on the wall, you will perceive that the appearances presented by the worms and their cysts are effectively demonstrated.

In 1876, Dr. Stirling, of Edinburgh, submitted to me, for identification, a portion of cat's lung containing worms. Speaking of the entozoon, he wrote: "In the alveolar tissue I found a small nematoid worm coiled up within a cyst. It is much smaller in size than a Trichina, and there are usually two and a half turns of it within the cyst." Now, the slides on the table have been prepared by Mr. Groves from the identical specimen sent to me by Dr. Stirling.

What is known respecting the life-history of the worm is chiefly due to the investigations of Leuckart, the published observations of Dr. Stirling being limited to the appearances presented by the encysted embryos. Briefly stated the facts are as follows:—In the adult state, *Olulanus tricuspis* dwells in and upon the mucous membrane of the stomach of the cat. It is a very small worm, the adult female only attaining the 1-25th of

an inch in its long diameter—say a millimetre. Its presence in the feline stomach is by no means harmless, inasmuch as it gives rise to increased vascularity, and even also to ecchymosis of the mucous membrane.

Unlike *Trichina*, the *Olulanus* carries only a few young in its interior; three being the average number of embryos present. However, in relation to the size of the parent worm, these embryos, as Leuckart phrases it, are truly colossal. They are nearly one-third of the length of the parent, being $\frac{1}{83}$ of an inch long by $\frac{1}{1666}''$ in breadth.

The small number of embryos does not, however, imply a feeble amount of germ-distribution. The swarming of the young within the tissues of the cat-host is sometimes prodigious in extent. Of the embryos that are hatched and discharged, a large proportion, perhaps the greater number, proceed at once to migrate on their own account, and in a direct manner within the tissues of the cat without waiting to be expelled along with the fæces in the ordinary way. I regard this phenomenon as an instance of illegitimate wandering from the right path, a spurious phase of migration, or, as Von. Siebold so aptly expressed himself concerning similar wanderings long ago, instances of "straying." In this way the young *Olulani* stray into the liver, into the diaphragm, into the pleuræ, and into the substance of the lungs. Within one or other of these organs they come to a state of rest and proceed at once to encyst themselves. If the swarming is extensive and complete their habit of thus straying from the right path necessarily involves both themselves and their victim in one common ruin. As regards those offspring that are carried passively along the legitimate path, their passage *per vias naturales* ensures for at least a certain number of them a more prolonged existence. Doubtless, as obtains with many Anguillules, the embryos, though dried up within the hardened cat-fæces, revive when, with the excrement nibbled by mice, they are transferred to the stomachs of these rodents. An experiment by Leuckart proved that ingested embryos of Olulanus are not destroyed by their entry into the stomach and intestines of the mouse. In short, not a shadow of doubt exists that the embryos thus passively transferred in the ordinary course of nature, undertake a final and legitimate wandering into the voluntary muscles of the little rodent. After the manner of trichinæ they bore their way through the tissues, and having selected the muscles as their final resting place, they proceed to encyst themselves in the same way that some of their fellow-embryos had done before them within the lungs of the feline host. Lastly, in order to arrive at sexual maturity as their parents did before them, they must, as encysted muscle-worms, be passively transferred to the stomach of another cat, where, probably after a few days, or, it may be, only a few hours, they are able to acquire the adult condition.

Such is the life-record of *Olulanus tricuspis*. The trichinosis of swine and other warm-blooded animals is the precise pathological homologue of the flesh-worm disease of mice. To this disorder I initiated and long ago applied the term *Olulanosis*.

Pathologically speaking, our little nematode is thus capable of producing three distinct morbid states. In adult life it is productive of verminous

catarrh of the stomach of the cat. In the straying embryonic stage it produces local traumatic irritation, leading eventually to the formation of a miliary nematode tuberculosis of the lungs and liver of the cat. In the true migratory stage, after a change of host, it leads to the production of *olulanosis* or *olulaniasis*.

Surely these phenomena are worthy of attention. Apart from their obvious practical bearing they are sufficiently instructive to the intelligent observer. We have seen how readily these parasites may be mistaken for Trichinæ under circumstances where no legitimate suspicion of trichinosis ought to have been entertained. Witness the Swedish epizöoty affecting cats. In this connection I may mention that a very curious coincidence came under my notice some ten years back. I will endeavour to recall the facts.

An eminent surgeon, acting as professional adviser to one of our Railway Companies, requested me to accompany him on a visit to a family of seven or more persons in humble life, all of whom either were at the time, or who had been shortly before, suffering from an obscure disease. The symptoms unquestionably resembled those observed in cases of Trichinosis. If I remember rightly two domestic animals were taken ill about the same period, a donkey and a cat. These had died, and were buried; the cat comparatively recently. We hoped to settle the Trichina question then and there; and having explained to one of the lads the necessity of removing a tiny portion of flesh in order to complete the diagnosis, he willingly submitted to the operation. This act of vivisection occurred without the aid of chloroform, and as it was not performed on a dog, but on a heroic specimen of our own race, I suppose the question of cruelty would not even present itself to the mind of the most ardent opponent of all species of cruelty to animals. Be that as it may, a very tiny fragment of the gastrocnemius muscle was detached and handed to me for microscopic investigation. I found no trichinæ, yet still neither of us were convinced that the family disorder was not due to Trichina. Resolved, if possible, to get further light cast upon this mysterious outbreak, Mr. Gay, F.R.C.S., the surgeon in question, ordered the cat to be exhumed. It was examined by others than myself for Trichinosis without success, but the lungs were found to be swarming with nematoids. Thus, in view of identification my efforts were again honoured, and I pronounced the animal to have died from *olulanosis*—a disease which none of the medical gentlemen who made the feline *post-mortem* had hitherto heard of. Whatever interpretation be put upon the human outbreak, the coincidence of the occurrence in man of an affection symptomatic of trichinosis, found in association with a trichinoid affection in an animal which proved to be olulaniasis, was both curious and instructive. It should, at least, serve as a warning to young observers, and induce them to be very cautious in pronouncing upon the nature of any disease in which they happen to detect the presence of immature nematoid worms coiled up in cysts.

I may add that a portion of the olulanised lung of the cat in question is preserved in the Museum of the Royal College of Surgeons. The preparation is marked in the catalogue, No. 1814A, and described as "Lung of Cat pneumonic from the presence of parasites." Presented by J. Gay, Esq.

Time will not permit me to give you an account of the history of the development of the strongyles of cattle and sheep, but I may remind you that already, in 1880, I had the pleasure to explain to the Club what was then known in this respect, and gave a detailed notice of some original experiments. On the occasion in question the value of the discussion was greatly enhanced by the observations which fell from Mr. Beulah.

The differential diagnosis of the various species of *Strongylus* is, taken by itself, a matter of great interest, zoologically speaking.* As a refinement in this department of observation, I may mention that it is perfectly possible for an expert in this branch of helminthology to detect the differences subsisting between the various embryos alike of strongyles and other allied nematoids.

In conclusion, let me add that it must be obvious to the meanest capacity that if we would stamp out divers parasitic plagues that affect both man and beast we must endeavour to ascertain whence each species comes and whither it goes.

Alas! the labour of such researches is practically endless. What a task the problem presents for generations of microscopists yet unborn! Of the hundreds of known species of helminths only a few have been exhaustively studied, so to say.

The number of the species thoroughly studied may be counted on the ends of our fingers. We have *Trichina spiralis*, *Fasciola hepatica*, so beautifully worked out by Thomas, and a few *Tænia*, *Echinorhynchi*, and one *Pentastoma*, concerning whose several life histories tolerably complete records exist.

In this regard, the collection of species and their zoological determination is one thing. Anatomical observation, aided by sections, staining, and mounting, is another step gained. But then there remains the question of experiments on living animals, involving both expense and much personal sacrifice of time. Both of these difficulties might eventually be bridged over, were we not met with obstacles arising from the determined hostility of certain well meaning people who disapprove of this, the most essential part of the biological method of research. We can make no solid advances in helminthology unaided by experimental research, which method, after all, however freely employed, would serve to allay far more suffering than it could produce.

Unfortunately, the influence of some of these obstructors of science is very considerable; so great, indeed, that one might almost speak of it as being equalled only by the profundity of ignorance which characterises its foremost abettors. A few simple lessons gathered from a contemplation of the behaviour of parasites would do some of these obstructors and sentimentalists a great deal of good; and I venture to think that our dear and grand old Shakespeare would, as regards the vexed question, have ranged

* At this point Dr. Cobbold gave a brief account of the diagnostic marks presented by the tails of strongyles. Drawings representing on a large scale the hoods of the male worms were referred to; especial attention being called to those of *Strongylus micrulus* and *Str. filaria* of the calf and sheep respectively. The ray-patterns of the hoods of *S. paradoxus* and *S. dentatus* of the pig, of *S. filicollis* and *S. contortus* of lambs, of *Str. clathratus* of the elephant and *S. commutatus* of the hare were also described and contrasted.—Ed.

himself on the scientific side. Speaking figuratively, the rôle of the human parasite was well understood by him, and I sometimes think he must have been acquainted with the genuine article. At all events he classified those beings as evil "that do fastest propagate," but then did he not also say: "There is some soul of good in things evil, would men observingly distil it out." It is this very process of intellectual distillation recommended by Shakespeare that we have together sought to utilise this evening, and I trust that our humble efforts in this direction may not be entirely unproductive of good results.

The following objects were exhibited in the library:—

Pond life...	Mr. F. W. Andrew.
Freshwater Polyzoon (? n.s.)	Mr. E. C. Bousfield.
Section of Brain of Calf	,,
Anchors and plates of *Synapta*, in situ ...	Mr F. Coles.
Sections of stem of Vine	Mr. A. L. Corbett.
Aphis, *Trama troglodytes*	Mr. H. G. Glasspoole.
T.S. Stem of *Limnanthemum*	Mr. G. E. Mainland.
Diatoms, *Sceptroneis gemmata*	Mr. H. Morland.
Living serpula	Mr. A. W. Stokes.
Diatoms, *Pergodiscus armatus*	Mr. G. Sturt.
Sting and poison bag of Wasp	Mr. J. Wilson.

Attendance—Members, 71; Visitors, 12.

March 27th, 1885.—Ordinary Meeting.

Dr. M. C. Cooke, M.A., A.L.S., Vice-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:—Dr. W. Hodges, Mr. Henry W. Parritt, Mr. Peter W. Squire, Mr. J. T. N. Thomas, and Mr. Chas. J. Wainwright.

The following donations to the Club were announced:—

"Proceedings of the Manitoba Historic and Scientific Society"	From the Society.
"Historic Names of Places in the Canadian North-West"	,, ,, ,,
"Mound Builders," by Bryce M. Wright	From the Author.
"Proceedings of the Belgian Microscopical Society"	In Exchange.
"Journal of the New York Microscopical Society"	,, ,,
"Transactions of the Eastbourne Natural History Society"	,, ,,
"The American Monthly Microscopical Society"	,, ,,
"The American Naturalist"	,, ,,
"Proceedings of the Royal Society"	From the Society.
"Monograph of the British Phytophagous Hymenoptera," Ray Society's Publication ...	By Subscription.
"Annals of Natural History"	Purchased.

The thanks of the Club were voted to the donors.

The Secretary exhibited a new Iris Diaphragm, by Mr. Hunter, made to go close up under the object.

The Secretary read a letter from Colonel O'Hara, enclosing a series of photographs of diatoms from Galway Bay, and asking for assistance in identification.

A large number of dipping tubes of a superior kind were placed upon the table for distribution amongst the members by Mr. Le Pelley, to whom the thanks of the meeting were unanimously given.

Dr. M. C. Cooke read a paper "On some remarkable Moulds," illustrating the subject by drawings, which were handed round for inspection.

Mr. Karop enquired if the fungus mentioned as having been found by Mr. Durham in the human ear was associated with any disease, or whether it was one of those aggregations which were sometimes found on the ears of out-patients attending hospitals?

Dr. Cooke said he thought Mr. Durham stated that there was a disease of the ear for which he was consulted, and that he removed the mould in the course of his treatment.

Dr. Matthews, in proposing a vote of thanks to Dr. Cooke for his paper, said that there were certain subjects which seemed to be above criticism, because in the mouths of experts they were statements of facts which were simply beyond dispute. In the instance before them it was well known that Dr. Cooke had made the subject so much his own, and his observations were so correct, that they were beyond the limits of ordinary criticism.

A vote of thanks to Dr. Cooke was then put to the meeting and carried unanimously.

Mr. Karop said, that whilst this question was before the meeting, he would mention a rather remarkable place in which he had once found some of these fungi. He was examining some bottles of sections of human spinal cord preserved in strong methylated spirit, and in one bottle of the series he found the upper part of the spirit was covered by a mycelium of some kind, which was quite black. He had mentioned it to Dr. Cooke, but he did not at the moment remember anything which grew in spirit.

Dr. Cooke acknowledged the vote of thanks, and said that the very short time at his disposal for the preparation of a subject did not leave him much choice as to what it should be, and in looking over what was ready to hand he thought that the notes which he had read contained something which was novel or new, and if not controversial they had at least some points of interest. If there had been time in which to think over a subject, the one he had brought forward would, perhaps, be amongst the last which would have occurred to him as being suitable; but under the circumstances it seemed to him the best thing to be done. Amongst the five species named there were some curious facts which showed the polymorphous character of these moulds—the first being found in a stoppered bottle, the second in a dead insect, the third in the ear of a living human being, the fourth on a living tree, and the fifth found growing on the leaves of ferns, without apparently doing any injury to them. He did not remember ever to have found them

growing in spirits, but in their low forms they would grow in a solution containing a large quantity of spirit.

Mr. J. D. Hardy described, by the aid of a diagram drawn on the board, the peculiar method of feeding observed in the case of *Daphnia Pulex*. The food was carried in the current caused by the legs, to the hinder part of the interior of the shell, and the particles contained therein carried into a funnel, to which is attached a very distinctly-formed organ which stops all inorganic matter or particles too large for mastication ; such particles as they accumulate in the funnel being cleared away by the hook of the hind leg. Such as were passed were masticated by the jaws and passed on to the end of the tongue, which was a long flexible tubular organ, which could be opened at will along its length. It had (when closed) a very small opening. Whatever particles accumulated at the end of the tongue were cleared away by the hook on the first pair of legs. Whatever was sucked in by the tongue was carried along it at once to the alimentary canal.

Mr. Goodwin said he was very pleased to find that Mr. Hardy had taken up this subject. He had himself noticed that there was an in-taking of food at the posterior portion of the animal, but he found a great difficulty in tracing its progress so as to see it entering the alimentary canal. In the endeavour to do this he stained some starch granules with iodine, and attempted to feed the Daphnia with them, but it would have nothing to do with them ; one day, however, he chanced to see a Daphnia draw in the egg of a rotifer, and he was able to trace the progress of this entirely.

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

Notices of meetings and excursions for the ensuing month were then given, and the proceedings terminated with the usual Conversazione, and the following objects were exhibited :—

Sea slug, *Limapontia nigra*	Mr. F. W. Andrew.
Parasites from a Bat	Mr. F. Coles.
Diatoms frum Burrin, Ireland, *in situ* ...	Mr. A. L. Corbett.
Alcyonium digitatum	Mr. W. M. Holmes.
Section of lower jaw of Shrew Mouse	Mr. J. J. Hunter.
New form of graduating Iris diaphragm ...	,, ,,
Larva of *Corethra culiciformis*	Mr. G. E. Mainland.
Diatoms, *Sceptroneis caduceus*	Mr. H. Morland.
Brachionus pala-synchæte	Mr. R. T. C. Nevins.
Lophopus crystalinus	Mr. C. Le Pelley.
Entozoa *Oxyuris vermicularis*	Mr. W. Watson.
Ovary of Poppy, fertilised, and unfertilised ...	Mr. J. Willson.

Attendance—Members, 51; Visitors, 5.

On a Supposed New Infusorian of the Flagellata Eustomata.

By George J. Burch.

(*Read April 24th*, 1885.)

Plate XI.

In March, 1884, I found in a ditch, by Port Meadow, Oxford, an animalcule, which I have been unable to identify with any described in Saville Kent's book. It was growing on duckweed, and also on the cases of gnat larvæ, of which there were many attached to the weed.

Each colony consisted of a compound stem, no portion of which was contractile, bearing from 10 to 50 heads upon branchlets somewhat thinner than the main stem. These heads appeared, in most positions, of an irregular pear shape, the broad end projecting on one side into a blunt proboscis, from which arose a single stout flagellum. About the centre of the creature was a very strongly refracting oval spot, with a somewhat corrugated surface, which I imagined to be the gizzard. Between this and the mouth, which lies in a cup-shaped depression close under the proboscis, was a passage, the walls of which I could distinctly see, even when there was no food in it.

The creature was remarkably active, the movement of the flagella being so vigorous as to keep the whole group in constant agitation.

The flagellum of each individual waved with a steady circular vibration, most often with one node, but sometimes with two, until some particle of food, generally a micrococcus, came within reach.

Then, *before the flagellum touched it*, a sudden vigorous stroke was made, which appeared to bring the curve of the flagellum behind it, and so throw the food into the mouth. At the same moment, with a rapidity very difficult to follow, the head made a dart forward exactly as a dog snaps at a fly (this movement may result simply from the increased activity of the flagellum, though I incline to believe that the creature has the power of bending the head in various directions on the stem, like Vorticella). Imme-

diately afterwards, before I could see how it was managed, the food was safely lodged in the creature's throat.

This was repeated again and again, the particles being gradually forced down towards the central vesicle, at a little distance apart. The conclusion was irresistible, that in some way the creature is conscious of the proximity of something eatable, and catches it by a voluntary effort. The mere action of feeding, enabled me at a glance, to distinguish it from the other Flagellates which I found in the same water. On several occasions particles too large to swallow were caught; when this happened the flagellum was instantly stretched straight across the head and pressed firmly down; and if in this way the food could not be forced into the mouth, after three or four seconds it was allowed to escape.

Not imagining that it might be something new, I made no measurements, but only took a rough sketch with the camera lucida, from which I find that the heads were about half the length of those of *Carchesium polypinum*.

Specimens were very plentiful for some weeks. The heads do not apparently break loose from the stems on slight provocation like other Flagellates, for I had one group out of the tank on two successive days, and it was unaltered. With the double spot lens the creatures appear of the usual whitish hue, but with direct sunlight, under a low angled quarter, the heads are of a pale green at the edges and purplish in the centre.

I made some careful observations with the $\frac{1}{8}$th, and came to the conclusion that the cup-shaped depression in the head is bordered with three equidistant prominences, at the base of the largest of which, or from the apex of it—I could not determine which—is the flagellum, and close under the flagellum the opening of the gullet.

Unfortunately, when I had time to go to the Bodleian Library to try to identify the creature, and found it was not in Saville Kent's book, I could no longer get any specimens. I have searched for them this spring, but a bridge is being built near the ditch, and I fear they have been destroyed.

If it should be decided that this is a new species, I would suggest the name "*raptor*," but if there is no genus in which it can be placed, I would call it "*Harpakter socialis*," from "αρπαζω," *I snatch*, which would at once identify it among the *Flagellata eustomata*, from its method of seizing its prey.

G. J. Burch del. W. Rhein sc.

On some Fossil Marine Diatoms Found in the Moravian "Tegel," from Augarten, near Brünn.

By Prof. P. T. Cleve, Hon. F.R.M.S.

(*Read June 26th*, 1885.)

PLATES XII and XIII.

In the marine deposits of Moravia, known as Tegel (marl or clay), belonging to the miocene and pliocene divisions of the tertiary formation, fossil diatoms have been recently found by Herr E. Thum, of Leipzig, who has kindly sent to me a collection of mounted specimens for description. He informs me that they were detected in the "Tegel," from Augarten, near Brünn. Whether it belongs to the miocene or pliocene formation I am unable to determine.

The following is a list of the species sent by Herr Thum :—

Cocconeideæ.

Cocconeis pellucida, Hantzsch in Rab. Beiträge, p. 21, Pl. 6, Fig. 11 (1863). Grunow, Novara Algæ, p. 12. (Not *C. pellucida* of Verh., 1863.) I have seen three upper valves. Length, ·084-·143 mm.; breadth, ·063-·084; striæ, 12 in the ·01 mm. This species is found in the warmer seas, as the Mediterranean, Red Sea, Indian Ocean, &c., and also in the Nankoori deposit.

Mastogloiaceæ.

Orthoneis splendida (Greg.), Grun. *Cocconeis splendida*, Greg. D. of Cl., p. 21, Pl. 1, f. 29 (1857). *C. punctatissima*, Grev. Mic. Journ., v., p. 8, Pl. iii, f. 1 (1857). *Mastogloia cribrosa*, Grun. Verh., p. 577 (1860). *Orthoneis splendida*, Grun. Novara Algæ, p. 15 (1867). Van Heurck Syn., Pl. 28, f. 1-2 (1880). I have seen four examples from this deposit. Length, ·088-·168 mm.; breadth, ·07-·13; puncta, 5 in ·01 mm. Living specimens are smaller, and measure in length ·05 to ·11 mm., breadth ·03-·09 mm. Striae in living specimens vary from $5\frac{1}{2}$ (Greg.) to 8 (Grev.) in ·01 mm.

NAVICULACEÆ.

Navicula aspera, var. *intermedia*, Grun. in A. Schm. Atl., Pl. 48, f. 14, 15 (1876). Franz. Josef's Land Diatomeen, p. 56, Pl. A., f. 20 (1884). One of the Tegel specimens measures ·2 mm. in length and ·034 mm. in breadth, and has 7 striæ in ·01 mm.; the striæ are nearer to the median line on one side than the other. This form is found living in the Arctic seas.

N. nitescens (Greg.), Diat. of Cl., pp. 15 and 69, Pl. 1, f. 16 (1857). A. Schm. Atl., Pl. 7, f. 38 (1875). (*N. Smithii* var.) One specimen, closely agreeing with the figure in the Atlas, measures ·12 mm. in length, and ·002 mm. in breadth, and has 6 striae in ·01 mm. This species is also found recent in most seas.

N. prætexta, Ehr. *Pinnularia prætexta*, Ehr. Mb. 1840. Several specimens, all agreeing very closely with the figures in A. Schm. Atl., Pl. 3, f. 31-33. Length, ·1-·24 mm.; breadth, ·06-·12 mm.; striæ, 7-7·5 in ·01 mm.

Found recent in most marine gatherings.

N. Lyra, var. *elliptica*. A. Schm. Atl., Pl. 2, f. 29, and Pl. 3, f. 11 (1875). Van Heurck. Syn., Pl. 10, f. 2. One specimen (len. ·115, br. ·075 mm.; striæ, 6 in ·01 mm.) closely resembles the figure in the latter work. Common in recent marine gatherings.

N. inhalata. A. Schm. Atl., Pl. 2, f. 30 (1875). One specimen (length ·14, breadth ·08 mm.) has 9 striæ in ·01 mm. The specimen from Samoa, as figured in the Atlas, has 13 striæ in ·01 mm.; in other respects the Tegel specimen agrees well with it.

N. gemmata, Grev., Edin. N. Phil. Jour., x., p. 30, Pl. 4, f. 7 (1859). *N. spectabilis*, Grun., Verh., p. 533, Pl. 3, f. 11 (1860). *N. Grunowii*, Rab. Flor. Eur. Alg., p. 203 (1864). *N. gemmata*, var. *biseriata*, Grun., Novara Algæ, p. 100, Pl. 1 A., f. 16 (1867). *N. gemmata*, var. *spectabilis*, A. Schm. Atl., Pl. 8, f. 38 (1875). *N. grunowii*, A. Schm. Atl., Pl. 70, f. 73 (1881). Three specimens ·14-·20 in length and ·05-·052 mm. in breadth; striæ 3 in ·01 mm. One of the specimens is slightly constricted in the middle, and very much resembles *N. pristiophora*, Janisch in A. Schm. Atl., Pl. 70, F. 72. *N. gemmata* is found living in warm seas, as the Mediterranean, Red Sea, the West Indies, California, &c., and in a fossil state in Californian guano and the Nankoori deposit.

N. bomboides, A. Schm. Atl. See Diat. Pl. 1, f. 2 (1874). A.

Schm. Atl., Pl. 13, f. 36-38 (1875). I have seen only one specimen ; it is ·13 mm. in length and ·42 in breadth. It has only a slight central constriction, as in figure 38 of the Atlas. The striæ are 4·5 in ·01 mm.

N. gemmatula, Grun. A. Schm. Atl., Pl. 13, f. 20-21 (1875). A somewhat corroded valve (Pl. 12, f. 1); measures ·18 mm. in length and ·048 in breadth, and has 4·5 striæ in ·01 mm. It resembles the last-named form, but is larger, It also resembles *N. mæsta*, A. Schm. Atl., Pl. 69, f. 18-19, which, however, has closer striæ (7 in ·01 mm.). Nearly related to our specimen is *N. Lesinensis*, Grun., m.s., measuring ·144 mm. in length and ·05 in breadth, with 5 striæ in ·01 mm., but the depressions parallel to the median line are narrower.

N. Beyrichiana. A. Schm. Atl., Pl. 69, f. 16-17 (1881). One specimen, which measures ·18 mm. in length and ·05 in breadth, and has 3·3 rows of distant puncta in ·01 mm. This species has been found in Ægena (? fossil).

N. Crabo (Ehr.), Kütz. *Diploneis Crabo*, Ehr. Mb. (1844). *N. Crabo*, Kütz., Sp. Al., p. 83 (1849). *N. Pandura*, Breb. Diat. Cherb., Pl. 18, f. 4 (1854). I have seen four valves from the "Tegel," all of which have lost their finely-sculptured layer. All of them agree very well with Figures 4 and 8 (pl. 69) in the Atlas ; Figure 8 seems to be more nearly related to *N. multicostata*, if this is really distinct from *N. Crabo*.

Surirelleæ.

Surirella opulenta. Grun. Verh., p. 461, Pl. 11, f. 10 (1862).

S. fastuosa, var. *opulenta*. A. Schm. Atl., Pl. 20, f. 1. One large specimen.

S. Baldjikii. Norman, T.M.S., ix., p. 6, Pl. 2, f. 2. A. Schm. Atl., Pl. 20, f. 7. One specimen. This species is still living in the Mediterranean and Black Seas.

Campylodiscus hibernicus, Ehr. A. Schm. Atl., Pl. 55, F. 10-11. I have seen one perfect specimen from the "Tegel." Mr. Thum informs me that this well-known freshwater species really occurs in this deposit. This seems highly improbable, as all the other species found in it are purely marine.

C. Clypeus, Ehr. Ehr. Mb., p. 205 (1840). *Cocconeis Clypeus*, Ehr. (1838). I have seen one small specimen closely agreeing with figure 3, Pl. 55, in Schm., Atl.

C. obsoletus, Ch., n.sp. Valve orbicular or oval, diameter ·17 mm., central area large, surrounded by a circle of short puncta. Limbus, with a few irregular and obliterated canaliculi. Margin with short cellules. Of all the described forms of Campylodisci with which I am acquainted, this shows the nearest affinity to *C. tabulatus*, A. Schm. Atl., Pl. 52, f. 4, but the canaliculi in that species extend from the margin to the circle of puncta surrounding the central margin. Pl. 12, f. 2, $\frac{280}{1}$, *b. c.*, margin in different foci $\frac{1000}{1}$.

Synedreæ.

Synedra fulgens (Kütz). W. Sm. *Gomphenema*, Kütz (1833). *S. fulgens*, W. Sm., 1853. Van. Heurck Syn., Pl. 43, f. 1-4. I have only seen a fragment of a valve ·02 mm. broad, with unusually coarse striæ, 6 in ·01 mm.

Entopyleæ.

Gephyrea media, Arnott, M.J.S. viii., p. 20 (1860). *Achnanthes angustata*, Johnst. (nec. Grev.), M.J.S. viii., p. 14, Pl. 1, f. 13 (1860.) Costæ 6·5 in ·01 mm. The species found in the "Tegel" are identical with those from the Moron deposit. It occurs living in California, Japan, &c.

Striatelleæ.

Rhabdonema adriaticum, Kütz. One specimen.

Grammatophora maxima, Grun. Verh., p. 416, Pl. 5, f. 5 (1862). A large and robust form, ·18-·3 mm. in length and ·018 in breadth. No striation could be detected.

Isthmieæ.

Isthmia nervosa, Kütz. No difference between this specimen and the recent form could be detected.

Biddulphieæ.

Biddulphia pulchella, Gray. (1821). The Tegel specimens are identical with the recent forms.

B. Tuomeyi (Bail.), Roper. *Zygoceros Tuomeyi*, Bailey (1843).

B. Tuomeyi, Roper (1859). Van Heurck Syn., Pl. 98, f. 2-3. This is a very variable species; some specimens so nearly resemble *B. elegantula*, Grev., T.M.S. xiii., Pl. 6, f. 13, that they might be taken for that species, whilst others can scarcely be distinguished from *B. regina*, W. Sm. Syn., Vol. ii., p. 50, Pl. 76, f. 323. Van Heurck Syn., Pl. 98 f. 1.

Syringidium, sp. I have seen one imperfectly developed frustule which seems to belong to *S. Americanum*, Bail. (Van Heurck Syn., Pl. 106, f. 2.) Pl. 12, f. 3, $\frac{480}{1}$.

Triceratium Favus, Ehr. Type form.

T. Favus, var. *maxima*, Grun. Van Heurck Syn., Pl. 107, f. 5. Distance between the angles ·15-·25 mm. Cellules (1-1·4 in ·01 mm.) very regularly arranged in lines parallel with the margins ; surface of valve covered with coarse granules (10 in ·10 mm.), radiating from the centre to the margins. Although the form of the valve and the arrangement of the cellules are the same as in the typical *T. Favus*, the presence of the radiating granules seems to be sufficient to constitute it a distinct species.

T. arcticum, Brightwell, 1853. A. Schm. Atl. Pl. 79, f. 12-13. Large triangular (·15 mm. between the angles) cellules in lines radiating from the centre angles ; obtuse, with rows of smaller cellules, 8 in ·01 mm. In addition to the coarser cellulation the surface is covered with very small cellules, as shown in figures 5, 6, 7, Pl. 79, of the Atlas.

T. Moronense, Grev. (T.M.S. xiii., p. 9, Pl. 4, f. 18, 1865). Of this species I have seen two specimens. Distance between the angles ·08-·15 mm. So far as I know this species has only been found in the fossil deposits of Moron and Nankoori.

T. latum, Grev. (T.M.S., xiii, p. 103, Pl. 9, f. 20, 1865). A. Schm. Atl., Pl. 77, f. 38-39. One specimen. Distance between the angles ·075 mm. In all respects identical with A. Schmidt's figures ; this species has been found living at Singapore and Celebes.

T. turgidum, Ch. n.sp. Valve in s.v. triangular, with very broad angles ; outline orbicular, very convex ; centre with scattered puncta, which become closer as they approach the margin. In s.v. the centre is very turgid, and the angles produced. Distance between the angles ·07 mm. Pl. 12, f. 4, *a b*, $\frac{280}{1}$.

T. Stokesianum, Grev. (T.M.S., xiv., p. 8, Pl. 2, f. 23, 1866). The form found in the Tegel, and which I refer to the above named species, differs from Greville's figure, the veins not forming transverse bars ; they are also shorter and more irregular. In a small specimen they are very short, but I do not think these differences are of any specific value. I have examined four specimens. Distance between the angles ·1-·16. The centre of the valve has a few puncta (?) differing from the ordinary cellulation ;

they are probably short spines or apiculi. A small specimen shows considerable affinity to *T. Jensenianum* Grun. (A. Schm. Atl., Pl. 77, f. 15-16), but differs from that form by the short veins being more numerous. Pl.12, f. 5, *a b*, $\frac{280}{1}$

T. parallelum, Ehr , Grev. Triangular form=*T. obtusum*, Ehr.? Cleve, West Ind. Diat., p. 16 (1878). *T. parallelum* var. *trigone*, A. Schm., Pl. 76, f. 14-17, (1882). Quadrangular form= *Amphitetras parallela*, Ehr., Mb. (1840). *Triceratium parallelum*, Grev. T.M.S., xiii., p. 104, Pl. 9, f. 22 (1865). Hexagonal form, Grev. l.c., f. 23. Both the triangular and quadrangular forms occur in the "Tegel." The species is found living in the warmer seas, as the Mediterranean, Red Sea, West Indies, Gallopagos Islands, and as fossil in Ægina Moron and San Jeremie, F.K).

T. tesselatum, Grev. (T.M.S. ix, p. 71, Pl. 8, f. 14). This species belongs to a group of Triceratia; extremely difficult to exactly determine, so many slightly differing forms having been described as distinct species and also imperfectly figured. As my determination may not be perfectly correct, I give a figure of the only specimen I have seen from the Tegel deposit. Distance between the angles, ·08 mm. Pl. 12, f. 7.

T. irregulare var. *hebetata*, Grun. Van Heurck Syn., Pl. 111, f. 10. One specimen closely agreeing with the above figure. The angles and margin show a structural difference when the focus of the objective is altered. This is probably caused by the existence of two differently sculptured layers. In one focus the angles have large cellules, in the other very small ones. I have some doubts as to this form being the true *T. irregulare*.

T. trisulcum, Bail. (in Pritch. Inf., p. 854, Pl. 8, f. 24, 1861). A. Schm. Atl., Pl. 78, f. 5-8. Of this form I have seen several specimens. Distance between the angles ·10-·18 mm.

Var. *minor*, Cleve. Small. Distance between the angles, ·1 mm. The apices of the angles are more acute than in the larger form. Pl. 12, f. 6, $\frac{480}{1}$

T. nobile (Grev.), Cl. *Amphitetras nobilis*, Grev. T.M.S. xiii, p. 105, Pl. 9, f. 27 (1865). One large specimen. Distance between the angles ·115 mm., rows of cellules, 4 in ·01 mm. A small quadrangular specimen agrees well with *Amphitetras producta*, Grev., T.M.S. ii., p. 94, Pl. 9, f. 11 (1862); not *T. productum*, Grev. (1861), nor *T. balearicum*, Cl. Grun. and green Sv. Vet. Ak. Handl., T. xviii, p. 25, Pl. 6, f. 73.

T. antediluvianum (Ehr.), Van Heurck. *Amphitetras antediluviana*, Ehr. (1839). I have seen only one specimen from the Tegel deposit, and this is not the type form; the lobes are less obtuse. It more nearly resembles the last described form, from which it differs principally by its coarser cellulation (3 cellules in the ·01 mm.) and less produced lobes. Distance between the angles ·07 mm.

Eupodiscus Argus, Ehr. *Tripodiscus Argus*, Ehb. (1840). *E. Argus*, W. Sm., Syn. vol. I, 1859. Van Heurck Syn., Pl. 117, f. 3-6. Several specimens examined, but no difference could be detected between them and recent forms.

Aulacodiscus Oregonensis, Bail. 1862. *A. Oreganus*, Ralfs. 1861. A. Schm. Atl., Pl. 34, f. 4-5.

A. amoenus, Grev., T.M.S. xii., p. 10, Pl. 1, f. 3 (1864). A. Schm. Atl., Pl. 41, f. 13. One specimen agreeing very well with A. Schmidt's figure.

A. Grunowii, Cl., n.sp. Valve large, ·1-·3 mm. in diameter, with distant rows of granules radiating from the centre, where they are scattered. Between these are very small puncta; below the granulated surface is a reticulated layer; number of rays 6-10. Pl. 12, f. 8, $\frac{280}{1}$.

This beautiful species approaches very closely in general appearance to *A. Grevilleanus*, Norman (T.M.S. xii., p. 10, Pl. 1, f. 1, 1864), but the markings on that species show many important differences; nevertheless, our species has a close affinity with it. *A. Grevilleanus* was found in the Moron deposit.

Cerataulus turgidus, Ehr. (1843). Van Heurck Syn., Pl. 104, f. 1-2. Two small specimens, ·05-·06 mm. in diameter.

C. Johnsonianus (Grev.), Cl. *Biddulphia Johnsoniana*, Grev. T.M.S. xiv., p. 6, Pl. 2, f. 14-15 (1866). A very robust species, ·18 mm. in diameter. The puncta of the valve form irregular wavy lines, about ·11 in 0.1 mm. (Moron deposit, Greville.)

Auliscus confluens, Grun. A. Schm., Probetafel, f. 1 (1874). Atlas, Pl. 32, f. 6-8. Several specimens, diameter ·1 mm.

A. cælatus, Bail. (1853). The specimens from the Tegel agree with Figure 12, Pl. 32, in A. Schm. Atl. (from Moron).

A. Normanianus, Grev. T.M.S. xii., Pl. 11, f. 11 (1864). A. Schm. Atl., Pl. 32, f. 3, and Pl. 67, f. 5. One valve agreeing in every respect with the Moron specimen.

A. pulvinatus, Cl., n.sp. Valve nearly orbicular; processes

two, large, centre punctate depressed, surrounded by two elevated rings, separated by a furrow. Structure : minute puncta, arranged in irregular radiating lines. Margin with a few short apiculi. Diameter ·08 mm. Pl. 13, f. 9, $\frac{48}{1}$

ACTINOPTYCHEÆ.

Actinoptychus undulatus, Ehr. Large specimens ·08-.18 mm. in diameter. Between the three marginal nodules and the central area are distinct raphes.

A. splendens (Shadb.), Ralfs. Van Heurck Syn., Pl. 119. Besides the typical form I have observed the following varieties :—

var. *Californica*, Grun. Van Heurck Syn., Pl. 120, f. 1.

var. *Nicobarica*, Grun., l.c., f. 4.

A. glabratus, Grun, l.c., Pl. 120, f. 6.

var. *incisa*, Grun., l.c., f. 8.

A. vulgaris, var. *Virginica*, Grun., l.c., Pl. 121, f. 7. Pl. 13, f. 11. Another variety occurs in the Tegel, having a coarser reticular and more distant rows of puncta. Pl. 13, f. 10.

A. Simbirskianus, A. Schm. Atl., Pl. 29, f. 11 (1875). One specimen, resembling the figure in the Atlas.

A. Boliviensis, Janisch. A. Schm., Atl. Pl. 1, f. 23 (1875). One large specimen. I regard as varieties of this species —

A. Gründleri. A. Schm. Atl., Pl. 1, f. 22 (1875).

A. Pfitzeri, l.c., Pl. 29, f. 1 (1875).

The differences between the three forms consist in the number of the marginal nodules, the form of the blank spaces, and the depression of the surface, but all these characters are variable. In Pl. 13, f. 12, I give a figure of *A. Pfitzeri*, from the Tegel. *A. Gründleri* has two nodules, and is larger, but does not otherwise differ.

A. Moronensis (Grev.), Cl. *Omphalopelta Moronensis*, Grev. T.M.S. xiv., p. 122, Pl. 2, f. 14 (1866). This species does not seem to be rare in the Tegel, and varies in size from ·08-·26 mm. in diameter. Small specimens agree with Greville's figure, but the large valves are more flattened and are slightly hexagonal.

Asterolampra Marylandica, Ehr. (1844). Diameter of valve ·11 mm., rows of puncta 8 in ·01 mm.

THAUMATODISCI CLEVE.

In this family I propose to include some very remarkable forms of Diatomaceæ, the valves of which have prominent central processes. I place in this family the genera *Thaumatonema*, Greville,

T.M.S., 1871. *Strangulomena*, Greville, T.M.S. (1873), and a new and undescribed genus from the Tegel, *Pyrgodiscus*, Kitton, MS.

The genus *Thaumatonema* bears a long process, proceeding from the centre of the circular valve, which afterwards becomes widely forked. The apices of the forks articulate with those of the adjoining frustule. Valve (discoid) turgid, with a flattened centre.

Pyrgodiscus (from Πυργος, a tower), has a conspicuous square, tower-like elevation, bearing large spines on its sides and angles. Valve orbicular, with a large square central elevation, armed with long and stout spines; margin with small processes placed on elevations. Surface with irregular line of radiating puncta. The processes are connected with the central elevation by smooth radiating lines.

Pyrgodiscus armatus, n.g. Kitton. End of the central elevation flattened, with rows of small puncta, which do not reach the centre, margins with four stout spines, below which and alternating with them are four similar spines. Diameter of disc ·08-·1 mm. (height of "tower" 25·4 F.K.) The structure of the valve seems to bear some resemblance to that of *Polymyxus* (?) *pulchellus*, Grun. (in Van Heurck Sy., Pl. 123, f. 5) and *Thaumatonema costatum*, Grev. (T.M.S. 13, Pl. 8, f. 3). Pl. 13, f. 13 *a.b.c.*

Herr Thum has not yet succeeded in finding an entire frustule; it is therefore uncertain whether the two valves are alike. I am much inclined to believe that they are not. My reason for this is that he has sent me a specimen, which seems to me to be either the opposite valve of a frustule or an abnormity. It is certainly nearly allied to *P. armatus*. The following is a description of it: Valve more irregular in structure; it has 5 spines and a slight indication of a sixth, but which do not project from a central elevation. Pl. 13, f. 13, *d.* $\frac{480}{1}$.

Arachnoidisca Cl., N. Fam.

Arachnoidiscus ornatus, Ehb. (1849). A. Schm. Atl., Pl. 73, f. 4-6. Several corroded specimens.

Stictodiscus Californicus, Grev., var. *areolata*, Grun. A. Schm. Atl, Pl. 74, f. 1. (1882). I have seen five specimens agreeing well with the figure in the Atlas, taken from a somewhat corroded valve from the Moron deposit. Diameter ·08-·15 mm. On uninjured specimens, the lines of marginal puncta split up into 2-3 rows of small puncta.

Actinocyclæ.

Actinocyclus Ehrenbergii, Ralfs. (1861). Van Heurck Syn., Pl. 123, f. 7.

A. (*alienus*, var.? *Grun.*) *undatus*, Cleve., Disc. ·07-·1 mm. in diameter; pseudo nodule indistinct; valve with radiating and branching lines of puncta (or small cellulæ) 5-6 in ·01 mm.; surface concentric, elevations and depressions. It is with some hesitation I refer this form to *A. alienus*; the radiating lines of puncta do not form such distinctly oblique and decussating transverse rows as shown in Grunow's figures in Van Heurck's Syn., Pl. 125, f. 10 and 12; near the margin they have this arrangement, but on the other part of the valve they resemble *A. subtilis.*, fig. 7 (Pl. 124), Pl. 13, f. 14 $\frac{480}{1}$.

Melosireæ.

Paralia sulcata (Ehb.), Cleve (1864), *Gallionella sulcata.* Ehb., (1838). *Orthosira marina* Sm. S.B.D. II., p. 59 (1856), *Paralia marina*, Heib. (1863).

Melosira? clavigera, Grun. Van Heurck Syn., Pl. 91, f. 1-2, (1881). *M. Sol.* (Ehr.) Kütz. *Gallionella Sol.*, Ehb. (1844). *M. Sol.*, Kütz. (1849). Van Heurck Syn., Pl. 91, f. 9.

M. Omma Cl. n.sp. Valve orbicular with a circle of puncta (6-7 in ·01 mm.) between the margin and the centre (but nearer the former), the margin finely striate (21 in ·01 mm.), the remainder of the valve smooth. Diameter, ·085 mm. Pl. 13, f. 15. $\frac{480}{1}$.

M. Borreri, Grev. Brit. Flora.

Podosira antediluviana, Cl. Valve very convex and robust, with minute puncta scattered at the centre, but forming minute irregularly radiating lines on the other parts of the valve. Pl. 13, f. 16, $\frac{480}{1}$.

Pyxidicula cruciata, Ehr. (1841), Mg., Pl. 33, f. 7. One specimen. Dia. ·056. Cellules 3-4 in ·01 mm.

Endictya oceanica, Ehr. (1845). A. Schm. Atl., Pl. 65, f. 10. Diameter ·09-·15 mm. Cellules 2 in ·01 mm.

E. minor. A. Schm. Atl., Pl. 65. f. 4 (1881), *E. oceanica* in Cl. and Möll, Diat. No. 110. Diameter ·09 mm. Cellules 3 in ·01 mm. *Craspedodiscus Coscinodiscus*, Ehr. (1844.) A. Schm. Atl., Pl. 66, f. 3-4. One specimen ·11 mm. in diameter. Cellules in the limbus 2 in ·01 mm.; in the concave part 4 in ·01 mm.

Coscinodiscus griseus, Grev. T.M.S., III., p. 230, Pl. 9, f. 7

(1863.) I have seen one valve ; it has a small central space without granules. Row of granules 9 in ·01 mm., margin with short granulated striæ ·16-·01 mm. Diameter ·055 mm. The arrangement of the lines of puncta agrees very [well with Greville's figure, but differs from that in Van Heurck (Syn., Pl. 132, f. 1), which has also very much coarser marginal striæ. The "Tegel" specimen also differs very much from figures 13 and 14 (Pl. 58 in Schmidt's Atlas), which have coarser granules, and the margins are not striate.

C. elegans, Grev. T.M.S. xiv, p. 3, Pl. 1, f. 6 (1860). A. Schm. Atl., Pl. 58, f. 7. Several specimens from ·05 to ·08 mm. in diameter. Rows of puncta 3 to 4 in ·01 mm., marginal striæ 12 in ·01 mm. I regard as a variety *C. biradiatus*, Grev. (T.M.S. ix, p. 42, Pl. 4, f. 7 (1861)., and A. Schm. Atl., Pl. 58, f. 2). This form also occurs in the Tegel.

C. Thumii, Cle., n.sp. Valve ·075 mm. in diameter; lines of granules radiant, unequal in length, not reaching the centre; crowded near the margin, where they are 6 in ·01 mm. Pl. 13, f. 17, $\frac{480}{1}$.

C. nitidus, Greg. (1857). A. Schm. Atl. Pl. 58, f. 18. Valve ·088 mm. in diameter. The puncta exhibit a tendency to form radiating lines.

C. radiatus, Ehb. (1839), Grun. Diat. Fr. Jos. Land, p. 19. Cellules about 2·5 in ·01 mm., in the margin about 4 in ·01 mm. Diameter ·12 mm. Some varieties approach near to *C. crassus*, *C. heteroporus*.

C. Argus, *C. marginatus*, and *C. Oculus Iridis*, but they are not typical specimens of these species.

C. robustus, Grev. (T.M.S. xiv., p. 3, Pl. 1, f. 8, 1866). Specimens from the Tegel are ·09-·01 mm. in diameter, and have 2 cellules in ·01 mm. Some of the Tegel specimens very much resemble A. Schm., figure 3, Pl. 62, in Atl. Others having smaller cellules (3-·01 mm.) approach closely to *C. marginatus*, *C. bimarginatus*, and *C. radiatus*.

C. Asteromphalus Ehb. (1844). Some splendid specimens occur in the Tegel of the varieties *eximia*, Grun. (A. Schm. Atl., Pl. 63, f. 12), and var. *hybrida*, Grun., Fra. Jos. Land Diat. 79, Pl. c., f. 9. *C. centralis* (Atl., Pl. 63, f. 1.)

Xanthiopyxis oblonga, *Ehb.* (Mg.; Pl. 33, 17, f. 17). This curious form is probably an auxospore of some Diatom, perhaps a

Hemiaulus, and is nearly related to *Stephanopyxis limbata*, Ehr. (Van Heurck Syn., Pl. 83, ter. f. 13-14.) Pl. 13, f. 18.

Some 80 species of Diatoms have been found in the Tegel of Brünn, and with the two exceptions *Campylodiscus hibernicus* and *C. Clypeus* (the former occurring in fresh and the latter in brackish water); all are decidedly marine. Only a comparatively few appear to be extinct, and of those a remarkable number have been detected in the "Moron deposit," which is said to be found near Seville, in Spain.

Of the recent species many forms are now living in the far-distant seas of Japan, California, West Indies, &c., proving that the Tegel was a deposit in a sea of a tropical or sub-tropical character.

It is of great interest to compare these fossil forms with recent specimens, and to note how little their characteristics have been altered by the conditions to which they have been exposed during the long period that has elapsed since the later tertiary and the present time.

Specimens of the Tegel Diatoms, mounted as "Typen Platten" can be obtained of Herr Thum, 2, Teichstrasse, Leipzig.

Additional Forms Found by F. Kitton in a Sample of the Tegel, Cleaned by Herr Thum.

Campylodiscus Echeneis, not unfrequent.

Nitzschia circumsuta, several valves.

Surirella elegans? several valves, only differs from the fresh-water form in the canaliculi being more robust.

Stauroneis phœnicenteron, fragment of a valve.

Nitzschia scalaris, fragment of a valve.

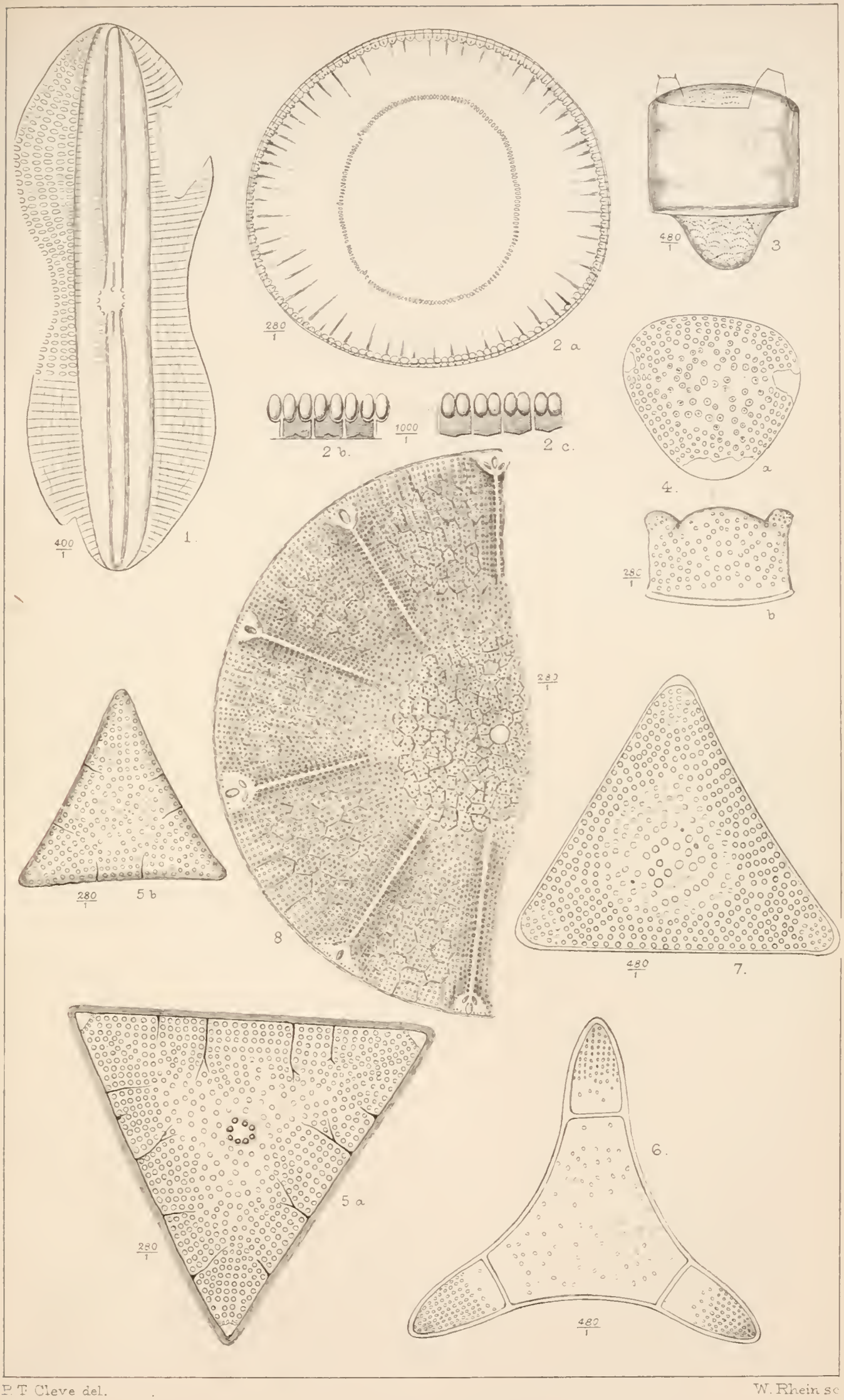
Navicula major, two valves.

Trinacria excavata, one valve.

Aulacodiscus angulatus, one valve agreeing exactly with a specimen in my collection, identified by Dr. Greville.

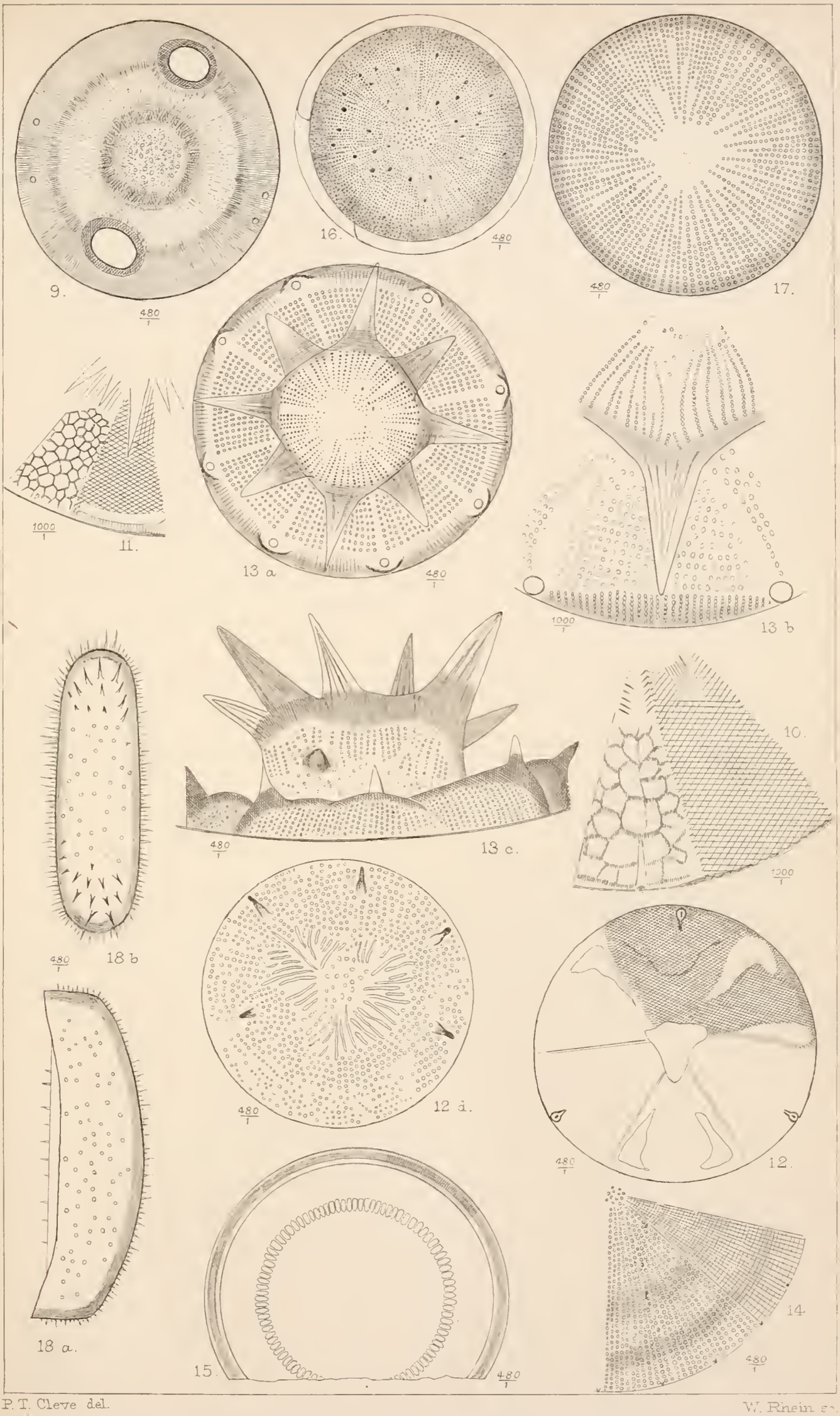
Aulacodiscus, n.sp. When the lower surface is in focus it is somewhat like a coarse *A. margaritaceus*, but when the objective is focussed on the upper surface the markings very much resemble those in *Aulacodiscus* (*Eupodiscus*) *Argus*. The furrows are much more distinct than those on *A. margaritaceus*; number of processes, 6; diameter of valve ·0040.

A. Grunowii does not appear to be very rare in the Tegel, as



P. T. Cleve del. W. Rhein sc

DIATOMS FROM THE BRÜNN "TEGEL."



P. T. Cleve del. W. Rhein sc.

DIATOMS FROM THE BRÜNN "TEGEL."

fragments frequently occur; my specimen is imperfect (about two-thirds of a valve.) This form has also some resemblance to *A. superbus*, Kitton.

Cosmiodiscus, Barbadensis, Grev., (?) var. I have seen two or three valves of what I take to be Greville's species. This form is very common in a Tegel from Struhar, Hungary.

Arachnoidiscus Ehrenbergii. One specimen.

Asterolampra Marylandica. One specimen.

Navicula aspera, var. *intermedia.* If the fact of the lines of striæ on one side of the median line being shorter than on the other is of any generic value, the above-named diatom belongs to the genus Alloioneis; but I have found forms with the pseudo stauros and the lines of striæ equal (*N. aspera* type); without the stauros and the lines of striæ also equal; with the striæ unequal *(Alloioneis)*; with striæ nearly touching the median line, and an inconspicuous blank space round the central nodule. All these forms have the characteristic striæ of the type form, and gradually merge into each other.

DESCRIPTION OF PLATES.

Plate XII.

Fig. 1. Navicula gemmatula, var? $\frac{400}{1}$.
" 2. Campylodiscus obsoletus, Cl., n.sp., *a.* $\frac{280}{1}$, *b. c.* $\frac{1000}{1}$.
" 3. Syringidium, sp., $\frac{480}{1}$.
" 4. Triceratium turgidum, Cl., n.sp., $\frac{280}{1}$.
" 5. ,, Stokesianum, *a. b.*, $\frac{280}{1}$.
" 6. ,, trisulcum, var. *minor*, Cl., $\frac{480}{1}$.
" 7. ,, tesselatum, $\frac{480}{1}$.
" 8. Aulacodiscus Grunowii, Cl., n.sp., $\frac{280}{1}$.

Plate XIII.

Fig. 9. Auliscus pulvinatus, Cl., n.sp., $\frac{408}{1}$.
" 10. Actinoptychus vulgaris, var. $\frac{1000}{1}$.
" 11. ,, ,, var. Virginica, $\frac{1000}{1}$.
" 12. ,, Boliviensis, var. Pfitzeri, $\frac{480}{1}$.
" 13. Pyrgodiscus armatus N.G. et. sp. Kitton, *a.* S.V. $\frac{480}{1}$, *b.* part of do. $\frac{1000}{1}$, *c.* F.V. $\frac{480}{1}$, *d.* opposite valve of do.? or abnormal form?
" 14. Actinocyclus (alienus ?) undatus, Cl., $\frac{480}{1}$.
" 15. Melosira Omma Cl., n.sp., $\frac{480}{1}$.
" 16. Podosira antediluviana Cl., n.sp., $\frac{480}{1}$.
" 17. Coscinodiscus Thumii Cl., n.sp.
" 18. Xanthiopyxis oblonga, $\frac{480}{1}$, *a.* F.V. *b.* S.V.

On the Mysterious Appearance of a Diatom.

By F. Kitton, Hon. F.R.M.S.

(*Read July 24th,* 1885.)

In my list of Norfolk Diatoms I note two species occurring in the water supply of the city of Norwich. These were *Asterionella gracillima*, Heib, and *Diatoma elongata.* Previous to the covering in of the reservoirs these forms were nearly always present in the deposit left in a precipitating glass, or on a piece of filtering paper after allowing the water to run slowly through it for several hours. Since the reservoirs have been covered I have not been able to find these or any other forms in the water, but I have noticed that occasionally during the spring and summer months rust-coloured stains appeared on the carafes if the water was allowed to remain unchanged for a few days. This I thought might be attributed to the presence of lime and iron, particularly as they apparently disappeared with effervescence when acid was introduced. A few weeks ago I scraped off a little of the film and examined it with a $\frac{1}{4}$-inch objective, when I found it was composed entirely of frustules of *Achnanthes* (*Achnanthidium*, Brêb.) *linearis ;* this somewhat surprised me, as I have never found it on the filter papers. I therefore (on June 25) filtered 8 ozs. of the water into a glass-stoppered bottle, using a filter paper 1 inch in diameter and a very small glass funnel. When the bottle was filled I removed the paper and boiled it in sulphuric acid, which I afterwards decarbonized with chlorate of potash ; the residuum, after the usual washing and concentration, I examined, but could find no indication of diatomaceous remains. I now turned my attention to the bottle of filtered water. In the course of a few days the stains began to appear, and on July 7th were much increased in size and depth of colour. I poured off the water and removed the film with a camel's-hair pencil ; after cleaning with nitric acid I found that this also consisted of the above-named Diatom unmixed with any other form. As this is a very minute species (·0004″ in length and less than ·0002″ in breadth), I thought it just possible that some of the frustules might have

passed through the paper and have continued to increase in the filtered water. In order to test this I filtered some emery powder, which had remained in suspension six or seven hours, the particles of which were less than the ·00005 in size ; these I found did not pass through the filter.

I do not conclude from this that it is a case of spontaneous generation, but rather as indicating the existence of microspores sufficiently minute to pass through the paper. I have some bottles of distilled water, prepared two months ago, none of which exhibit any indications of the existence of Diatoms or other organisms.*

* The development of mycelia takes place very rapidly in the distilled water containing cleaned preparations unless it is mixed with at least an equal quantity of spirit. This, I believe, is due to the cork, the bottom of which moulds, and the spores fall into the water and produce mycelia.

THE PRESIDENT'S ADDRESS.

Delivered at the Annual General Meeting, 24th July, 1885.

By Dr. W. B. Carpenter, C.B., F.R.S., &c., &c.

You will excuse me, gentlemen, I am sure, if I limit my remarks to a very few points. One of the manifestations of the nervous prostration or depression under which I have suffered is a great failure of voice. The genial weather and dry air of the last two days have rather invigorated me, I am happy to say, or I should not have been down here this evening.

In the first place let me congratulate you on having secured the services, as President, of Mr. Michael. Mr. Michael is pre-eminently one of that class which I think it is the especial function of this Club to foster, the class of those who take up the microscope and microscopical research as a means of pleasurable occupation, but who pursue it not as mere dilettanti, but in the spirit in which I recommended it to you in my opening address. The value to one's self, and the interest, I think, of microscopic study, are greatly raised by a systematic pursuit of some limited department, after having qualified the mind by a general logical study to appreciate the importance of a larger acquirement of biological information, obtained, it may be, by books, but as much as possible by actual observation. But the taking up of a particular group of natural history—which, as I then explained to you, one is sometimes directed to by mere accident—the taking up a special group and working that group as thoroughly as the individual's means of research permit, that is the way in which science is benefited, and I can assure you that it is the way in which the pleasure and advantage of microscopical research to the individual are most felt —much more than by the mere dilettante pursuit of this, and that, and the other study, which lead to nothing.

Mr. Michael is, I believe, engaged during a large part of his time in business—professional work—which has nothing whatever to do with any department of biology, but he has devoted himself

for many years to the study of one particular group, the *Oribatidæ*, and yet from observations I have heard from him, here and elsewhere, it is quite clear that he has obtained a very large amount of general biological information, which gives him an interest in knowing what is going on in other departments; but it is the special study of the *Oribatidæ* which has gained for Mr. Michael great credit amongst naturalists, and which has added very considerably to our knowledge of an extremely curious and interesting group.

Now with regard to the communications which have been made during the present year, I would just mention two in especial; one the communication made to us by Mr. Buffham, on the conjugation of *Rhabdonema*. Those who were present on the night on which that communication was made will remember that I then made some remarks upon it, which I need not now repeat. I would only say at the present time that the peculiar phenomenon which Mr. Buffham believes to have taken place—he has not actually observed it, remember—is the most singular thing that we know, if it does occur as he believes, and I do hope that he, or some one else, will follow up those observations, and will be able to produce further evidence that the interpretation he has put upon them is the correct one. Everyone who is familiar with any department of natural history study will know that you may see a thing with the ordinary eyes, but, as it were, you have to see it with the mental eye also, and that you may be perfectly correct in describing what you see if you merely describe it or draw it, and yet you may be quite wrong in the interpretation you put upon it. Now I may refer to myself as a "dreadful example." When I brought out my Memoir on the "Structure of Shells," now about 40 years ago, nobody doubted at all that I was correct in the interpretation which I put upon what I saw. The plates of that memoir, published in the British Association's Proceedings for 1844—of which, if there is not a copy in the library, I shall be happy to give a copy—for lately these old Proceedings have been given away, as it were, by the Council of the British Association, and I secured a few copies of the two volumes containing those memoirs. There are 20 plates in the first, and 20, I think, in the second, published in 1847. There is not a single thing in those plates which I cannot show; they were drawn by the best microscopical draughtsman of the time—Mr. Leonard; but the interpretation I put upon

them now is very different. What I and everybody else believed were cells in those days, we do not believe are cells at all now; and what I believed were vessels, prove in many instances to be parasitic growths in the substance of the shell. That shows the difference of interpretation in the things you actually see, and it shows you how important it is to distinguish between the two — the things you see with the bodily eye, so to speak, and the things you see with the mind's eye. In those days everybody was finding cells everywhere. It was just the beginning of the cell doctrine, and when the cellular structure of the epidermis of the higher animals was discovered, of course the very natural inference was that the things corresponding with the epidermis—the epidermic skeleton—would be proved to be cellular also; and the evidence seemed quite satisfactory, and yet now that evidence is found to bear a very different interpretation. You know the old saying, that a wise man changes his mind as often as he sees occasion for it. I have never stuck to an error when I really felt there was sufficient ground for changing my opinion, and, therefore, in the later editions of my book on the microscope, I have given what I believe to be the true interpretation of these appearances. So it is quite possible that the appearances described by Mr. Buffham may be susceptible of some other interpretation. I very cordially hope that these observations may be followed up through successive seasons until it shall be shown that there is only one interpretation, whatever that may be, put upon them.

Now, I have a few remarks to make upon another communication, which we had from Mr. Lowne on the structure of the eyes of insects. It was not my good fortune to be present at more than just the conclusion of that communication, but I knew Mr. Lowne's views on the subject; and I have since read the last paper which he communicated to the Linnæan Society. It was with very great regret that, just about Easter, I read in the columns of "Nature" a strong condemnation of this paper, and of the want of proper knowledge on the part of the Council of the Linnæan Society, which had induced them to publish it; and this, from one of the ablest of the younger school of naturalists, Professor Ray Lankester, of whom I wish to speak with every respect as to his great ability, his large contributions—most important contributions —to various departments of biological research; whose father was an old fellow-student of mine in this very building, and was to the

time of his death a valued friend. But I should take that letter of Professor Ray Lankester as just an example of what scientific criticism ought *not* to be; and I do not hesitate to say this to you, because I have said exactly the same thing in private to Professor Ray Lankester himself. I happened to be staying, at the time when I read it in "Nature," with my friend, Professor Allman, formerly of Edinburgh, who now resides at Parkstone, and with whose extremely valuable contributions to various departments of study—of the lower animals especially—many of you are doubtless familiar. Professor Allman is a man of very wide attainments, both in botany and zoology; who commands the respect of everyone who knows him; who has been a most able teacher in Edinburgh, where he held a Professorship of Zoology for many years, and who still is cultivating this science. He is working out the hydroid polypes of the chalk formation, and everything that Professor Allman has done has been done extremely well, and done in the very best spirit as a man. He entirely agreed with me in my great regret at the tone and the manner of Professor Ray Lankester's criticism. Now, I believe Mr. Lowne is right scientifically. I have gone into the subject a little since. I have not seen Mr. Lowne's preparations, but I have conversed with those who have, and I have seen the most important recent German memoir upon this subject. The point under discussion is, what is really the retina of the eye? what is really the position of it? Mr. Lowne says there is a distinct membranous layer that cuts off the nerve filaments from passing to what others consider the true retina. Now, I put aside altogether the question whether Mr. Lowne is right or wrong, but Mr. Lowne has been a very good worker, we all know. He was the first who introduced or applied the more modern methods of microscopical research to the investigation of the eyes of arthropods. I very well remember the valuable paper which he contributed to the Royal Society a good many years ago. We all felt that it was a very great advance upon previous knowledge, and a great advance in the method of investigation; and, therefore, I think that anything that Mr. Lowne brings forward as the result of his later investigation upon this subject is to be received and treated with respect. We may differ from him, we may think that he has made a mistake, that he has misinterpreted what he sees, or that his preparations do not accurately show what can be shown; but I do think that it is not for anyone to say dicta-

torially that Mr. Lowne is absolutely and clearly wrong; and I wish to put it upon record that I have a very strong objection—derived from the habit of a life and a considerable experience in criticism—I have a very strong objection to the assumption by anyone of the tone, "I am Sir Oracle, and when I ope my mouth let no dog bark." As I have said before, I do not wish in any way—in the least degree—to detract from the valuable work which Professor Ray Lankester has done, or from the very great respect in which I hold any opinion of his in this matter, or any other matter of the kind; but I do not think that any worker who is really honestly endeavouring to add to our knowledge of a very difficult subject should be, if I may so speak, "snubbed" in the way Mr. Lowne has been snubbed.

I do not think, gentlemen, that I have anything special to add with regard to the proceedings of this year. I believe they have been quite up to the average of good work, and I have every reason to believe that, under my successor, that average is likely to be increased, and raised rather than lowered.

I may just mention one or two directions in which scientific inquiry, I think, may very well be prosecuted by those who have the opportunity for it. One is a subject in which I take myself a very great interest—the question whether the bacteria (a proper knowledge of which is becoming of increased importance in every-day life) whether the bacteria have permanent specific forms, and not only specific forms, but distinctive potencies, which some naturalists, very careful observers, are disposed to attribute to them, or whether they are capable of being modified by culture or by natural influences so as to change their potency—to diminish or increase it, or altogether alter their characters. Now, I have always been one, as many of you may be aware, who has taken the view of the very wide range of species, especially among the lower types of animal and vegetable life. I was led to this very early, and I expressed it five-and-forty years ago; and everything I have seen and known since has increased my conviction that we must always make great allowances for external influences, and the greater allowance in proportion, so to speak, as the vital force is less—that is to say, as there is less power in the germ itself to withstand the influences of external conditions. Since we have come to connect this kind of bacteria growth with the production of diseases, a great number of things have come to be explained,

or at least to be made probable, which were previously considered mere curiosities, as it were. I allude to those very curious bastard forms of disease which are observable from time to time, the forms connecting different diseases with each other—diphtheria and scarlatina for instance, or scarlatina and measles. The manifestation of particular disease germs may be extraordinarily affected by the condition of the body in which they fructify. The small-pox of 200 years ago was a very different disease from the mitigated small-pox propagated by inoculation, before vaccination came into use—the old malignant type of small-pox, in which patients died within a few days after taking the disease, frequently before any eruption appeared at all, but with large patches of sub-cutaneous effusion—purpuric effusion—under the skin, that was known as the black-pox, which was described 250 years ago as having ravaged continental Europe with a severity even greater than the plague. That black-pox was prevalent in this country, as we learn from medical writings, and not only medical but historical, or the writings of the ordinary chroniclers of the times—that black-pox was prevalent, carrying off whole families sometimes, and the accounts given show that it was one of the most horribly loathsome of all diseases. Now, in the treatises on small-pox written by the best observers during the present century, that malignant small-pox is mentioned merely as a form which may show itself once now and then, but of which nobody has ever seen an epidemic in this present century, and my belief is that the effect of inoculation with small-pox was to eliminate this, because inoculation was only practised when a favourable epidemic of small-pox—that is an epidemic in which these malignant cases did not occur—was prevalent, and the cases selected for taking the virus from were mild cases, and that in that way everybody being inoculated with the small-pox, except in out-of-the-way country places, the malignant form, as it were, died out. It was, in fact, as in a somewhat similar way, getting rid of that malignant form, as Pasteur's inoculation of sheep gets rid of the malignant *chabon*. It is on record that the mortality of small-pox towards the end of the last century, when protected by inoculation, was often not more than one in 100. I have lately seen a paper, which was communicated to the Society of Arts a few weeks ago, on inoculation as practised among some of the hill-tribes of India not more than 20 years ago, and there the result seems to have been the same.

It had been traditionally practised there a great many years, centuries perhaps, and it had brought down the mortality from small-pox to a very small figure indeed; that had been superseded by vaccination, and under the very able administration of the medical officer of this district, the native prejudice against vaccination had been removed, and the mortality from small-pox brought down to next to nothing. But see what occurred during the siege of Paris in 1870. There had been a very severe outbreak of small-pox in Paris in the early part of the year, before the war broke out. In the civil population of Paris—not the military—vaccination had been very much neglected—re-vaccination especially; there was no authoritative performance of it excepting in the military; and in the French Army—the regulars—it had been on the whole very satisfactorily performed or kept up; and positively in June of that year, when there were more than 1,000 cases—deaths—from small-pox in that one month, in the civil population of Paris, there was an entire absence—such a complete absence of small-pox in the large garrison of Paris that the small-pox ward of the military hospital was closed. Then came the war; then came the replacement of the old soldiers of the garrison of Paris, who were wanted elsewhere, by levies hastily got together. There was a great deficiency of vaccine matter—many of these had never been vaccinated, and many more not been re-vaccinated; then came the shutting up of Paris as the German Army drew near, the crowding of the military hospitals, a very insufficient supply of food, and that not of a good quality—a kind of feeding that was liable to induce land scurvy, and what was the consequence? In November, 1870, there were, I think, about 120 cases of the malignant form of small-pox in the large small-pox hospital, which it had been necessary to institute—the old hospital of the Bicêtre. The reporter of this, Dr. Couran, who is now, I believe, at the head of the medical service of the Army, says that there has been no such epidemic of this malignant type of small-pox during the last century in Europe. Now observe, if you did not know that these patients had been subjected to small-pox infection, and if sometimes the case did not go on to develop the eruption—if they had all died before the eruption appeared, as they very commonly did die after the 5th or 6th day after the infection, we should not have known these two diseases to have been the same, so completely and entirely different were they in their types, and yet it was clearly small-pox infection

modified in its mode of manifestation by the constitutional condition of the patients. Now, my own belief is that there is a very large amount of this modification, and that there is a very large range of forms of disease that may be produced by the same infection; that the bacteria, when cultivated, as it were, in the human body, may undergo a very considerable amount of modification in their potentialities, and that they may under some circumstances give rise to one form, and under other circumstances to another form of disease. I worked out this view about a year and a half ago in a paper which I published in the "Nineteenth Century," which I daresay is accessible in some library to any of you who care to learn my views upon it. I may say that since I have published that paper I have had a very large amount of evidence sent to me kindly by various practitioners in the country, as to the variety of manifestations of what was clearly the same contagion, and these facts all fall in with my general natural history notions, you observe, formed from the experience of a life; for I may say that whenever I have come across a man who has attended to one particular groove—plants or animals—I have inquired about range, and have always learned it was a great deal wider than books would lead you to suppose—that you may have specific descriptions, but that these specific descriptions are liable to very considerable modification—I should say the types are liable to very considerable modification. Now this is a very important consideration, and I may say that there Professor Ray Lankester has performed good service in the careful study that he made some years ago of the form of these bacilli. That study is contained in the "Microscopical Journal"—not the "Journal of the Microscopical Society," but the "Quarterly Microscopical Journal"—and I believe that the varieties that he described in that—the variation of form—have been quite confirmed by many who have made a special study of bacilli. To my mind the variation of form and the variation of potentiality constitute one of the most interesting subjects of biological inquiry at the present time; and there is just one other very curious point in which microscopical evidence is wanting to complete a most interesting scientific research. Many of you know, I have no doubt, that the process of what is called nitrification, or the production of nitric acid, has long been one of the problems of chemistry. Of course we all know that nitric acid can be produced by passing a succession of electric sparks through a mixture of nitro-

gen and oxygen—common air, even—but still more, nitrogen and oxygen mixed in the proportion which produces nitric acid. Every thunderstorm probably produces a certain small amount of nitric acid in the air, but it is in the soil, you know, that nitric acid seems to be produced, and Mr. Waddington, the son of my old friend Mr. Waddington, of the old Microscopical Society, has published, a few months ago, a most interesting paper, which has made a great impression upon some of our most able chemists, leading to the conclusion that this nitrification is a result of the action of some protophyte. He has not been able to discover it microscopically, but the experimental evidence is so strong that I think there is very little doubt entertained by some of those to whom I have spoken on the subject as chemists—extremely good judges—that some minute organism is the real agent in producing this most important conversion.

Now, gentlemen, I feel that I have exhausted the little strength that I had, and I therefore must wish you farewell. I do so with great regret at my own shortcomings, but with every hope for the future welfare and prosperity of the Club.

Q.M.C. EXCURSIONS.

List of Objects Found on the Excursion to Esher, By Messrs. J. Funston and R. T. G. Nevins.

Sept. 6th, 1884.

DESMIDIACEÆ.
Closterium.
Micrasteria rotata.
DIATOMACEÆ.
Nitzschia.
Pinnularia.
Pleurosigma Spencerii.
CRYPTOGAMIA.
Marchantia polymorpha.
PHANEROGAMIA.
Drosera rotundifolia.
Hypericum elodes.
Peplis portula.
Scutellaria minor.
INFUSORIA.
Actinophrys Eichhornii.
Peridinium, sp.
Stentor Mülleri.
Trachelius ovum.
Vaginicola crystallina.
COCCIDÆ.
A white Coccus on an Agaric.

The day was very wet, and only three members went on this excursion.

List of Objects Found on the Excursion to Hale End, By Messrs. W. G. Cocks, J. D. Hardy, R. T. G. Nevins, C. Rousselet, J. Spencer, and A. Wildy.

Sept. 20th, 1884.

ALGÆ.
Protococcus viridis.
Uroglena volvox.
Volvox globator.
,, ,, in an abnormal mucoid condition.
DESMIDIACEÆ.
Closterium lunula, moniliferum, and others.
Desmidium Swartzii.
Micrasteria rotata.
DIATOMACEÆ.
Navicula.
Pinnularia oblonga.
INFUSORIA.
Amœba, a very large species.
Anthophysa Mülleri.
Arcella dentata.
,, *vulgaris.*
Bursaria vernalis.
,, *truncatella.*
Carchesium polypinum.

INFUSORIA.

Coleps hirtus.
Difflugia proteiformis.
Dinobryon petiolatum.
Enchelys nodulosa.
,, ,, in process of subdivision.
Euglena (viridis?) with bifurcate tail.*
Epistylis anastatica, attached in tufts to *Dytiscus marginalis.*
Hemidinium nasutum.
Loxophyllum mileagris (or *Chilodon cucullus*).
Peridinium tabulatum.
Phacus longicanda.
Rhipidodendron Huxleyi.
Spirostomum ambiguum.
Stentor niger.
Stylonichia mytilus.

HYDROZOA.

Hydra viridis.

ROTIFERA.

Anuræa culeata.
Brachionus Bakeri, & others.
Cephalosiphon limnias.
Floscularia cornuta.
,, *ornata.*
Lymnias ceratophylli.
Noteus quadricornis.
Notommata clavulata.
Polyarthra trigla.
Rotifer vulgaris.
Salpina.
Scaridium longicaudum.
Squamella bractea?
Stephanoceros Eichhornii.
Triarthra longiseta.

COLEOPTERA.

Dytiscus marginalis.
Gyrinus natator.

DIPTERA.

Corethra plumicornis. Larva.

HEMIPTERA.

Nepa cinerea.

Twelve members of the Club, and four members of the Hackney Society, attended this excursion, which was a very successful one. Two remarkable objects were found, one an enormous amœboid, and the other a rare rotifer, *Notommata clavulata.*

List of Objects Found on the Excursion to Richmond Park, By Messrs. J. D. Hardy, C. Rousselet, and A. Wildy.

October 4th, 1884.

CONFERVOID ALGÆ.

Lyngbya muralis.
Rivularia angulosa.
Spirogyra quinina.

DESMIDIACEÆ.

Closterium, sp. very minute.
Closterium lunula.
Cosmarium margaritiferum.
Didymocladon furcigerus.
Pediastrum, sp.
,, *granulatum.*
,, *pertusum.*
Scenedesmus quadricauda.

* The *Euglena* with "bifurcate tail" which was found by Mr. Hardy, is probably *Chlorogonium euchlorum*, Ehr., the distinctive characters of which are—"a red eye-spot, a tail, and two anterior filaments."

INFUSORIA.

Anthophysa vegetans.
Arcella vulgaris.
Carchesium polypinum.
Cothurnia.
Difflugia proteiformis.
Dileptus folium.
Epistylis grandis.
Euglypha alveolata.
Monads, collared.
Ophrydium versatile.
Vaginicola crystallina
Vorticella, with short thick stem, much branched.

HYDROZOA.

Hydra fusca.

ROTIFERA.

Cephalosiphon limnias.
Dinocharis tetractis.
Floscularia regalis.
Limnias ceratophylli.
Melicerta ringens.
Scaridium longicaudum.
Stephanoceros Eichhornii.

ENTOMOSTRACA.

Alona ovata.
Cypris reptans.
Daphnia male, very large body, 2 mm. long.
Sida crystallina.

Mr. Rousselet reports finding the new and beautiful *Floscularia regalis*, which was described and figured in the Journal of the Royal Microscopical Society.

Eight members of the Club, and one member of the South London Society, attended the Excursion.

List of Objects Found on the Excursion to Hackney Marshes By Messrs. J. Funston, J. D. Hardy, G. E. Mainland, and C. Rousselet.

October 18th, 1884.

CONFERVOID ALGÆ.

Oscillatoria.
Spirulina oscillatorioides.

DESMIDIACEÆ.

Closterium acerosum.
,, *lunula.*
Cosmarium tetraophthalmum.
Scenedesmus quadricauda.

DIATOMACEÆ.

Navicula, several species.
Stauroneis, sp.

INFUSORIA.

Arcella vulgaris.
Carchesium polypinum.
Chilodon cucullus.
Dileptus folium.
Euglena acus.
Euplotes vannus.
Paramecium aurelia.
Stentor Mülleri.
,, *polymorphus.*
,, *viridis.*
Stylonichia.

The foul state of the River Lea, and the Lea and Stort Navigation from sewage deposit, prevented many objects usually found therein from being obtained.

List of Objects Found on the Excursion to the Gardens of the Royal Botanic Society of London. By Dr. M. C. Cooke, Messrs. E. Dadswell, C. G. Dunning, H. E. Freeman, H. G. Glasspoole, G. E. Mainland, R. T. G. Nevins, F. Oxley, H. W. Parritt, C. Rousselet, and G. E. Western.

18th April, 1885.

FUNGI.

Ceuthospora lauri, Fr.
Diaporthe resecans, N.
Phoma leucostigma, D. C.
,, *ligustrina*,* S.
,, *stiticum*, B.
,, *vulgaris*, S.
Rabenhorstia rudis, Fr.

DESMIDIÆCEÆ.

Closterium acerosum.
,, *lunula.*
,, sp.
Docidium, sp.
Pediastrum Boryanum.
,, *granulatum.*
,, sp.
Raphidium falcatum (*Ankistrodesmus falcatus*)
Scenedesmus obliquus.
,, *quadricaudata.*
,, sp.

DIATOMACEÆ.

Cocconema lanceolatum.
Cocconema sp.
Encyonema cæspitosum.
,, sp.
Epithemia, sp.
Fragillaria, sp.
Gomphonema geminatum.
,, sp.
Melosira nummuloides.
,, sp.
Navicula, sp.
Pinnularia, sp.
Pleurosigma Spenceri.
,, sp.
Synedra radians.
,, sp.

ALGÆ.

Botryococcus Braunii.
Cladophora glomerata.
Nostoc commune.
Oscillaria, sp.
Protococcus viridis.
Spirogyra, two sp.
Tetraspora lubrica.

* Determined for the first time as British.

PROTOZOA.

Acineta mystacina.
,, sp.*
Acineta stage of *Opercularia articulata?*
Actinosphærium Eichhornii.
Actinophrys sol.
,, three sp.
Another rhizopod much smaller than *A. sol*, having numerous moniliform rays.
Actinophrys stage of *Vorticella microstoma?*
Amœba princeps.
,, sp.
Arcella vulgaris.
Coleps hirtus.
Cothurnia unberbis.
Dileptus folium.
Epistylis anastatica.
,, *flavicans.*
,, *grandis.*
,, *nutans.*
Euplotes charon.
,, *patella.*
Opercularia (epistylis) nutans.

PROTOZOA.

Phacus (Euglena) longicauda.
Phacus sp.
Sphærophyra sol.
Stentor cœruleus.
,, *Mülleri.*
,, *polymorphus.*
,, sp.
Trachelius ovum.
Tracheolerca olor.
Trichodiscus sol.
Vaginicola crystallina.
,, sp.
Vorticella campanula.
,, *nebulifera.*
,, *spectabilis.*
,, sp.
Zoothamnium arbuscula.
,, sp.

PORIFERA.

Spongilla, sp.

CŒLENTERATA.

Hydra viridis.
Limnocodium (craspedacustes) Sowerbii.

ROTIFERA.

Anuræa curvicornis.
Brachionus amphiceros.
,, *urceolaris.*
,, sp.
Callidina elegans.
Chætonotus larus.
Enteroplea hydatina.
Eosphora digitata.
Euchlanis triquetra.
,, sp.
Floscularia cornuta.
,, *ornata.*
Lepadella, sp?
Limnias ceratophylli.
Mastigocerca carinata.
Monocerca rattus.
Notommata hyptopus.
Œcistes crystallinus.
,, *umbella.*

* A curious species having the tentacles in bundles of five or six, proceeding from a common point and extending to different lengths in close opposition, having the appearance of single knotted tentacles.

ROTIFERA.
Philodina erythropthalma.
,, sp.
Pterodina patina.
Rotifer vulgaris.
Synchæte, sp.
Triarthra longiseta.
TARDIGRADA.
Macrobiotus Hufelandii.
ANNELIDA.
Anguillula, sp.
Nais, sp.

ENTOMOSTRACA.
Canthocamptus minutus.
,, sp.
Chydorus sphæricus.
Cyclops quadricornis.
,, *tenuicornis.*
,, sp.
Cypris fusca.
,, sp.
Daphnia pulex.
MOLLUSCOIDA.
Fredericella sultana.

The day was very fine. About sixty-two persons attended the Excursion, of whom 14 were members of other Societies, or friends.

FREDK. A. PARSONS,
Hon. Sec. Excursions Sub.-Com.

PROCEEDINGS.

April 10th, 1885.—Conversational Meeting.

The fifth and last of the series of demonstrations was given by Dr. W. B. Carpenter, C.B., F.R.S., &c., &c., the subject being the structure of the skeleton of the Echinodermata.

He was assisted by Mr. Lewis Wright, who exhibited on a screen, by the aid of the new patent gas microscope, some beautiful photographs and microscopic preparations of echinoderms, spine sections, spicules, &c., illustrating the lecture.

The following objects were exhibited in the library:—

Section of Cocoanut shell...	Mr. F. Coles.
Bacillus anthracis, with spores	Mr. W. J. Curties.
Eggs of Vapourer moth	Mr. F. Enock.
Diatoms, *Biddulphia granulata*	Mr. H. Morland.
Cholera *Bacillus*	Mr. E. M. Nelson.
Polyxenus lagurus...	Mr. C. Rousselet.
Type slide of 50 Diatoms	Mr. W. Watson.

Attendance—Members, 55; Visitors, 7.

April 24th, 1885.—Ordinary Meeting.

A. D. Michael, Esq., F.L.S., F.R.M.S., Vice-President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

Mr. A. E. Russell was balloted for and duly elected a member of the Club.

The Secretary read a letter which had been received by Mr. Hailes, the Hon. Sec. for Foreign Correspondence, intimating that in recognition of the courtesies extended to their Secretary during his recent visit to England he (Mr. Hailes) had been elected an Honorary Member of the Denver Microscopical Society.

The following donations were announced:—

"Proceedings of the New York Microscopical Society"	From the Society.
"Proceedings of the Canadian Institute of Toronto"	,, ,,
"The American Naturalist"	In exchange.
"Proceedings of the Royal Microscopical Society"	,, ,,

"Quarterly Journal of Microscopical Science" ...	Purchased.
"Annals of Natural History"	,,
"Seven Slides in illustration of Mr. Cheshire's paper on the Anatomy of the Bee ...	From Mr. Enock.

The thanks of the meeting were unanimously voted to the donors, and on the motion of the Chairman a special vote of thanks was passed to Mr. Enock for his valuable addition to the Cabinet.

A paper by the Rev. G. J. Burch, "On a New Flagellate Infusorian," was read by the Secretary.

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

Mr. F. R. Cheshire gave a *resumé* of his paper "On the Economy of the Hive Bee." Commencing with a description of the formation and varieties of the cell, the life history of the bee was traced from the egg to the mature condition, in the cases of workers, drones, and queens, details being given as to the different periods and other circumstances peculiar to each. The subject was treated in a very interesting and popular manner, and was illustrated by a number of beautifully-executed diagrams, showing the anatomy of these insects.

The Chairman, in inviting remarks upon the subject, said it was certainly a matter of extreme interest to hear a subject discussed in so popular a manner, by a gentleman so well qualified to undertake it from his thorough acquaintance with the economy and the anatomy of the bee, down to its very minutest details. With regard to the casting of the skin of the alimentary canal, this was a matter not in any special way confined to the bee, but belonged also to other larval forms, in which the casts were sometimes effected with such perfection that details could often be made out through them which could not be seen in other ways. He did not know that it was necessary to press the lining of the alimentary canal into service in order to explain how the cast skin filled the cell, because as it was cast during the growing period it would be extremely elastic, as compared with the skin of the adult insect, and would therefore always cover a much larger space than it occupied before separation. He was sure that the members would feel greatly indebted to Mr. Cheshire, especially as they could so thoroughly rely upon the information received.

Mr. Hammond called attention to the fact that the eyes of the drone were larger and more prominent than those of the bee, occupying so large a space, indeed, as to meet at the top of the head. This was also observed to be the case with the male blow-fly, and he inquired if it was common to the males of other insects, and if so, for what probable reason?

Mr. Cheshire said that theory would account for it by the fact that the queen seldom mated with a drone from her own hive, and as the drones had to follow the queen by sight on the wing they would need acute eyes—for similar reasons, no doubt, the queen had small wings as compared with the drone.

The Chairman said it was not only in the case of flies, but also in the hymenoptera that this kind of variation was to be observed, both as regarded

the eyes and the antennæ—for if the antennæ were set wider apart the eyes must of course be wider also; or, on the other hand, if the approximation of the eyes was altered the position of the antennæ must be varied accordingly.

Mr. Nelson inquired what was represented by a red spot shown on the top of the head of the bee in the diagram?

Mr. Cheshire said it was one of three simple eyes, or ocelli.

Dr. Matthews asked if Mr. Cheshire could give them any reason for the high temperature which had been observed to exist in bee hives?

Mr. Cheshire said this was rather a question for the chemist than the naturalist, but it appeared to be due to the constant oxydation of sugar; the honey collected consisted mainly of cane sugar, which was gradually converted into grape sugar, in the process of which a large amount of oxydation went on. The behaviour of the bees was peculiar under different conditions of temperature—at 40° they were quiet, but if it fell below that they kept moving, and at 0° their movements were much more active, and they kept moving their wings as if in this way to keep up the temperature.

Mr. E. M. Nelson read a paper "On the Pygidium of the Flea," in the course of which he stated that he had taken up this object from a "brass and glass" point of view, because he found it was referred to in the "Micrographic Dictionary" eight or nine times as a test object, whereas he found that the so-called hairs were spines, which formed nothing that could be called any sort of test for a high power objective. If, however, they would take some of the hairs which were found on the proboscis of a blow-fly, they would find that one of the finest things they could see was the ultimate end of one of these hairs. In answer to the question, what was the Pygidium? he was inclined to regard it as an auditory apparatus. There were some round holes which he thought were probably the ends of eustachian tubes, and the filaments or hairs would no doubt be of use in catching and communicating sonorous vibrations.

Mr. Michael said he had seen Mr. Nelson's method of exhibiting these objects, and could therefore vouch for the accuracy of his descriptions. With regard to the suggestion that the Pygidium might be an auditory apparatus, though it might seem to be a somewhat unusual position for such an organ, yet the position of the flea's head when feeding was such that any organ situated there for the purpose of hearing would be disadvantageously placed for the purpose.

The thanks of the meeting were unanimously voted to Mr. Cheshire and Mr. Nelson for their communications.

Announcements of meetings for the ensuing month were then made, and the proceedings terminated with the usual conversazione, when the following objects were exhibited:—

Water mite, *Atax apsilophora*	Mr. F. W. Andrew.
Lophopus crystallina	Mr. C. G. Dunning.
Aquatic worm	Mr. H. E. Freeman.
Larva of *Chironomus prasinus*	Mr. A. Hammond.
Fly, with parasite attached	Col. O'Hara.

Limnocodium Sowerbii	Mr. G. E. Mainland.
Diatoms, *Mastogloia angulata*	Mr. H. Morland.
Limnocodium Sowerbii	Mr. C. Le Pelley.
Fredericella	,, ,,
Medusa	,, ,,
Diatoms, *Epithemia* sp.	Mr. C. Upton.
Coscinodiscus sol.	Mr. G. C. Wallich.

Attendance—Members, 58; Visitors, 5.

May 8th, 1885.—Conversational Meeting.

The following objects were exhibited in the library:—

Zoophyte, *Phalansterium digitatum*	Mr. F. W. Andrew.
Legs of various Bees	Mr. F. Enock.
Sprouting Apple Pip	Mr. H. Epps.
Mouth of *Balanus*	Mr. F. Fitch.
Palate of *Trochus*	Mr. W. M. Holmes.
Æcidium and Uromyces on *Ranunculus ficaria* ...	Mr. G. E. Mainland.
Diatoms, *Navicula Trevelyana*	Mr. H. Morland.
Diatoms, *Navicula Lyra*	Mr. E. M. Nelson.
Corethra plumicornis...	Mr. R. T. G. Nevins.
Diatoms, *Porpeia ornata*	Mr. G. Sturt.
Spicules of Gorgonia, and Holothuria	Mr. W. Watson.
Spinnerets of Garden Spider	Mr. J. Willson.

Attendance—Members, 48; Visitors, 8.

May 22nd, 1885.—Ordinary Meeting.

Dr. John Matthews, F.R.M.S., Vice-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. Henry Buckland, Mr. John W. Clinch, Mr. P. W. Pocock, Mr. W. Rhein, and Mr. Thomas Williams.

The following donations to the Club were announced:—

"Proceedings of the Royal Dublin Society" ...	From the Society.
"Proceedings of the New York Microscopical Society"	,, ,,
"Proceedings of the Botanical Society of Edinburgh"	,, ,,
"Transactions of the Royal Dublin Society" ...	,, ,,
Six Slides of Parasites	,, Mr. Freeman.

The thanks of the Club were unanimously voted to the donors, especially to Mr. Freeman for his valuable addition to the Cabinet.

Mr. E. M. Nelson described some experiments which he had been making with the binocular microscope. He had long thought that the binocular did not give images so good as the monocular, and he had endeavoured to find out how this came about, and to remedy it if possible. He obtained a

Wenham prism of good quality, and had it properly fitted; then, finding that the left tube was rather longer than the right, he had the eyepieces differently focussed to suit, having them so marked as to be able to tell the one from the other. Having done this, he found that matters were improved, but that there was still something more which required a remedy. To test it he took one of the fine bristles from the maxillary palpi of a blow-fly, but he found that no kind of illumination would make it appear sharp if it were placed on the stage in a vertical position, but if it were placed horizontally across the prism it was perfectly shown. Another experiment was in respect of the stereoscopic effects obtained when the object was in different positions, and the object selected for this purpose was the central pseudo-trachea of the proboscis of the blow-fly. On examining this he found that when it was placed in a vertical position, there was no difference between the stereoscopic effect with and without the prism, except as regarded the marginal portions of the field, where the eyes were to a certain extent deceived, but when the object was placed horizontally a strongly stereoscopic effect was produced. On the central membrane of the trachea there were a number of small spines, which formed excellent test objects, and if these were placed vertically they appeared foggy, and nothing could be clearly made out about them; but when seen in the horizontal position their appearance was so changed that it was hardly possible to recognise them as the same objects. In his specimen there was a slight dip or depression in one part of the membrane, which could not be perceived under any illumination with the monocular, but under the binocular, in a horizontal position, it was perfectly well seen, though the same instrument failed entirely to show it when the major axis of the lips was in a vertical position. He wished to draw the attention of the members of the Club to these matters, in the hope that someone might be able to find out the cause of the difference and to suggest a remedy.

Professor Charles Stewart said that Mr. Nelson's attention appeared to have been chiefly directed to the effects produced upon lines. He should, therefore, like to ask if he had tested the effects also by points or discs, so as to ascertain if a circle had any tendency to become elliptical in a horizontal direction? because, though such an effect might be due to some quality of the instrument, it might also be explained by supposing it to be due to astigmatic vision.

Mr. Nelson said he had not examined points in the same way, but he had experimented with diatoms and found the difference in the stereoscopic effects to be surprisingly marked, especially in the case of *Heliopelta*.

Mr. Karop thought the effect was probably astigmatic, though it possibly might be due to some optical cause, and enquired if Mr. Nelson had made his experiments with more than one prism, as perhaps there might be some defect in this particular prism.

The Chairman said that, as regarded the difference in the length of focus of the left hand tube, he might mention that Messrs. Powell and Lealand always marked their eyepieces R and L, each being compensated for the length of the tube they were intended for. However perfect a prism might

be, it would have some variations in density, the effects of which would be greatly aggravated by striæ; he believed it was absolutely impossible to get one uniformly dense throughout. As to the appearance of the hair, he thought this was very likely a question of the angle of the lens. Dr. Carpenter had recommended for the purpose a low-angled ½in.

Mr. Hardy understood Mr. Nelson to say that some of these appearances were equally seen with the monocular; if so, had he tried rotating the object glass so as to ascertain if the fault was in any way due to that?

Mr. Nelson said he did not mean to imply that there was anything like this distortion with the monocular, but only that with the binocular the blur was seen in the vertical position of the object. He had tried various objectives, as a ½in. of 80°, a ½in. of 40°, a 1in. of 30°, and a ⅔in. of 35°. He had also tried those of various makers, so that he did not think there was anything in them to cause the error; he had also tried a different prism and several different instruments on the pseudo-trachea. He had noticed an imperfect diffusion of the light as it passed through the prism, and he did not suppose it was possible to put any piece of glass in the course of the rays without affecting them in a greater or less degree.

The Chairman said that in practice a number of prisms were worked together, so as to obtain a better and flatter surface, but he maintained that it was not possible by any process of grinding to produce surfaces which were absolutely flat.

Mr. Hailes said there was one source of error which had not been noticed, and that was that in using the Wenham binocular they looked through the prism with one eye, but not with the other; he should like to hear if Mr. Nelson had tried these experiments with the Stephenson binocular, where there were two prisms, and each eye saw the object under the same conditions.

Mr. Nelson said he had tried the Stephenson binocular and found that there was no image at all worth comparing with that shown by the Wenham instrument, whilst the loss of light was very considerable. For convenience of working it might be a useful form; but he had never seen an object shown by it in a manner he considered worth looking at.

Mr. Parsons gave some account of an organism which he had found at the Royal Botanic Society's Gardens in Regent's Park—he thought it was some kind of *Acineta*, and made a rough drawing of it upon the board in order that the members might be able to assist him in identifying it.

The President having requested the members present to help Mr. Parsons to a diagnosis of the creature, a vote of thanks was passed to him for his communication.

Members were reminded that at the next ordinary meeting they would be asked to nominate and elect an auditor of the accounts, and also to nominate some of their number for election as members of Committee at the forthcoming annual meeting.

Announcements of meetings, excursions, and of the excursionists' annual dinner were then made, and the proceedings terminated with the usual conversazione, and the following objects were exhibited:—

Argulus foliaceus	Mr. C. Dunning.
Rhyncholophus phalangoides	Mr. H. E. Freeman.
Stellate hairs, *Deutzia*	Mr. W. M. Holmes.
Aquatic larva	Mr. G. E. Mainland.
Arachnoidiscus ornata in situ.	Mr. H. Morland.
Cholera bacillus	Mr. E. M. Nelson.
Diatoms, *Cocconeis* sp.	Mr. C. Upton.
T.S. stem of Lime tree	Mr. J. Willson.

Attendance—Members, 44; Visitors, 3.

June 12th, 1885.—Conversational Meeting.

The following objects were exhibited :—

Asplancha Ebbesbornii	Mr. F. W. Andrew.
Nitella tenuissima	Mr. E. Dadswell.
Cyclosis in *Anacharis*	Mr. G. Hind.
Utricularia minor, with captured prey ...	Mr. G. E. Mainland.
Diatoms, *Triceratium orbiculatum*	Mr. H. Morland.
Sponge, *Farrea Occa*, from Japan, showing the veil of spicules	Mr. B. W. Priest.
Chelifer	Mr. C. Rousselet.

Attendance—Members, 38; Visitors, 4.

June 26th, 1885.—Ordinary Meeting.

Dr. Jno. Matthews, F.R.M.S., Vice-President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following donations to the Club were announced :—

"Proceedings of the Royal Microscopical Society"	From the Society.
"Proceedings of the Natural History Society of Glasgow"...	" "
"Proceedings of the East of Scotland Naturalists' Union"	" "
"Journal of the New York Microscopical Society"	" "
"Proceedings of the Chester Society of Natural Science"	" "
"Report of Hackney Microscopical and Natural History Society"	" "
"The American Naturalist"	In exchange.
"The American Monthly Microscopical Journal"	" "
"Annals of Natural History"	Purchased.
"Quarterly Journal of Microscopical Science"	"

The thanks of the Society were voted to the donors.

The Secretary reminded the members present that, in accordance with the rules of the Society, nominations for Officers and Members of Committee for the ensuing year must be made that evening, and that a list of persons so nominated would be printed on the balloting lists and submitted for election at the Annual Meeting on July 24th. It would also be necessary to propose and to elect two Auditors of accounts, in order that they might present their cash statement at the annual meeting. The President and Officers, together with one Auditor, were nominated by the Council, but it was competent for any member to substitute other names at the time of election, if it was desired to do so.

The following nominations on behalf of the Council were then made:—

As President—Mr. A. D. Michael, F.L.S., F.R.M.S.

As Vice-Presidents—Dr. W. B. Carpenter, Dr. M. C. Cooke, Dr. Jno. Matthews, Professor Chas. Stewart.

As Hon. Treasurer—Mr. F. W. Gay.

As Hon. Secretary—Mr. G. C. Karop.

As Hon. Foreign Secretary—Mr. H. F. Hailes.

As Hon. Reporter—Mr. R. T. Lewis.

As Hon. Librarian—Mr. Alpheus Smith.

As Hon. Curator—Mr. C. Emery.

And as Auditor on behalf of the Council—Mr. W. Hainworth, jun.

The Chairman said it was now the duty of the members to propose the name of some gentleman to act on their behalf as Auditor in conjunction with Mr. Hainworth.

Mr. Dobson was thereupon proposed by Mr. Parsons and seconded by Mr. Buffham.

These nominations having been submitted to the meeting, Messrs. Hainworth and Dobson were duly elected the Auditors of the Society's accounts.

The Chairman said their next business was to nominate four or more gentlemen to fill vacancies on the Committee, caused by the retirement by rotation of Messrs. Groves, Hardy, Jacques, and Nelson, who were, however, eligible for re-election if the members thought fit.

The following nominations were then made:—

Mr. E. M. Nelson,	proposed by	Mr. Waller,	seconded by	Mr. Hardy.
Mr. Hembrey,	,,	Mr. Priest,	,,	Mr. Dadswell.
Mr. Freeman,	,,	Mr. Buffham,	,,	Mr. Hailes.
Mr. George Western,	,,	Mr. Parsons,	,,	Mr. Priest.
Mr. Groves,	,,	Mr. Lewis,	,,	Mr. Alpheus Smith.
Mr. W. W. Reeves,	,,	Mr. Hembrey,	,,	Mr. Gregory.

The Secretary said that they had received, through Mr. Kitton, a paper "On the History of some New Diatoms," by Professor Cleve, of Upsala. It was a most valuable contribution, but was, he thought, both too long and too technical to be read at the meeting on that occasion. It would therefore be taken as read, and would be printed *in extenso* in the Journal, so that all would have the opportunity of reading it at their leisure.

The thanks of the Society were unanimously voted to Professor Cleve for his communication.

Mr. R. T. Lewis exhibited and described a new Gauge which had recently been invented for the purpose of readily ascertaining the thickness of wires or plates, and which was capable of indicating the results with accuracy to the $\frac{1}{1000}$ of an inch. He thought perhaps some apology might be needed for troubling them with a matter which was not strictly of microscopical interest, and had not the excuse of being made of either brass or glass; but although, so far as he was aware, its inventor had not intended to apply it to any microscopical purpose, it had been found of use in the measurement of glass slides, cells, and covers, and as such he had been asked to bring it to the meeting. It was really made for the use of electricians and engineers, to replace, with considerable advantage, the old form of wire gauge, which merely consisted of a steel plate having a series of slots cut in the edges, each of which was numbered according to an agreed scale. The article to be gauged was tried in these, and the number of the one into which it most nearly fitted was said to be its "gauge." Recently, the question of gauges had been considered by Chambers of Commerce, and as it appeared that those in common use were often at variance, a new "Standard Wire Gauge" had been agreed upon, and with the sanction and authority of the Board of Trade now superseded the old Birmingham Wire Gauge. The differences between the two were not sufficient to alter the number of the gauge, though when subjected to accurate measurement it would be found that these differences ranged from 1 to 5 thousandths of an inch. For purposes of scientific or international measurement it was frequently desirable to express thickness in fractions or decimals of the inch or millimetre, and the ordinary form of gauge was quite useless for this purpose; there was too much difference between the sizes, and any attempt to measure by means of a ruled standard micrometer would render only imperfect results, even where hundredths of an inch were attempted. The new gauge before them (known as Trotter's Patent) was, however, capable of showing at a glance, and by one operation, not only the Standard Gauge, but the proportional part of an inch to 3 places of decimals, and that of the millimetre to two places of decimals. The instrument was of polished steel, in size 2½in. long and ½in. wide, and made in two pieces which were accurately fitted to slide one in the other by means of a dovetailed groove, the edges of the outer section being milled for convenience of holding whilst the inner slide was being moved. On the lower edge of each section was a scale divided and marked by figures from 6 to 40. The upper edge of the outer section was divided for the space of 1 inch into 10ths and 50ths, and the adjoining space for the length of 1 centimetre was divided into millimetres and halves. The *modus operandi* was explained by means of a diagram, it being simply necessary to open the slide, and having pressed the substance between its jaws, to read off the required measurement from the scales. The Standard Gauge was ascertained by finding which of the two identical numbers on the lower scales were coincident; in the diagram these were the 16's, so that the thickness was determined to be number 16 S.W.G. Turning to the upper 1 inch scale, it was seen that the arrow head of the zero mark was slightly beyond the third division

of the $\frac{1}{50}$ inch graduations, and that the fourth mark of the vernier was coincident with a mark on the scale above, the reading being, therefore, ·064, inch; and proceeding in the same way with the adjoining scale, the reading was found to be 1·62 mm. It was pointed out in further illustration of the ingenuity of the invention that on the reverse side of the instrument there was another scale by means of which the sectional area of a round wire was shown in thousandths of a square inch, and this value would enable the electrician to readily determine the weight per 100ft., the resistance, and the quantity of current which the wire would safely carry.

The communication was illustrated by a diagram, and by the exhibition of the patent gauge, together with a standard micrometer rule, divided to 64ths and 100ths in.; and also one of the ordinary wire gauges by way of comparison.

The Chairman said the contrast between the two gauges was certainly very great, and he could not sufficiently admire the mechanism of the little apparatus before them.

Mr. Hardy had often thought that the fine adjustment of the microscope might generally be used for measuring the thickness of cover glasses. If the screws were always made 50 threads to the inch, then, by focussing at the top and bottom of a cover glass, it would be easy to ascertain by a certain movement exactly the thickness. He had done this roughly himself, but he believed his fine adjustment was at the rate of 60 turns to the inch.

Mr. Hailes said that Smith and Beck always graduated the milled head of their fine adjustment for the very purpose of measuring depth, and had supplied directions in their book to instruct the purchasers how to use it.

The Chairman said that Powell and Lealand also always graduated the heads of their fine adjustments for the purpose of measuring depth.

Mr. Karop said there were many other things made for the purpose of measuring thickness, and although no doubt this gauge might be very useful for some things, he thought thin glass would be very apt to get broken. Zeiss made an instrument especially for the purpose of measuring thin cover glasses. Then there was the old lever of contact; and some time ago a little thing was shown there by Mr. Hensoldt for a similar purpose. The gauge exhibited was no doubt more useful to the engineer.

Mr. Hailes said that the gauge shown by Mr. Hensoldt was the ordinary gauge used for measuring pianoforte wire.

The Chairman said that some years ago he showed what he called a caliper eyepiece, which was a modification of the indicator by Quekett, but each finger-point was curved and was moved by a tangent screw. All that was needed, therefore, was to take up the cover glass with the stage forceps, and to fit its edge into this optical gauge under the microscope.

He also wished to draw attention to a matter which had been under consideration by the Committee, and which they wished to bring before the members of the Club. Members were no doubt aware that it had often happened lately, when the date of a meeting came round they were without a paper, and to meet the inconvenience of this state of things the Committee proposed, if possible, either by notice or agreement, to arrange for some

given subject to be brought forward for discussion, so that members might be able to come prepared to discuss it. He thought there was great value in discussions of this kind, and could say for himself that he never went home from one without feeling that he had learnt something. And if notice were given beforehand, gentlemen would be able to turn their thoughts to the subject, and would come better prepared to join in the proceedings. He asked the members present to take the matter into their consideration, and if it met with approval the Committee would take some steps to put it into shape. It was not right, in his opinion, that any member of the Club who had special knowledge which might be of use to his fellow-members, should keep that knowledge to himself.

The Secretary said that whenever he received notice of any communication *in time*, he always advertised it in a number of papers. It was sometimes complained that no notices were to be seen, but he wished to point out that unless the notice of the subjects reached him sufficiently early it was of course impossible to get them inserted in time for those papers which only appeared at weekly intervals.

Announcements of meetings and excursions for the month were then made, particular attention being called to the Annual Meeting of July 24th, and the proceedings terminated with the usual conversazione, the following objects being exhibited :—

Hydrobia ulva, with embryos	Mr. F. W. Andrew.
Skin of Star-fish, *Uraster rubens*, showing madreporiform tubercle	Mr. Chas. G. Dunning.
Operculum of egg of plant bug from Chili ...	Mr. H. E. Freeman.
Crystals of Santonin	Mr. W. M. Holmes.
Planaria	Mr. C. Rousselet.
Diatoms, *Coscinodiscus excavatus*	Mr. C. Upton.
T. S. Aerial root of *Dendrobium*	Mr. J. Willson.

Attendance—Members, 52 ; Visitors, 7.

July 10th, 1885.—Conversational Meeting.

The following objects were exhibited :—

Section of Thistle, triple stained	Mr. F. W. Andrew.
Chironomus varieganus	Mr. F. Enock.
Stratiomyd larva	Mr. A. Hammond.
Pterotheca aculeifera	Mr. H. Morland.

Attendance—Members, 29 ; Visitors, 3.

July 24th, 1885.—Annual Meeting.

Dr. W. B. Carpenter, C.B., F.R.S., &c., &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. A. G. Sadgrove, Mr. J. A. D. Parker, and Mr. J. L. M. Porter.

The following additions to the Library were announced :—

"The Proceedings of the Geological Association" ...	In Exchange.
"The Proceedings of the Royal Society"	" "
"The Journal of Microscopy and Natural Science" (Postal Microscopical Journal)	" "
"The American Monthly Microscopical Journal" ...	" "
'American Naturalist"	" "
"Bulletin de la Société Belge de Microscopie"... ...	" "
"Geological and Natural History of Canada (Report of Progress 1882-3-4"	Presented.
"Van Heurck's Diatomacie de Belgique"	Purchased.

A short communication from Mr. Kitton "On the Mysterious Appearance of a Diatom," was read by Mr. Hailes.

The President said as there were no remarks made on the paper he would propose a vote of thanks to Mr. Kitton, with the expression of a hope that he would follow up these observations, because the point that he had raised was a very interesting one: whether there are microbes so minute as to pass through a filtering paper that stops particles of emery so small as the 50,000th of an inch. He might mention that, when he was engaged in sounding, bringing up specimens of water from the bottom of the Mediterranean, on which a very fine mud is constantly being deposited, the particles were so fine as to be quite unrecognisable in the ordinary water of the Mediterranean. When this settled down after being diffused by winds and currents, the water brought up from the bottom was quite white, and he found that the best ordinary filtering paper was quite incapable of stopping these particles—they passed through it. He had a particular reason for wishing to clear the water, and it was necessary to pass it through the same filter several times, so that the pores of the paper becoming clogged by that very fine sediment, the water came out pretty clear. The very best filtering paper did allow very fine particles to pass through, as every chemist knows, and it was to be hoped that Mr. Kitton would endeavour to ascertain by repeated experiments whether the appearance of these diatoms was due to the passage of microspores, which we did not know as a general product of diatoms, through the fine substance of the filter.

Announcements of meetings, &c. for the ensuing month were then made and the ordinary meeting terminated.

The meeting was then made special in order to proceed with the business

of the Annual General Meeting, Mr. Mainland and Mr Buffham being nominated by the President as scrutineers of the ballot.

The Secretary read the 20th Annual Report, and the Treasurer his statement of accounts.

Mr. Charters White proposed that the reports just read be adopted. This was seconded by Mr. Waller, and carried unanimously.

The President said while the scrutiny of the ballot was going on, he would wish to express his very great regret at his unavoidable failure to perform the duties of a President on several occasions. When it was first proposed to him to undertake this duty, he rather demurred, on the ground of the uncertainty of his health for the last two or three years. He was, however, assured that the Club would be very glad to have him among them when he was able to come, and at the same time would not grumble if he felt that his own health was a primary consideration with him, and he abstained from coming when he thought it might be a risk to do so. They might remember that on the very first evening he appeared among them he was suffering from a very severe cold, but that was nothing more than a cold and hoarseness, and he took upon himself the risk, but for some three months past nearly, he had unfortunately been the subject of a very depressing complaint, beginning with neuralgia of the head, which left behind it a very considerable depression of nervous power, so that he was obliged to pass a good deal of every day on the sofa, and to take to a course of novel reading instead of anything more instructive. He found that any continuous sustained attention, either in writing or reading, was a very severe trial to him, and that any little over-exertion was sure to be followed by a severe depression. Mr. Karop was kind enough to come and talk over the business of the Society with him a few evenings before. He had seen one or two other friends during the day, and went to bed after Mr. Karop's kind visit very tired, and it was against the wishes of the home-rulers that he had come down that night, but he did feel that it was due to the Club to make a little effort, even though he might be a little more depressed the following day in consequence. He thanked them for their kind reception of him when he had been present, and their indulgence when he had been necessarily absent. He hoped, in fact he felt sure, that the business of the Club had not suffered by his absence, for every member of the Committee, especially the Vice-Presidents and officers, knew the business a great deal better than he did, and he had been in their hands when he had been present. The Club had such an efficient staff that he felt sure the absence of the President could not be in any way seriously felt, and that he had been rather ornamental than useful when he had been present. He would just say, with regard to the contributions of objects for the cabinets, he had hoped to have been able to prepare a set of the typical forms of Orbitolites, with sections and preparations of the animal, but had felt utterly unable to take up the microscope for use during the last three months, and therefore must defer the final arrangements of them until after the vacation, when he hoped to be more set up and prepared for that little effort. He would have a few words to say presently in the way of a short address. This much

was merely personal, to explain the reasons for his shortcoming, and to thank the members most cordially for their kind indulgence.

With regard to the Treasurer's report, it would be observed that the balance at the end of the year (£77 7s. 10d.) was a little less than the balance at the beginning (£100 18s. 10d.), but that was partly due to loss incurred by the failure of Mr. D. Bogue, and partly to the increased amount spent on printing the Journal; but as the Journal was so well filled with valuable information, he was quite sure that they would not regret that it had been so expended. On the other hand, there was an increase in the number of members. The losses had been very much more than sustained by the junction of new members, and therefore he thought they might say that the finances of the Society were in a very sound and satisfactory condition.

The President then announced that the following gentlemen had been elected as officers and members of Committee for the ensuing year :—

PRESIDENT—Mr. A. D. Michael, F.L.S., F.R.M.S.

VICE-PRESIDENTS—Dr. W. B. Carpenter, C.B., F.R.S., &c., &c. ; Dr. M. C. Cooke, M.A., A.L.S., &c. ; Dr. John Matthews, F.R.M.S. ; Prof. Chas. Stewart, M.R.C.S., F.L.S.

HON. TREASURER—Mr. F. W. Gay, F.R.M.S.

HON. SECRETARY—Mr. G. C. Karop, M.R.C.S., &c.

HON. SECRETARY FOR FOREIGN CORRESPONDENCE AND EDITOR OF JOURNAL—Mr. Henry F. Hailes.

HON. REPORTER—Mr. R. T. Lewis, F.R.M.S.

HON. LIBRARIAN—Mr. Alpheus Smith.

HON. CURATOR—Mr. Chas. Emery.

FOUR MEMBERS TO FILL VACANCIES ON THE COMMITTEE—Mr. F. W. Hembry, F.R.M.S. ; Mr. W. W. Reeves, F.R.M.S. ; Mr. E. M. Nelson ; Mr. J. W. Groves, F.R.M.S.

The President then delivered his annual address.

On the close of the address the President left the room, and the chair was occupied by Dr. M. C. Cooke, who said that when he was not expected, perhaps, to have been called upon to occupy the position he did, a resolution was put into his hand which he thought he could not do better than move from the chair. He was sure he should have the cordial support of the Club in this resolution ; it was in effect a vote of thanks to the President who had just left the room, both for his services during the past year and for his remarks that evening. He did not know that he could do better than propose it at once. There were two or three observations which he had intended to have made,—hoping that the President would have been with them a few minutes longer,—and to have noticed some of the views he (the President) particularised. One as to whether bacteria and bacilli were altered in culture as being an important subject for investigation. All those who had spent thirty or forty years in biological study would come to the conclusion that there was a far greater variation in biological objects than was allowed to take place by young beginners, who are too apt to imagine that every variation must constitute a new species. All artificial cultivation should, he thought, always be watched very carefully, as it

tended to develop variation, and results are likely to follow different to the results that are produced in a natural manner, and, therefore, we could not argue safely back again that such results were results actually produced in nature. A reference was made earlier still by Dr. Carpenter to the illustrations that he had produced for some of his own books, and those plates, for which he made drawings some forty years ago, he said were accurate still, and were now of value, but that the inferences that he drew from those plates were all displaced and altered. He (Dr. Cooke) had constantly urged upon young beginners, and old ones too, to draw, draw, draw! To make plates, engravings, drawings. Never mind if they did not say a word about them. Words all change, but let us have faithful representations of objects. During his later years he had applied himself to the production of plates rather than to the writing of books about them. He urged his hearers not to mind whether they gave names to their objects, but to draw them faithfully, accurately, and truly, and they would last all time, whilst their descriptions were old, antiquated, and effete in 10 or 20 years. With these observations, he begged to propose from the chair a vote of thanks for the President's services and for the address he had given that evening.

This was carried unanimously.

Mr. McIntire said he had been requested to propose a vote of thanks to the Committee and Officers of the Club. He knew the services of the officers of the Club in past years—how efficiently they had been rendered; and there was one point which had always distinguished them, but particularly this year, and that was their unselfishness. The ability goes without saying, but the unselfishness had been particularly marked. He begged to propose a vote of thanks to them for their services. This was seconded by Mr. F. W. Andrew, put from the chair, and unanimously carried.

Mr. Buffham proposed a vote of thanks to the Council of University College. This was seconded by Mr. Charters White, and carried unanimously.

Mr. Nevins then proposed a vote of thanks to the auditors and scrutineers. This was seconded by Mr. Rousselet, and unanimously carried; and the proceedings terminated with the usual conversazione.

Attendance—Members, 44; Visitors, 7.

REPORT OF THE COMMITTEE.

JULY 24TH, 1885.

Your Committee have the satisfaction to present a favourable Report on this, the twentieth anniversary of the Club.

The quality of its communications, the interest of the meetings, and the efficiency and utility of the Club generally, have been fully maintained during the past year.

The total number of members is quite up to the average; 36 have been elected, 16 have resigned. Our losses by death are : Mr. W. Ladd, F.R.M.S., Rev. W. Read, M.A., Mr. O. S. Bishop, Mr. T. Spencer, and Dr. G. D. Brown.

The following is a list of the papers read at the meetings, and printed in the Journal :—

"On a Hydrostatic Fine-adjustment," by Mr. E. M. Nelson.

"On the Relations and Evolution of the various types of the Genus Orbitolites," by the President.

"On the suppposed Sexual Threads in the Zygnemaceæ," by Mr. F. Bates.

"On a Hydroid Polyp found in the tanks of the Royal Botanical Society's Gardens," by Mr. F. A. Parsons.

"On the Conjugation of *Rhabdonema Arcuatum*," Kütz; by Mr. T. H. Buffham.

"On some Remarkable Moulds," by Dr. M. C. Cooke.

"On a New Flagellate Infusorian," by Rev. G. J. Burch.

"On the Economy of the Hive-Bee," by Mr. F. Cheshire.

"On a new Measuring Gauge," by Mr. R. T. Lewis.

"On some Fossil Marine Diatoms," by Prof. Cleve (Upsala.)

Short descriptions of new instruments, appliances, and methods of procedure, will be found in the Proceedings.

Besides these, five demonstrations on microscopical subjects, or in which the microscope is a necessary means of research, were given in the class-room during the winter months. Although the

term "demonstration," in the strict sense of the word, cannot, perhaps, be applied to all the series, they were certainly appreciated by the large number of members attending them, and introduced matters of great interest which could not very well be brought before the ordinary meetings. They were as follows :—

1884.

Dec. 12. "On Bacteria and the methods of staining them," E. Thurston, L.R.C.P.

1885.

Jan. 9. "On the Structure of the Eyes in Arthropoda," B. T. Lowne, F.R.C.S.

Feb. 13. "On Collecting and Mounting Fresh Water Algæ," Dr. M. C. Cooke, M.A.

Mar. 13. "On Lung Parasites," Dr. T. S. Cobbold, F.R.S.

Apr. 10. "On the Skeleton of the Echinodermata," Dr. W. B. Carpenter, C.B., F.R.S.

Summarised reports are given in the Journals, and the Committee take this opportunity of expressing their thanks to those gentlemen who communicated the means or result of their investigations on these occasions. They feel that thanks are particularly due to Dr. Carpenter, who spared neither time nor trouble in rendering his subject clear and interesting to his audience.

The remainder of Mr. Crisp's donation has, in accordance with his desire, been expended in purchasing indispensable works of reference for the Library, a list of which appears below.

The collection of works now in the possession of the Club already exceeds the space at the disposal of the Librarian, and as no more room can be accorded by the Council of University College, your Committee will shortly have to consider the propriety of making other arrangements.

Annexed is a list of the books presented or purchased for addition to the Library since the publication of the last report :—

	Presented by
"Worthington Smith's Diseases of Field and Garden Crops"	Dr. M. C. Cooke.
"Dr. Braithwaite's British Moss Flora." Part 8.	The Author.
"Transactions of the Linnean Society"	Mr. F. Crisp.
"Journal of the Royal Microscopical Society"...	The Society.
"Proceedings of the Royal Society"	" "
"Hardwicke's Science Gossip"	The Publishers.

"Cameron's Phytophagous Hymenoptera" Vol. 2	By Subscription Ray Society.
"American Naturalist"	In Exchange.
"American Monthly Microscopical Journal" ...	"
"Journal of the Postal Microscopical Society"...	"
"Challenger Reports." Vols. 9-11.	Purchased.
"Wolle's Desmids of the United States" ...	"
"Dippel on th Microscope"	"
"Quarterly Journal of Microscopical Science" ...	"
"Annals and Magazine of Natural History" ...	"
"Dr. Cooke's British Fresh Water Algæ." Completion	"
"Grevillea"...	"
Transactions and Proceedings of various Societies and sundry Pamphlets	"
"Dalzell's Powers of the Creator." 3 Vols.	Mr. Crisp's donation.
"Dalzell's Rare and Remarkable Animals of Scotland." 2 Vols.	
"Ehrenberg's Infusoria"	
"Ehrenberg's Micro-Geology"... ...	
"Berkeley's Cryptogamic Botany" ...	
"Pascoe's Zoological Classification" ...	
"Hine's Catalogue of Fossil Sponges"...	
"Hassell's Food and its Adulterations"	
"Sternberg's Photo-Micrographs"	
"Magnin and Sternberg's Bacteria"	
"Agassiz Bibliotheca Zoologica." 4 Vols.	

The following slides have been presented to the Cabinet :—

Mr. F. Oxley	24
" G. Sturt	70
" A. D. Michael	43
" A. C. Tipple	6
" E. M. Nelson	300
" F. Enock	7
" H. Morland	1
" A. Pennington	1
" H. E. Freeman	6

The valuable series of *Oribatidæ* presented by Mr. Michael, and the Van Heurck Diatoms by Mr. E. M. Nelson, are worthy of special notice.

The Excursions during the past season were fairly successful, and well attended ; a large number of interesting objects are recorded, described, and in some cases figured in the Excursions' Portfolio ; many have been exhibited at the meetings, and one has

formed the subject of a paper, an example which might be more largely followed.

The Annual Dinner of the Club was held at the Holborn Restaurant, on Dec. 12th, Dr. W. B. Carpenter, C.B., F.R.S., in the chair, and was attended by about 100 members and guests. The success of these entertainments is entirely due to the efforts of the Sub-Committee, officially appointed two years ago, and their services are certainly appreciated by all who benefit by them. The musical arrangements were, as usual, most admirably conducted by Messrs. Cole and Willson.

The Excursionists' Annual Dinner was held at Leatherhead, on June 19th, instead of June 27th, as announced. On this account probably, the number was rather smaller than usual, but the dinner itself, under the presidency of Prof. Charles Stewart, left nothing to be desired, and the vocal music contributed by the Messrs. Rogers and friends added considerably to the pleasure of the gathering.

The four numbers of the Journal issued since the last report are sufficient evidence of the care and ability bestowed upon them by our esteemed editor, Mr. Hailes. The necessary expense incurred in producing them forms a large item in our accounts, and it is trusted that members will continue to supply material which shall justify the outlay and the reputation of the Club. For the future the Journal will be published by Messrs. Williams and Norgate, of Henrietta Street, Covent Garden, W.C.

The great privilege of holding our meetings at University College has again been renewed by the Council, and the thanks of the Club are due to them for this and other favours.

Your Committee have also to thank the Officers of the Club for their various services, and in conclusion they confidently look forward to a continuance of the career of prosperity and usefulness which has been so characteristic of the Quekett Microscopical Club during its twenty years' existence.

TREASURER'S STATEMENT OF ACCOUNTS.

Dr.	£	s.	d.
To Balance in hand, July 1, 1884	100	18	10
Subscriptions since received	201	10	0
Dividends on Compounding Subscriptions ...	4	6	2
	£306	15	0

Cr.	£	s.	d.
By Postage and Carriage	5	12	9
Printing and Stationery	10	19	6
Attendance, Lighting, and College Expenses ...	22	7	6
Petty Expenses	5	8	10
Purchase of Property	21	8	5
Journal	160	18	2
Demonstrations	2	12	0
Balance	77	7	10
	£306	15	0

Amount invested in New Three Per Cent. Annuities, £140.

We, the undersigned, having examined the above statement of Income and Expenditure, and the Vouchers relating thereto, hereby certify the same to be correct.

WM. HAINWORTH, }
H. H. DOBSON, } Auditors.

July 17, 1885.

PRESIDENT'S INAUGURAL ADDRESS.

Delivered September 25th, 1885.

By A. D. Michael, F.L.S., F.R.M.S.

It is, I believe, the time-honoured custom in this Club for the President to deliver some kind of introductory address on the occasion of his taking the chair for the first time; and, even were it not a custom, his own inclinations would naturally prompt him to make some reference to the new circumstances in which he found himself placed. It is with feelings of a very pleasant kind that I enter on the duties of the office to which you have called me, because it is an assurance of the friendship and goodwill which my fellow-members of the Club have always shown towards me, and also, in a far higher degree, because I regard it as indicating that, in your judgment, I am more likely to be of service to the Club, as its President, than any other gentleman who is for the moment available; had this not been your opinion you would not have allowed feelings of friendship to have led you to select me. It is naturally a source of great gratification to me that I should have your friendship and your favourable opinion, still I am well aware that there are many members in the Club of older standing and greater attainments than myself; nevertheless, I feel assured that you have done your duty, and it now remains for me to do mine.

It is, I think, needless for me to say that I will, as President, do my best for the Society, because I trust you will believe, without any assurance from me, that I shall in the future, as I did in the past, endeavour to do the best I can for the interests of the Society, whatever position I may occupy in it. I confess to feeling some diffidence in taking the chair in succession to such a President as Dr. Carpenter, who, during his long and laborious life, had acquired a very wide range of experience, and had attained to an extent and variety of knowledge such as I cannot myself hope to emulate. It is only to few that opportunities are given of acquiring so wide a range of information, and fewer still that possess the ability to retain in their minds what has thus been gathered, and to speak promptly and efficiently upon almost any biological subject

which may come before them. In choosing me to follow such a President you must be aware that you have selected one who is, to a great extent, a specialist, and whose general biological knowledge is far less than that of many in this room; it may be, however, that this will not prove to be wholly a disadvantage, since it can scarcely be a healthy thing for a society to rely too much upon its President, and to allow his ready ability to take the place of personal efforts amongst the members. My duty will be rather to endeavour to encourage and to develop what others may be ready to do, than to occupy the Society's time myself, to see that every man who can be induced to do anything has an opportunity of doing it, and that he is not discouraged from the effort; and to hold an even course if differences should ever appear. These considerations naturally lead me to think of the future of the Club, and what I should wish it to be. It may, and no doubt will be said, that this is not a dry scientific Society, but a Club in which the social element largely exists. I am quite aware that such is the case, and that it is under the influence of this social element that an amount of success has been attained such as does not always fall to the lot of a purely scientific Society; but I believe that its social success has depended upon its scientific element, and that it is a collection of men of similar tastes, views, and objects in the application of a magnificent tool to a great variety of subjects. I remember, not long ago, the starting in London of another Club, which went by the name of "The Dilettante Circle;" its members were artists and musicians, and it commenced its existence under very favourable circumstances, its entertainments were most enjoyable, but its object was enjoyment only, its members assembled for the mere pleasure of the evening, and, from the first hour of its existence, it was overshadowed by the wings of the demon of *ennui*. Little by little men grew tired, and little by little they drew off, until the Society gradually died out. This element of *ennui* would be certain to pervade meetings where pleasure was the sole aim and object. The dilettante spirit, if too much developed, is the bane of a Club like ours; it is perhaps rather too widely spread, although a little of it is no doubt not only permissible, but even desirable; and, therefore, whilst I insist that the microscope should not be regarded merely as a means of enjoying the beauty which it reveals, I am very far from agreeing with those who talk with some little contempt of "mere beauty" as a thing not worthy of consideration. My earliest

recollections are of how, as a child, I revelled in the beauty of the insects and the flowers, just as, later in life, I have gloried in the shifting beauties of the mists driving across the mountain-tops, or sat for hours watching the sunlight dancing on the great waterfalls of the Alps or the Pyrenees; but, beautiful as all these things may be, if the enjoyment of them be not joined to anything else there will come a time when it will pall, and when the mind will lose its appreciation of what the eye contemplates, just as we find that artists often cease to admire the beauties which they cannot paint. Thus also, great as may be the amusement obtained by the collector of merely beautiful objects, yet when he devotes himself more seriously to the subject, and goes a little more closely into it, taking a more special view, and trying to tread in the paths of original investigation, then he will find that his pleasure will be both greater and of a far higher quality than before. If it be possible, in the position which you have called upon me to occupy, for me to assist any member of the Club in mounting from the pursuit of amusement to the more important study of a subject, from that which gives pleasure in a small degree to that which affords it in a higher sense, it will at all times be my desire to do so to the fullest extent of my power. There are many ways in which those who take an interest in microscopical subjects go to work. It is recommended by some that they should go out collecting generally, bringing home a great variety of objects, and then setting themselves to the task of endeavouring to identify them. By so doing no doubt they impress upon the mind general ideas of the way in which such objects are divided into classes, and form some notions of their outward appearance; but it is after all laborious and rather ungrateful work, occupying a great deal of time and attention, and if it be repeated many times it leaves little opportunity for other things, and causes the collector often to pass by objects of greater interest and importance. I am personally more inclined towards the view that it is better for a man to take up something special which he can grasp more closely; and if he wish to get a different class of objects identified, then to obtain assistance in so doing. I cannot help seeing that we have in this Club a vast amount of manipulative power, a great number of first-class instruments, and of competent observers; but I am not quite sure that we make the best of them. There are vast fields around us which, if not absolutely unworked, are only partly worked, and I believe that most of our members would find far more valuable

results to arise from turning their attention in these directions than from simply working in old lines. Amongst the many subjects which are not yet worked out as they might be, I may mention the almost new study of Petrology,which, although still in the hands of a very few observers, is rapidly becoming a subject of high interest and importance; the spectroscope also offers a wide and promising field; and the value of the microscope, as applied to commercial considerations, is hardly yet recognised. These are branches affording great promise, and there are very few persons who give attention to them. It may be said that ours is not a Club in which such researches are expected, and that its use is rather for the purpose of training and raising up microscopists, and then drafting them off to other bodies where work of this kind is more exhaustively carried out. There is some truth in this, and it is to the credit of the Club that it can be truly said, and that we can point to so many in other societies whose work in microscopy was commenced in the Quekett Club. It is true that there is a natural tendency among our older members to become engrossed in other and more learned societies, but it is also true that we have still amongst us a great many earnest workers, and that the best men still find it to be to their pleasure and their interest to remain amongst us, for it is by steady progress that men are able truly to advance, whether they occupy the place of simple students or that of teachers or investigators. It is, however, desirable to the greatest possible extent, that, in order to counterbalance the inevitable loss of older members, those of younger standing should be encouraged to come forward and to communicate to the meetings the results of their observations. I have noticed that there seems to be a great amount of hesitation on their part in this respect, and no doubt it is an awkward thing to come forward and to read one's first paper. It is said that Frenchmen are killed by ridicule; but however true that may be, I believe that practically Englishmen are more afraid of it. Let me urge our younger members to put such feelings on one side, and to give their fellows the benefit of their experiences without fear of being laughed at. For my own part I can only say that, during my period of office, my most earnest desire will be that I may have the assistance of the younger members at the meetings, and if I can induce them to do something more than collect slides, it will not be necessary for me again to announce, as I am forced to do to-night, that at this meeting of the Club there is not any paper.

Notes on Palmodactylon subramosum, and on a New British Species of Vaucheria.

By M. C. Cooke, M.A., A.L.S.

(*Read October 25th*, 1885.)

Plate XIV.

On page 25 of my recent work on British Fresh Water Algæ I have stated that "one or other of the many forms of *Hydrurus penicellatus* has been called *Palmodactylon subramosum*, Nag."

This form has recently been found in Britain, and a fragment sent to me for verification by Mr Thomas Hebden, of Hainworth, near Keighley. It was found during the month of July, but in small quantity, and mixed with other species. The collector says: "I have been repeatedly to the same place but so far have not been able to procure another specimen."

This form was described by Nägeli in his "Unicellular Algæ" (p. 70), under the name of *Palmodactylon subramosum*, and was repeated under the same name in Rabenhorst's "Flora Europæa Algarum" (p. 44), and Kirchner adopts it in his "Algen von Schlesien" (p. 107). Nevertheless, we see no reason to modify our original view, that it is only one of the many forms of *Hydrurus*. Unfortunately the specimens found were so meagre as to be insufficient to furnish any conclusive evidence.

On page 116 of the above work I have given a synopsis of the known species of Vaucheria found in Europe, according to the arrangement adopted by Professor Nordstedt. When that list was made eight species were known to occur in Great Britain out of a total of 19, all belonging to the first group of 11 species, leaving group B, with six, and two uncertain species, unrepresented.

Since then Professor Nordstedt has spent some time in this country, rambling in many directions in search of Fresh Water Algæ, and he has succeeded in finding on the mud of the Thames, at Kew, above the bridge, at low water, another *Vaucheria*, his own species of *Vaucheria sphærospora* which belongs to the B group, section *Piloboloideæ*, numbered 15 in the above-named synopsis. This, therefore, is an interesting addition to our Flora,

the accuracy of the determination being vouched for by the learned Professor himself.

The following is the description of this species, which is figured in outline in "Botaniska Notiser" for 1878:—

Vaucheria sphærospora, Nordst. Bot. Not., 1878, p. 177, t. 2.

Loosely cæspitose, antheridea at the apex of longer, or rarely of the shorter branches, slightly tumid, very often a little incurved, acuminate, furnished about the apex with two (rarely 4) nearly opposite divergent conical processes, connected with the side or the base (at first with the apex) of the oogonium, by means of a short cell destitute of chlorophyll. Oogonium globose, or obovate-globose; oospore globose, chlorophyllose, membrane not thick, not entirely filling the oogonium.

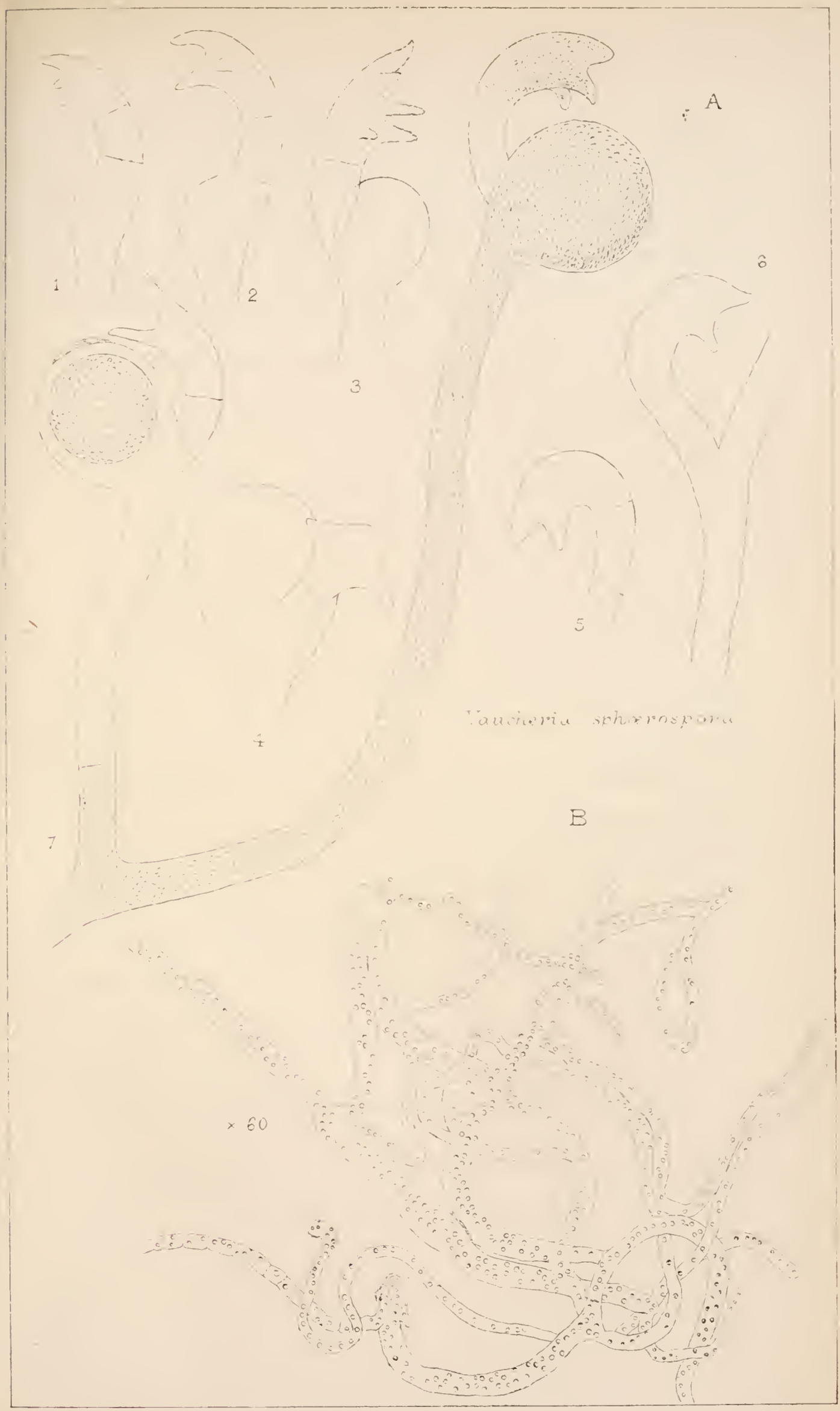
Size. Threads ·026-·06 mm. diam. Oogonia ·104-·136 mm. diam. Oospore ·088-·120 mm. diam.

On the mud at low water of the Thames at Kew. Commonly marine.

PLATE XIV.

A.—Figs. 1-6, antheridia of *Vaucheria sphærospora*; Fig, 7 oogonia with antheridia (after Nordstedt).

B.—*Palmodactylon subramosum* (from photograph × 60).



M. C. C. del. W. Rhein sc

On an Unusual Form of Tube made by Melicerta ringens.

By T. Spencer Smithson.

(*Read October 25th* 1885.)

While trying the well-known experiment of supplying *Melicerta ringens* with powdered carmine in order to show the formation of the pellets with which it constructs its tube, I had the good fortune to be able to watch the building of the whole of one tube by a young melicerta, which showed considerable deviation from the ordinary type of architecture; and I venture to bring the case before the Quekett Microscopical Club as it appears to me to possess several points of interest.

In the first place the young *melicerta* began by building half a course in the usual way with apparently solid pellets, but instead of continuing to do so, it suddenly commenced to heap up, in a most erratic manner, pellets of the ordinary shape, but composed of transparent, gelatinous matter with a few particles of carmine imbedded in it, giving the tube a somewhat mottled appearance.

The walls of the tube, owing to the loose way in which they were made, were about double the thickness of those constructed in the usual manner.

Since my first discovery I have found another young *melicerta*, in the same trough as the first, beginning to build in the same extraordinary manner, and this fact leads me to think that want of material is the primary cause of this curious mode of building. I merely offer this as a crude suggestion, and shall be very glad if any member of the Club can give me a better explanation of this, as it appears to me, interesting case of alteration of instinct by confinement.

I regret that I have been unable to send one of the tubes for examination, but this would be impossible without great risk of injuring the animals, both being attached to the side of a small zoophyte-trough.

Historic Microscopy.

By E. M. Nelson.

(*Read Nov. 27th*, 1885.)

During my absence from town this summer I came across some quaint old descriptions of microscopes, which interested me so much that I determined to make some notes of them, in the hope that they might interest you also. My object in bringing this paper before you is not to enter any debatable ground as to whether A or B introduced a new principle or improvement with regard to the microscope, but merely to trace the growth of human intellect as expressed in the optical and mechanical parts of the microscope, from the early simple type to the modern complex one.

The earliest magnifying glass or simple microscope known is the rock-crystal biconvex lens in the British Museum. This was found at Nineveh, and is probably not less than 2,500 years old.

After a lapse of 22 centuries, we come to the compound microscope of Zacharias Jansen, in 1590. It consisted of two biconvex lenses in a tube. The instrument was exceedingly rude, having no stage, focussing, or illuminating apparatus.

In 70 years we come to a great improvement by Hooke, who, in 1664, added a field glass to the eye-piece. This is practically the compound microscope which is still in use, viz., eye-piece, formed of an eye glass and a field glass, and an objective. The instrument was fitted with a very rough focussing apparatus, and an illuminating lens formed of a globe filled with water, a method still used by watch-makers and engravers. This microscope had no stage.

In 1668 Eustachio Divini invented a compound non-aplanatic object glass.

S. Campani, a contemporary of Divini and of Huyghens, used an eye-piece which we now call Huyghenian, but which the French call after Campani. I believe, however, that there is no doubt about its being the invention of Huyghens.

The compound microscope was now abandoned in favour of the simple lens, it being found that the image from a non-aplanatic lens would not bear magnifying, the aberrations produced by the lens being also magnified.

Leeuwenhoek, in 1667, worked single lenses of high power, and put a screw focussing adjustment to the instrument, which caused the object to approach or recede from the lens.

Sir Isaac Newton suggested reflecting microscopes in 1679, but there is no account of one having been made at that time.

Stephen Gray used drops of water in 1696 ; his apparatus, like that of Leeuwenhoek's, had a screw focussing arrangement.

P. Bonnani, in 1698, produced a microscope with a coarse adjustment and fine adjustment, a stage, and a condenser. It was very rough, and the adjustments were hardly as fine as some of the preceding models; but the principles are to be found in the microscopes of the present day.

J. Wilson introduced a simple microscope, with a screw focus, in 1702. These were of two forms ; one not unlike the seed microscope now in use, and the other something like Leeuwenhoek's.

These microscopes were very popular, but as they offer no new link in the chain of development, we will pass over them without any further description.

We now come to the first compound microscope made for sale, viz., that by J. Marshall, circa 1735. The stand was a wooden box, with a drawer for apparatus in it. There was an upright support fixed to this by a ball and socket joint. This support carried the body and the stage. The stage could slide backwards and forwards in a vertical direction. There were numbered divisions marked on the upright support, which numbers corresponded with numbers on the object glasses. By this means a coarse adjustment was effected. If, for example, an objective was fixed to the body, then the arm which carried the body was clamped to the upright pillar at the marked division. The direct acting screw then made the fine adjustment. There was a substage condenser formed of a biconvex lens.

The most important microscope of the time was, however, that invented by Dr. Smith, of Cambridge, in 1738. He evidently saw that the aberrations of the uncorrected object glass rendered compound microscopes of little use. Leeuwenhoek's success with single lenses, and the popularity of Wilson's adaptation of them,

could be easily accounted for by the fact that although the single lenses had less power, they gave much sharper images, because the aberrations of the uncorrected lenses were not magnified.

Knowing this, he set to work to lift the compound microscope out of the mire; and so thoroughly did he do it, that 60 years afterwards I find it referred to in the following terms :—" In the opinion of the ablest judges, it is incomparably superior to them all."

In 1837, that is, 100 years after its invention, Sir D. Brewster says :—" It performs wonderfully well, though both the specula have their polish considerably injured. It shows the lines on some of the test objects with very considerable sharpness." What a report for a philosophical instrument 100 years old ! Can any one bring me a microscope twenty years old that will show the lines on some of the test objects of to-day " with very considerable sharpness ? " What philosophical instrument can you point to that has stood the scorching heat of 100 years of improvements without being demolished ? Dr. Smith, seeing the impossibility of doing anything with uncorrected lenses, devised a reflecting microscope, the arrangement of the mirrors being somewhat similar to that in a Cassegrain telescope. The rays of light, condensed on the object by a substage condenser, passed on to a concave speculum, which took the place of the object glass of the compound microscope; they were reflected back to a convex speculum, which brought them to a focus where they were examined by a biconvex eye-glass. There was a stop placed in the tube near the hole in the convex speculum to prevent any direct rays entering the eye. In speaking of the condenser, he says, " that this lens should be just so broad as to subtend the opposite angle to that which the concave speculum subtends at the object." This is, perhaps, one of the most extraordinary statements in the annals of historic microscopy. This principle, viz., that of placing the object in the conjugate foci of the objective and condenser, and of making the angle of the illuminating cone equal to the angular aperture of the objective, I have enunciated here for some years past, and have repeatedly exhibited objects under that illumination both here and elsewhere, little thinking that Dr. Smith had laid down the same principles 150 years ago. It would, indeed, be a grand thing if glasses nowadays were well enough corrected to permit of their being illuminated by solid cones of light equal in angle to

the objectives. After stating this fundamental principle he gets a little hazy, for he goes on to say, "that the annular frame of the lens must be very narrow, and connected to the microscope by two or three slender wires or blades, so as to intercept as little sky-light from the object as possible." Of course, any light passing through the object at a greater obliquity than the aperture of the concave metal would have no effect at all.

Although Sir D. Brewster passes such encomiums on this microscope, and enters minutely into its construction, he leaves these important principles untouched, not mentioning the illuminating part of the instrument at all.

As far as I am able to make out, Dr. Smith's microscope had a power of 300 diam., and an aperture of about 60°.

Lieberkühn used single lenses, and illuminated opaque objects by concave mirrors, 1738.

The concave mirror, which was still used, was an advance, but the single lens was retrograde; the sliding focussing arrangement was very crude. If these instruments were intended for use with diffused daylight, the bi-convex condenser was a mistake, but it would have been of advantage if a lamp were held in its principal focus. About this time Culpeper made a compound microscope, vertically placed on a box stand with a sliding-tube coarse adjustment, the position of the body being indicated for the various powers after J. Marshall's plan. Culpeper had no fine adjustment, but he was the first to put a concave mirror for the illumination of transparent objects. During the next 40 years the instrument goes through great changes in the hands of Cuff, Adams (father and son), Benjamin Martin, and Jones.

In 1743 Cuff's microscope had a box-stand like Marshall's and Culpeper's, a sliding coarse adjustment, with focus of objectives marked as before, and a direct acting screw fine adjustment. A diaphragm was here mentioned for the first time. The microscope, however, did not incline.

In 1746, Martin-Adams made a non-inclining microscope with a rack and pinion focussing adjustment to the stage. The various powers were fitted to a strip of brass sliding in the nose-piece, with a notch and spring to centre them. It also had a sliding tube focussing condenser fitted to the underneath part of the stage, box-stand, plane and concave mirrors.

In 1747 Cuff added a micrometer to his instrument, also im-

proved the Wilson microscope. Adams now improved his microscope by making the body move at the junction between the arm and the square bar, so that it could pass over any part of the object, instead of moving the object under the body. This so-called improvement was eminently in a retrograde direction, as it threw the optic axis of the body out of centre with that of the condenser, but Ross adopted it, as we shall see presently.

Adams put the condenser on a separate sub-stage, and altered the sliding strip of powers to a wheel of powers; in other words, a rotating nose-piece.

The last one of this series is the Martin-Jones. The following were its main features:—Inclining; rack-work focussing stage; sub-stage; tripod stand replacing the usual box; rotating nose-piece; draw-tube to body; rack and pinion movement to body in a vertical direction over the object; tangential movement to stage under the body, so the usual rectangular movements to the object were given half by the body and half by the stage. There was a super-stage bull's-eye condenser and Lieberkühn.

Martin after this brought out a microscopic pocket telescope. The four-lens eye-piece of a small pocket telescope was made into a microscope. The way this was carried out is so neat that it is worthy of notice. By twisting one of the tubes over the other, an aperture was revealed in the side of the telescope. The mirror, which stowed away in the cap of the telescope, fitted into the tube and light fell on it through the hole in the side. Objects were placed in small circular holes formed round metal discs, which also packed away in the cap. This formed what we should now call a rotating object-holder.

In 1777 De la Barre introduced changing eye-pieces, and in 1787, under the second Adams, non-aplanatic microscopes may be said to have reached their zenith.

The next thing which engaged men's minds was to get better results than the compound chromatic microscope would give. In this country Wollaston worked at simple microscopes, and Amici, on the Continent, at reflectors.

In 1812 Wollaston brought out a periscopic doublet, and afterwards Sir David Brewster an oil-immersion lens, an endomersion objective, and lenses of gems. Then came Sir David Brewster's great discovery, viz., the grooved sphere, which is the Coddington lens. Sir J. Herschel invented his doublet of a bi-convex and

meniscus in 1821. Andrew Pritchard made a triplet, Blackie one composed of a garnet, a quartz, and a flint glass, Sir D. Brewster one of two fluids and a solid.

Then comes the celebrated Wollaston doublet, in 1829, which was like a small Huyghenian eye-piece, with the plane sides of the lenses towards the object. This he fitted to a very neat stand with a plano-convex condenser placed beneath the stage, so that the object was in its focus. It had also a mirror, and rack-work focussing. This instrument may be called the culminating point of the simple microscope. We must now go back to the compound microscope. Amici, who had been trying to achromatize refractors, gave it up, and tried to improve reflectors. His method was a modification of Newton's. Goring, Pritchard and the Tulleys improved on it, and reflecting microscopes reached their most perfect form in the Goring-Pritchard "engiscope," with metals made by Cuthbert. "Engiscope" is a new word Dr. Goring tried to introduce for microscope; it means to see near things. Before leaving these antiques, let me mention that in Pritchard's engiscope we first find Tyrrell's stage-movements, which form is still retained by Messrs. Powell and Lealand. The body of these instruments was fixed, and the stage focussed instead. The stand was an ordinary telescope clip stand, with a compass-joint, only it had a cruciform foot instead of the usual tripod, a levelling-screw being placed in one of its legs.

We now come to the last part of our subject, namely, the invention of the achromatic objective for compound microscopes. It was, as you may well conjecture, by no means the work of one man, but the result of the combined action of many minds. I shall not mention all the names which go to make up that great list of workers to whom we are indebted for the beautiful instruments we now have. As this paper is an abstract of types rather than men, if I do not mention any notable worker in this field, it is not because I undervalue his labours.

In 1816, Frauenhofer, of Munich, made a single achromatic lens, but its performance was considered inferior to the chromatic lenses of that day.

In 1823, M. Selligues, in France, made a lens of four achromatic combinations, which were for combined or separate use. It does not appear that it was a very successful glass, but it was the first to demonstrate the great advantage of combining achromatics

in one combination or object glass. The focus of each of the compound parts varied from $1\frac{7}{8}$ to $1\frac{1}{2}$ inch, but the convex sides of the lenses were turned towards the object, so that the spherical aberration of the combination was at its maximum.

In 1825, M. Chevalier made lenses of less focal length, and turned the plane side to the object, which was a great advance on the previous method. His highest power was a combination of two $\frac{4}{10}$.

In the same year, 1825, Mr. Tulley, with the assistance of Mr. Joseph Jackson Lister, made a triplet of something less than one inch in focus and 18° in aperture. Afterwards he made another of still shorter focus, which, when combined with the first, increased the aperture to 38°. This combination is said to have stood a power of 300 diams. very well. Andrew Ross, speaking of these triplets, said, "that they never have been exceeded by any similar combination for accurate correction throughout the field."

Prof. Amici, in 1827, brought a horizontal microscope to this country with a triple achromatic objective.

In 1830, J. J. Lister read a paper before the Royal Society on "Some Properties in Achromatic Object-glasses Applicable to the Improvement of the Microscope." From the lines laid down in this paper, Ross, Powell, and James Smith made objectives which surpassed any made elsewhere.

In conclusion, let me point out how the extraordinary instruments I have already described got transformed into those of the present day.

Andrew Pritchard's compound refracting microscope consisted of a telescope tripod clip stand with compass joint for inclination, a Tyrrell's stage, a condensing lens on substage, and a mirror. The focussing adjustments of this instrument were peculiar. The arm carrying the compound body was fixed to a tube which fitted in the tube forming the tail-piece, and came out of the end of the tail-piece. The coarse adjustment was effected by pushing this tube in and out. At the end of this tube was a milled head, which, when turned round, worked a direct acting screw fine adjustment, in a manner similar to the ordinary Hartnack, only it was at the end of the tail-piece instead of in the usual place.

In 1826, Mr. James Smith made for Mr. Joseph Lister a microscope on the following plan :—Folding tripod stand with single pillar, compass joint. The compound body slides in a tube

fastened to the arm, with rack and pinion focussing, like the tail-piece of a telescope, eye-piece screwed into draw tube. There were draw tube steadying rods fixed to the tripod feet like a telescope, a mechanical stage, an elementary substage, and a mirror.

The last microscope I am going to describe is one of the earliest of Andrew Ross in 1831. Stand was non-inclining, vertical rod on tripod foot, rack and pinion, triangular bar, coarse adjustment, direct acting screw, fine adjustment, with milled head at the bottom of the pillar underneath the tripod foot. The mirror was fixed to one leg of the foot. A mechanical stage with rectangular movements, also mechanical movements to body to move it over the object. There was no tail-piece, but a condensing lens was placed in a tube fitting to the underneath part of the stage.

I have now brought the history of the microscope to a date so near the present time that the further advances in the construction of the instrument will be well known to you all.

On A Method of Equalising the Thickness of Slips when using an Oil Immersion Condenser.

By E. M. Nelson.

(Read Nov. 27th 1885.)

It is necessary that an oil immersion condenser should have a fairly long focus, otherwise it would be of no use if the slip happened to be rather thick.

If the slip is thin it will be found impossible to keep the oil contact when the condenser is in focus, unless you increase the thickness of the slip by uniting a thick cover glass to the back by oil. It will be found very difficult to do this without oiling the stage when the microscope is inclined. The oil between the condenser and the cover glass is sure to unite with that between the cover glass and slip, and then the cover glass falls, upsetting the whole arrangement. I have found the following plan to answer admirably: A piece of glass one inch square, upon one side of which, close to one edge, a strip $\frac{1}{8}$in. broad is fastened by shell-lac, is oiled to the back of the slip; the ledge hooking over the edge of the slip prevents it slipping down.

Final Notes on the So-Called Desiccation of Rotifers.

By Henry Davis.

(*Read November 27th*, 1885.)

A writer in the "Monthly Microscopical Journal" for June, 1873, criticising, in a friendly spirit, a paper on Rotifers I had recently read, intimated that its chief merit consisted in its certainty of closing all contention, and in putting the "inevitable dried Rotifer" at rest for ever. But he was mistaken; the dry Rotifer discussion, like the creatures themselves, may lie dormant for a time, but being "scotched, not killed," it revives again on the smallest provocation. In fact you may well consider it has been revived too often, and be little inclined to listen to a repetition, however brief, of a much more than thrice told tale; but when I state that my short paper is called "final notes," &c., you will, perhaps, see that there is at least one thing attractive about it, and may, therefore, forgive a last effort to simplify and solve a very old and difficult problem.

These notes form a sequel to a paper read before the Royal Microscopical Society, in April, 1873.* Before that date the matter stood thus:—nearly two centuries had elapsed since it had been discovered that certain minute aquatic creatures—now called Rotifera—could be kept in a dry shrivelled condition for a considerable time, and then become active on being supplied with water. But it was much later that special experiments were made to test the endurance of these Rotifers under extended drought and extreme temperatures. Very conflicting were the various accounts of the results, and in consequence two opposing parties were formed, one believing that the creatures could be boiled and baked to any extent, and air-pumped until they were dry through and through, or "desiccated," all without affecting their vitality. In fact, repeated thorough drying only tended to prolong their lives, as it was said they could be kept dry for an "unlimited time," and then

* "A New *Callidina*, with the Result of Experiments on the Desiccation of Rotifers."

be revived. Then there was the incredulous party, who denied some things stated by their opponents, and vainly tried to explain others.

In 1872 the balance of evidence so far favoured what may be called the dry-and-immortal theory, that the standard text books—in England at least—summed up entirely in its favour. Dr. Carpenter, in his "Microscope and its Revelations," said, when speaking of Rotifers and Tardigrades, "they can be reduced to a most *complete state of dryness*, kept in this condition *for any length of time*, and revive on being moistened. . . . Individuals have been kept in a vacuum with sulphuric acid and chloride of calcium (thus suffering the most *complete desiccation* the chemist can effect) and yet have not lost their capability of revivification." Pritchard taught exactly the same lesson.

About this time, however, G. H. Lewes, in his "Studies of Animal Life," made out a fair case for the other side. He did not indeed advance anything absolutely new, but his clear common-sense arguments told crushingly against the common fallacy, and led him very near to a full explanation of all the undoubted facts. His belief—like that of Spallanzani before him—was that sand and dirt formed a perfect protection against the absorptive and drying effects of a vacuum and of heat, and had found that Rotifers, when naturally dried on a glass-slip without dirt, never revived, therefore dirt was somehow the preservative.

I, for one, not being satisfied with the dirt theory, went carefully over all the experiments I could read of, having a good stock of material, mainly *P. roseolæ*. I found that they certainly could be revived after being heated to 200° (Fah.), and that some survived a week's confinement in the vacuum of an excellent air-pump with sulphuric acid.

Rotifers treated as described were then picked out with a pencil and crushed between two glasses under the microscope, when some of these Rotifers (which had undergone "the most complete desiccation the chemist could effect") distinctly emitted their contained *fluids*, and the certainty was apparent that the desiccating power of the air-pump had been over-rated. It occurred to me that Rotifers generally being slimy, their gelatinous secretion might, on their drying, coat these Philodines all over, and form a strong shell, proof against the air-pump and the ineffective chemist. Some grapes were then thinly coated with good glue, and as these were found to bear the air-pump with acid without fracture or internal drying, it was but a fair inference that the Rotifers, if similarly

coated, were similarly able to bear its action without injury. But of course there was no certainty—only a strong probability—that they were so coated.

It is not quite so clear how a dry gelatinous shell would be protective against heat, although it would be far better than the suggested porous dirt or sand; still, as experiments show that any temperature much above 200° both dries and kills the Rotifers, such a shell may be considered protective so far. Other creatures (even man himself in modellers' ovens for example) have been known to bear extremely high temperatures without much inconvenience.

There is no room for complaint as to the reception of my theory. The fifth and subsequent editions of Dr. Carpenter's book accepted it, Drs. Drysdale and Dallinger immediately adopted and adapted it to their Bacteria germs, and a micro-biologist of note found a good sounding name for the process,—"encapsulization."

But there was always a difficulty in proving that the living externally-dried Rotifers *were* encapsuled. I devised a sort of stage trap-tank, with a shelf inside, to induce them when active to dry apart from the dirt, &c.; this with partial success, as single dry specimens were sometimes found apparently gummed to the glass.

Dr. Hudson, writing in 1873, said:—"Mr. Davis's solution of a much-vexed question is as probable as it is new, and although it may possibly require confirmation from future observers, I have little doubt that such confirmation it will receive." Well, after twelve years, the confirmation has come at last. The Rev. Edward J. Holloway, of Clehonger, has found enormous numbers of *P. roseolæ* in the rain gutters of his church, and the very happy thought occurred to him of placing some strips of paper in these gutters in the rainy season, with a view to obtaining some clear gatherings of the Rotifers when they had dried. He was entirely successful. Dry groups in hundreds were taken. They have a varnish-like coating all over, and are distinctly glued together—mostly in one plane—and to the paper.

Examples are on the table under the microscope, some dry living groups on paper, and some in water taken this afternoon from the same paper. Writing of these, Dr. Hudson says:—"Mr. Holloway's beautiful groups prove your case beyond a shadow of a doubt. I have a whole pavement of Philodines glued together; moreover, transparent prolongations of the gelatinous secretion may be seen stretching from one to another."

Corrigenda to Prof. Cleve's Paper "On Some Fossil Marine Diatoms," &c.

In the above-named paper, which Professor Cleve placed in my hands to edit, I find that the following errors have unfortunately escaped my notice when revising the proofs, viz :—

At page 166, "*Navicula nitescens*," &c., should read "*Navicula nitescens* (Greg. *N. Smithii* var. *nitescens*," &c. Dele "(*N. Smithii* var.)" in line 2.

" " last line, for "Atl." read "Nord."

" 167, line 2, for "42" read "72."

" " " 17, for "Ægena" read "Ægina."

" " " 18, 19, 24, for "*Crabo*" read "*Crabro*."

" 168, for "*Gomphenema*" read "*Gomphonema*;" for "*Gephyrea*" read "*Gephyria*"; second line from bottom, for "76" read "46."

" 169, line 15, for "from the centre angles;" read "from the centre; angles obtuse."

" " " 32, for "s." read "f."

" 170 " 4, for "more" read "less."

" " " 6, for "*trigone*" read "*trigona*."

" " " 15, dele ";"

" " " 13 from bottom, for "24" read "27."

" " " 3 from bottom, for "not *T. productum*," &c., read "(not *T. productum*, Grev., 1861) and *T. Balearicum*, Cl. and Grun., kongh. Sv. Vet.," &c.

" 172 " 16, for "reticular" read "reticulation."

" " " 10 from bottom, for "pl. 2" read "12."

" " " 4 from bottom, for "Thaumatodisci" read "Thaumatodiscæ."

" 173 " 14, for "g" read "s."

" " " 18, insert "μ" after "4."

" " " 9 from bottom, for "Arachnoidisca" read "Arachnoidiscæ."

At page 174, line 1, insert "E" between "L" and "Æ."

" " " 6, insert "with" after "surface," dele "," after "concentric."

" " " 27, insert "n. sp" after "Cl."

" " " 6 from bottom, for "4" read "14."

" " " 4 from bottom, "*Craspedodiscus*" should commence a fresh paragraph.

" 175 " 27, *C. Argus* should run on with *C. heteroporus*; pl. xiii., for "12*d*." read "13*d*."

In my list of additional species I had inserted *Asterolampra Marylandica*. This is also in Prof. Cleve's list. In two or three instances "Ch" occurs for "Cl."

F. Kitton.

PROCEEDINGS.

August 14th, 1885.—Conversational Meeting.

The following objects were exhibited :—

T. Section of stem *Aponogeton distachum* ...	Mr. F. W. Andrew.
Marine polyzoa	Mr. J. D. Hardy.
Campylodiscus biangulatus	Mr. H. Morland.
Varieties of Diorite from Warwickshire coal fields	Mr. G. Smith.

Attendance—Members, 21 ; Visitors, 1.

August 28th, 1885.—Ordinary Meeting.

Dr. M. C. Cooke, M.A., A.L.S., Vice-President, in the chair.

The minutes of the preceding meeting were read and confirmed.

Mr. D. W. Greenhow was balloted for and duly elected a member of the Club.

The following additions to the Library were announced :—

"Annual Report of Commissioners of the Westminster Free Public Library"...	In exchange.
"The American Monthly Microscopical Journal"	" "
"Proceedings of the Canadian Society" ...	" "
"Proceedings of the Bristol Society" ...	" "
"Proceedings of the New York Society" ...	" "
"The American Naturalist"	" "

The Chairman said that they were that evening in the unfortunate position of not being provided with any paper, and as he was not aware of this until a few minutes before the meeting, it was, of course, out of the question to produce anything ; in fact, it would be hardly respectful to the Society to occupy their time with anything on which no thought had been bestowed. But whilst some other member might collect his ideas, he would himself meanwhile just mention one or two botanical facts which might be of interest to some of those present. One of these facts was concerning a short paper which appeared in the "Gardener's Chronicle," and which would be of interest to those who studied fungi, as relating to the common wheat mildew. The statement of fact was that Mr. Worthington Smith in examining the grain of oats, with a view to determine the course of development of the common black smut (*Ustilago*), found that in the intermediate stratum of the tissue there were growing some fixed spores of

the wheat mildew. This was the first time that these spores had been found growing in the kernel of wheat, and it seemed to show that the disease might be sown with the wheat, and thus be perpetuated through successive generations. It had been found before upon the straw, but not within the seed itself. Drawings were given with the paper, and it was not easy to estimate the value which this discovery might possess with reference to the subject of the eradication of the pest.

The other matter to which he would refer was a little incident which had occurred lately at the gardens at Kew, and which had a bearing in the same direction. In the Rockery at Kew there was a small patch about 2½ feet square of a common Alpine flower, *Gentiana acaulis*, growing together with other plants of a similar kind. The whole of this patch of Gentians was in an apparently sickly and dying condition, and being the nearest doctor he was called in to examine and prescribe for the patients. He found the plants were infested with a fungus known as *Puccinia Gentiana*, which was a fungus quite new to Britain, and thoroughly injurious to plants of this genus, to which it became attached in their native habitat. The question naturally arose why should this pest travel over from Germany or France and settle down upon this particular patch of Gentians in Kew Gardens? An inquiry as to their antecedents showed that they were imported plants, having been brought over from Germany during the previous year, and this led to the conclusion that they were imported with the disease in them, concealed within their tissues, and that it had subsequently developed in the way described. The whole of the plants were at once taken up and burnt, and it was to be hoped that these heroic measures would prevent the development of any more of the fungi. This led him to remark as to the value in this branch of natural history of constant and continuous work, and of the results which were certain to reward the worker who would only persevere in a given pursuit. Some time ago he wanted to get a complete catalogue of a particular genus for publication in "Grevillea," and for this purpose he resolved to look about in gardens and other places wherever he went to see if he could not find some other specimens to add to the list. He did this on every opportunity which presented itself in the course of six weeks, and at the end of that time he had raised the number of known species from 30 to 140. This showed what a little perseverance might accomplish, and he was sure the same thing would hold good in every other branch of study. If a person would confine himself to one particular point, he would soon be surprised to find how much could be made of it.

Mr. Buffham wished he could say something further upon the subject started by the Chairman, but confessed himself to be ignorant about it. He would, however, make a few remarks upon another matter, with reference to the paper which he read before the Club some time ago on the red seaweeds and their mode of fructification. He was in hopes that the reading of that paper might have been the means of finding him a coadjutor in the Quekett Club, but although it had not done so, he should be glad to take that opportunity of conveying to the members a few more ideas on the sub-

ject, for he wanted them to know that the rewards from this research were numerous, not only because this branch of microscopy furnished them with objects which were both numerous and very beautiful, but because there was also a high probability that really valuable work might be done. He might add that since the date of his paper he had been pursuing the subject further, and it had been his good fortune to come across a good many species which had not hitherto been recorded in Britain, and also some which had not been recorded at all. Usually it was found that these plants bore three kinds of fruit, the first being non-sexual (tetraspores), the second male (antheridia), and the third female (cystocarp). Usually only one of these kinds was found on the same plant, but sometimes it was otherwise. Now, on looking at it, the question was one of very great interest as to what could be the cause of a plant bearing sexual fruit in this way, and he thought it would be worth any one's while to pursue this inquiry. He had noticed that sometimes the worn ends of plants producing non-sexual fruit had grown out again and produced sexual fruit, and it occurred to him that perhaps it was the first products of the plants that were tetraspores, and that the process was something analogous to the process of nipping off the terminal shoots by gardeners to increase the productiveness of the other shoots. Here was, he thought, a line of inquiry which might very well be followed out with great prospect of reward. They need not confine themselves to a consideration of the red species, for the others would afford ample opportunities for study. The classification of these seaweeds had of late years undergone considerable revision since the publication of the valuable work in their library — Harvey's "Phycologia Britannica." Formerly these plants were classed according to their affinities so far as the means then at disposal enabled them to be determined, so that the common seaweed *Laminaria*, according to the old method, was placed in the highest class because it was seen to have a stem, and a root, and a leaf, but now, notwithstanding its apparent perfection of form, it was placed in the lowest class because it was found to produce only zoospores. Other instances of the same kind were cited as showing that there was in this direction a large field open to useful research, and that if any one would take up the subject there was abundant work for him to do.

The Chairman said that Mr. Buffham had pointed out some matters which he could say were well worth their attention. First, as to the beauty of the objects in this class, he entirely agreed with the remark as to that of the *Floridiœ*, not only in themselves as matters of colour and form, but if they would cut some thin sections of the stems they would find that they rivalled the famous sections of Echinus spines, about which so much used to be said. Then as to monstrosities, it was very much the habit of people to look at a thing and then to pass it by as "only a monstrosity," forgetting that these variations taught more of the morphology of a plant than could be learnt in any other way. Next, as to the alterations which were being made in the positions of species from one class to another. This had been the case in every branch, the reason being that whereas the old authors classified objects by their external affinities, the application of

the microscope had led to the discovery of bonds of union far closer than those which were previously known or suspected. The question as to why some plants produced only male organs and others only female was next taken in review, and he regarded the processes mentioned as rather analogous to budding than to what might be properly called seed, budding being produced before fruiting. These questions required further knowledge before they could be satisfactorily answered. At one time it was thought that in the case of Spirogyra one thread was male and another female, and some very pretty ideas were based upon this, only it happened that nature contradicted it, and the fair inference was that, not the whole thread was a separate plant, but that each cell was so. Some time ago curious experiments were made in animal life as to what conditions were necessary for the production of males or females, and some hard-headed farmers tried to turn this to practical account, with a fair amount of success. Then, again, in bees and aphides they had an example of an a-sexual condition, and it did not need any further remark to show that a study of many of these facts might lead to conclusions of great practical value and interest. He felt sure that they would return their thanks to Mr. Buffham for bringing up a subject which could not fail to be of interest to every practical man.

The thanks of the meeting were unanimously voted to Mr. Buffham for his remarks.

Announcements of meetings and excursions for the ensuing month were then made, and the proceedings terminated with the usual Conversazione. The following objects were exhibited :—

Bark of plane tree	Mr. F. W. Andrews.
Aquatic lepidopterous larva, *Hydrocampa lemnalis*	Mr. R. T. G. Nevins.
Moss, *Mnium hornum*	Mr. W. Watson.
An old French compound microscope with three simple lenses	Mr. C. Rousselet.

Attendance—Members, 34; Visitor, 1.

September 11th, 1885.—Conversational Meeting.

The following objects were exhibited :—

Tingis cardui (Thistle-bug) Pupa	Mr. F. Enock.
Larva of *Chironomus prasinus*	Mr. A. Hammond.
Sertularia, with polypes extended	Mr. J. D. Hardy.
Ders obtusa	Mr. R. T. G. Nevins.
Alcyonella fungosa	" " "
Spongilla igloorformis	Mr. B. W. Priest.
Alcyonella fungosa	Mr. C. Rousselet.

Attendance—Members, 29; Visitors, 0.

September 25th, 1885.—Ordinary Meeting.

A. D. Michael, Esq., F.L.S., F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

Mr. A. T. Spriggs was balloted for, and duly elected a member of the Club.

The following additions to the Library were announced :—

"Proceedings of the Royal Society"	From the Society.
"Journal of the Royal Microscopical Society"	,, ,,
"Proceedings of the New York Microscopical Society"	,, ,,
"The American Monthly Microscopical Journal"	In exchange.
"The American Naturalist"	,, ,,
"Annual Report of the South London Microscopical Society"	From the Society.
"Proceedings of the Belgian Microscropical Society"	In exchange.
Supplement to Piaget's "Les Pediculines" ...	Purchased.
Poulson's "Botanical Micro-chemistry" ...	,,

The thanks of the meeting were voted to the donors.

The President delivered his inaugural address to the Club, this being the first occasion on which he had occupied the chair since his election.

Professor Charles Stewart said that he was not aware when he came to the meeting that he should be called upon to say anything, but as there appeared to be no paper to come before them, he would just occupy a few minutes in recounting some recent observations. At the present time most persons were returning from their holiday trips, and he had himself just come back from the North Coast of Cornwall, where the rocks were of a very rugged character, and often exceedingly precipitous, and the sea in stormy weather rolled its great waves in direct from the Atlantic. On arriving he went down to the quay to take a look round, and, meeting some fishermen, inquired what they caught, and found that though there were not many crabs, they took a great many crawfish. A basket of these was hauled up for his inspection, and he found he could purchase them for 8d. or 10d. each instead of two or three shillings as charged in London. As soon as they were hauled up the great spiny fellows stood up and began making a noise resembling the very loud croak of a large frog. No doubt it would have sounded much louder if it could have been heard under water. These crawfish and a few others have the power of producing audible sounds, and the way in which it was done was rather interesting. By means of a drawing on the black-board Professor Stewart showed that in the mid line below the eye segment is that which bears the first pair of antennæ, this segment is provided with two smooth surfaces. On either side of the segment are found the larger second antennæ, the proximal pieces of which are fused together and with the carapace; these second pieces are provided on their

inner and upper borders with file-like surfaces which produce the sound by rubbing against the smooth parts above referred to.

Towards evening, whilst walking on the headland, he found that there were a great many of the large green grasshoppers (*Acrida viridissima*) in the tamarisk trees all around, and that they were making the air quite lively with their peculiarly loud, shrill, and continuous noise. [A drawing of the insect having been made upon the black-board, Professor Stewart proceeded to explain that at the base of the wing on one side there was a kind of ridge which had a serrated edge somewhat like a file.] This dentate ridge was the "fiddle-bow" which was the chief factor in the production of the noise. On the opposite portion of the other wing there was also to be found a very clearly-defined circular space covered by a delicate membrane, and it was by the rubbing of the bow across the hard ridges near this that the sound was produced. Of course it would be of no use for the creature to be able to make a noise unless that noise could be appreciated by its fellows, and so it might be fairly assumed that if any animal had a special apparatus for making a noise it would also be provided with a special apparatus for hearing it. Such an organ was found to exist just below the knee of the fore-leg. Now, though at first sight it might seem to be peculiar, yet it would be seen that after all this was not by any means a bad place for an auditory apparatus under the circumstances, because, as this insect, unlike the other grasshoppers, made a continuous sound, it would be very inconvenient if the organ of hearing was situated near to that which produced so much noise. Clearly, then, this position was well removed from the source of sound. On further examination it was found that in the position indicated there were two slit-like holes, each leading to a cavity, within which was found a kind of tympanic membrane connected by a nerve which could be traced as coming from the first thoracic ganglia. [The special and peculiar form of the nerve terminations was also drawn upon the board.] In the case of the common brown grasshopper the conditions were somewhat different, for, instead of a long-sustained noise, the creature uttered a series of short, sharp chirps, with a very clear interval between them, and therefore they might expect that the mechanism of its audition would be adapted to the circumstances. The sound was produced by rubbing the inner aspect of the femur of the hind leg upon the edge of the elytron, and there was found upon the first segment of the abdomen a small semi-lunar slit, which led into a little chamber. Inside this was a horny ridge, which occupied nearly half its diameter, and a very thin membrane was stretched across this, so that it very much resembled the top of a tambourine. It had been thought that this was an organ for increasing the resonance of the sound, though he inclined to the belief that it was not a sound-producer, and he agreed with those who thought that it was rather an organ of hearing. But, whatever it might be, it was certain that the noise made was intermittent, and that the organ was perfectly in the position for hearing to advantage. Examination showed that from the last thoracic ganglion a nerve ran directly to this part, a fact which went far to show that the arrangement might be an auditory apparatus.

The President felt sure that all present would join in returning their hearty thanks to Mr. Stewart for his very lucid remarks on the sound-producing and sound-receiving organs of these grasshoppers. It was rather interesting to know that the circumstance of a sound-receiving apparatus being situated in the front leg was not confined to insects, but might be traced in the Argasidæ. Professor Hullal, of Berne, had found it in the Persian Argas (*Argas persicus*).

The thanks of the meeting were unanimously voted to Professor Stewart for his communication.

Mr. Morland said that, like Mr. Stewart, he had also just returned from his holiday, only he went in an opposite direction—to Jutland. Whilst there he made inquiries about the famous diatomaceous stone which had frequently been described, but which appeared to be very little known in this country. However, he thought this would no longer be the case, as he had brought over such a quantity that he had to pay considerable excess on his luggage. He had some of the material with him for distribution to those interested in it. In preparing it for examination he had cleansed some by dissolving it in hydrochloric acid and then boiling it with soda. He then treated the residue with sulphuric acid, and finally bleached it with chlorate of potash. He thought the material really came from a great depth: that which he had collected had evidently been thrown up by the waves.

The thanks of the meeting were unanimously returned to Mr. Morland for his communication.

The President called attention to a number of beautifully executed drawings of food-stuffs, &c., which Mr. Connor had brought for the inspection of the members.

Announcements of meetings, &c., for the ensuing month were then made and the proceedings terminated with the usual Conversazione.

The following objects were exhibited:—

Eurycercus lamellatus	Mr. F. W. Andrew.
Head of Plumed Gnat (*Chironomus*), showing all the parts in natural colour...	Mr. F. Enock.
Parasite of Swan (*Ornithobius cygni*)... ...	Mr. H. E. Freeman.
Diatoms from Mors Island, Jutland	Mr. H. Morland.
"Cementstein" from Mors Island	" "

Attendance—Members, 47; Visitors, 2.

October 9th, 1885.—Conversational Meeting.

The following objects were exhibited:—

Section of Eggshell of Emu	Mr. F. W. Andrew.
Actinosphenia splendens	Mr. E. Carr.
Scotch Heather	Mr. A. L. Corbett.
Zoothamnium arbuscula...	Mr. C. G. Dunning.
Navicula Durrandii, Kitton, n.s.	Mr. A. Durrand.
Oakapple fly, *Andrecus terminalis*	Mr. F. Enock.

Reproductive organs male earwig	Mr. F. Fitch.
Section of leaf, *Coffea arabica*	Mr. H. G. Glasspoole.
Lepidopterous larva, s.p.	Mr. W. Goodwin.
Fossil polyzoa from the chalk	Mr. W. M. Holmes.
Isthmia enervis, and *Arachnoidiscus*, in situ ...	Mr. G. E. Mainland.
Hantzschia marina	Mr. H. Morland.
Sponges, Echinoderms, &c.	Mr. B. W. Priest.
Dolerite from Tasmania...	Mr. G. Smith.
Synedra undulata	Mr. C. Upton.
Parasites from Dog	Mr. J. Willson.

Attendance—Members, 50; Visitors, 3.

October 23rd, 1885.—Ordinary Meeting.

A. D. Michael, Esq., F.L.S., F.R.M.S., 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. Charles Collins and Mr. Charles Clayton.

The following additions to the Library were announced:—

"The American Naturalist"	In exchange.
"Journal of the Royal Microscopical Society"	" "
Braithwaite's "British Moss Flora," Part IX...	From the Author.

The Secretary read a letter received from the Secretary of the Croydon Microscopical Society, inviting the co-operation of members of the Club at the 16th Annual Soirée of the Society to be held at the Public Hall, Croydon, on November 18th.

The President said he had brought to the meeting for exhibition a slide which he thought might be of some interest from its comparative rarity, being the larval form of *Antedon rosaceus*, known as *Pentacrinus Europæus*. There appeared to be some difficulty in finding it, and he was rather astonished to hear that the Secretary of the Penzance Natural History Society, who was formerly a member of this Club, had not been successful in doing so. Mr. Thompson, to whose researches they were indebted for most of their knowledge on the subject, and also Sir Wyville Thompson, stated that they had found it upon seaweed, but he had not been successful himself in finding it there, except in occasional instances, his mode of obtaining it being from the crab-pots which were used by the fishermen off the coast of Cornwall. These pots were tolerably large wicker frames, which, when intended for use in a wild sea, were made larger and stronger than usual, so that those in use at the place he had mentioned were about three feet in diameter, and were loaded with about a hundredweight of granite. They were baited with fish, and were then tied together in strings of from 8 to 15, according to the size of the boat which was to carry them. They were then taken out for a mile or

more from the shore and simply flung into the sea with about 80 yards of rope between each pot, and three or four buoys with a long rope to them at each end of the string. The buoys disappeared in the water, but the men got the position by a rough and ready method of sight-lines from objects on shore, and at the turn of the tide the pots were found again without much difficulty ; and if the collector went out in a crab-boat for the purpose of obtaining *Commatulæ*, it would perhaps happen that seven out of eight pots which were hauled up would be without a specimen upon them, whilst others might be covered with them, and thus at the proper time of year the larvæ would be found in abundance. It needed a good sailor, however, to go out to collect them in the boats in this way, as he had done. But by-and-bye there would come a time when these pots had to be brought ashore to be mended, and then occurred one of the best opportunities for the collector, although the specimens thus obtained were not always found in the best condition. He got the men to let him know when a lot of deep-sea pots were going to be brought home, and one of the results of his examination of them was the slide which he had brought down that evening. The President then proceeded to show, by means of drawings on the black board, the general structure and progressive development of this organism, pointing out that it began its life as a free swimming larva, ciliated, and in many respects resembling the Annelids ; that the mouth developed from the front end and the stalk from the hinder portion, which was formed of five basal plates, the front being similarly furnished with five oral plates, and a circle of radial plates being then developed between the other two, all these plates, even at this early stage, had the typical Echinoderm structure. Brachial plates started from the radial plates and the tentacles or claspers curved down from the central dorsal plate. After becoming fully developed, the head broke away from the stalk, and became the beautiful free swimming Commatula, which was however more usually found hanging firmly on to the pots by means of its claspers. It might quite properly be thought of as a star fish upside down. At one time it was usual to regard the *Pentacrinus* form as the perfect creature.

Dr. M. C. Cooke said that he had brought to the meeting for distribution some of the small winged seeds of *Paulownia imperialis ;* the packet contained sufficient for all the members present who liked to take them at the close of the meeting.

He also read short communications "On a new species of British *Vaucheria*" and "On *Palmodactylon Subramosum*," a photo-micrograph of the latter (× 60) being handed round for inspection.

The President invited remarks upon these subjects, observing that it was clear from what they had heard that, although things might have been looked for as carefully as the Algæ had been searched, there was still opportunity for a first-class collector to make new discoveries amongst them.

A short communication from Mr. T. Spenser Smithson, "On an unusual form of tube made by *Melicerta ringens*," was then read by the Secretary.

The President thought that there was some uncertainty in this case as to

whether the variation resulted from the fact that the trough did not contain suitable matter for building, but only some kind of flocculent matter likely to swell, or whether it was a variety as to the building of the tube It was a matter of frequent observation that, in spite of the extreme regularity of the tube under ordinary circumstances, it did vary considerably in confinement, because the creature was then obliged to use such material as it could get.

The thanks of the meeting were voted to the authors of the various communications.

Announcements of meetings, &c., for the ensuing month were then made, and the meeting concluded with the usual Conversazione.

The following objects were exhibited :—

Melicerta tyro	Mr. F. W. Andrew.
Nettle bug, *Capsus capillaris* (pupa)	Mr. F. Enock.
Moth (*Tinea*), from Cacao bean	Mr. H. Epps.
Melicerta cephalosiphon	Mr. E. K. Jaques.
„ *ringens*	„
Crinoid larva of *Antedon rosaceus* (*Pentacrinus Europæus*)	Mr. A. D. Michael.
Cocconeis, n.s.	Mr. E. M. Nelson.
Pisciola geometrina	Mr. C. Rousselet.
Section of carboniferous limestone containing Foraminifera from Stafford	Mr. G. Smith.
Crystallized silver	Mr. W. Watson.
Head of White Ant	Mr. J. Willson.

Attendance—Members, 46; Visitors, 5.

November 13th, 1885.—Conversational Meeting.

The President having called the attention of the members, said that since the last meeting the Club had suffered a great loss in the death of Dr. Wm. B. Carpenter—a death rendered more sad by the circumstances under which it had occurred. No name was more intimately connected with the progress of microscopical science in this country than that of Dr. Carpenter, whose well-known work on the microscope had passed through so many editions, and was still the leading English treatise upon the subject, and was probably in the library of almost every man in the room. Dr. Carpenter's name was not known in connection with microscopy only, but equally in the departments of physiology, and comparative biology. Throughout his life he had been a steady and industrious worker, and few men had left behind them more substantial proofs of the wide and constant nature of their scientific labours than he had.

The Quekett Club would feel his loss all the more acutely on account of the very late period at which he had been their President; indeed, but for his failing health he would have filled the chair up to the time of his death,

and, although he had retired from office, he was engaged at that very period in negotiations for the benefit of the Club.

The President then put from the chair the following resolution, which had previously been passed by the Committee:—"That the members of the Quekett Microscopical Club desire to record their deep sorrow for the death of their late accomplished President, Dr. Wm. B. Carpenter, and to express their sympathy with his family in the loss they have sustained, and their conviction that although Dr. Carpenter has passed away, his world-wide reputation as one of the most eminent in microscopy and physiology will long survive him."

This resolution was unanimously passed by the members.

The following objects were exhibited:—

Lucernia auricula	Mr. F. W. Andrew.
Spiracle and trachea of silkworm	Mr. C. Collins, jun.
Coral from Singapore	Mr. A. Durrand.
Head of *Culex pipiens*, showing antennæ in their natural form and colour ...	Mr. F. Enock.
Section of Cementstein, from Mors, Jutland.	Mr. H. Morland.
Diatoms, with dark ground and binocular $\frac{1}{16}$ O.G.	Mr. E. M. Nelson.
Stentor polymorphus	Mr. C. Rousselet.
Parasite of Vulture	Mr. A. Tipple.
Pleurosigma angulatum	Mr. C. Upton.
Type slide of *Holothuridæ*	Mr. W. Watson.
T. V. section of Bignonia	Mr. J. Willson.

Attendance—Members, 53; Visitors, 4.

November 27th, 1885.—Ordinary Meeting.

A. D. Michael, Esq., F.L.S., F.R.M.S., 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. F. Harris, Mr. F. G. Lloyd, and Mr. G. T. Stevenson.

The following donations to the Club were announced:—

"Proceedings of the Royal Society of New South Wales"	In exchange.
"American Monthly Microscopical Journal" ...	,, ,,
"Proceedings of the Geologists' Association" ...	,, ,,
"The American Naturalist"	,, ,,
'Proceedings of the Belgian Microscopical Society"	,, ,,
"Transactions and Report of the Eastbourne Natural History Society"	,, ,,
"Pritchard's Microscopic Objects"	From Mr. Crisp.
Two Slides—1, Section of Jutland Cement Stone; 2, Coscinodiscus, from ditto	,, Mr. Morland.

The thanks of the meeting were voted to the donors.

The Secretary said that a member of the Club had placed in his hand the card of Mr. Webb, of Albany, Western Australia, who, he said, could be strongly recommended as a collector of natural history specimens in that Colony. He mentioned the matter knowing how valuable it sometimes was to know of a person who could be relied upon in the event of his services being required.

Mr. Nelson exhibited and described a new aplanatic lens, recently made by Zeiss, of Jena.

The President said he had the opportunity of seeing those lenses a short time ago, and was greatly pleased with their performance. The field was extremely large and flat, and the focus was much longer than that of lenses of ordinary construction.

Mr. Nelson then read a short note "On a New Method of Equalising the Thickness of Slips of Glass for use with Immersion Condensers," and also a paper "On Microscopical Antiquities," illustrated by numerous diagrams of the various types of the early forms of microscope.

Mr. J. D. Hardy said he had brought down the old instrument referred to by Mr. Nelson, at his request, but he had not used it so as to ascertain its capabilities. It was a beautiful piece of brass work.

Mr. Karop said it seemed a most extraordinary thing, on looking at the illustrations before them, to observe with what facility makers seemed to devise mechanical figments to be added to the microscope with no possible advantage to the worker. The French and Germans adhered to the simple forms much more than the English did, and it was only necessary to look at one of those instruments of the Varley type to see that it was filled up as far as possible with racks, and pinions, and screws, and caps, until it seemed as if the object was to prevent its use as a microscope as far as possible. It was really quite curious to see the diabolical ingenuity of mechanism introduced into some of the most modern specimens.

The President said that he was sure they would feel that their best thanks were due to Mr. Nelson for his very interesting and welcome paper, which had afforded them a great deal of information, and had certainly involved a great deal of research. The paper would have been of value to them for its antiquarian interest alone, but apart from that it had almost a greater interest, because it showed them the various stages in the growth of the instrument with which they worked, and it taught them how the wants of the workers had become gradually felt, and what steps had been formulated by men of intelligence gradually to meet those wants. The consideration of these wants, and the way in which they had been met, might have a yet further value as a possible guide to what might probably be the course to be taken in the future—for by showing them in what way men got over the very serious difficulties which involved the growth of the microscope, they might to some degree be guided as to the course to be pursued in the case of instruments which had not reached the perfection to which the microscope had been brought in the present day.

The thanks of the meeting were voted to Mr. Nelson for his communications.

Mr. Henry Davis read a paper "On some Further Notes on the Dessication of Rotifers." Specimens of dried mud containing *Philodina roseola* were offered to those members who cared to apply for them.

The thanks of the meeting were, upon the motion of the President, unanimously voted to Mr. Davis for his very interesting paper.

The President announced that in consequence of the 4th Friday in December falling this year on Christmas Day, their ordinary meeting for that month would be omitted—so that their next ordinary meeting would not take place until January.

The proceedings then terminated with the usual Conversazione.

The following objects were exhibited :—

Spirorbis nautiloides	Mr. F. W. Andrew.
Section of Cementstein...	Mr. W. J. Brown.
Head of Silkworm	Mr. C. Collins.
Rotifers, *Philodina roseola* dried and re-animated	Mr. H. Davis.
Selected Foraminifera, from Singapore ...	Mr. A. Durrand.
Plumed gnat, *Tanypus zonatus*	Mr. F. Enock.
Ovipositor and sheath of *Phalangium Opilio*	Mr. F. Fitch.
Aquatic worm	Mr. G. E. Mainland.
Head of *Cysticercus*, from Hare	Mr. W. Watson.
A Cuthbert-Amici Microscope, dated 1827	Mr. J. D. Hardy.

Attendance—Members, 55 ; Visitors, 8.

December 11th, 1885.—Conversational Meeting.

The following objects were exhibited :—

Fairy shrimps, *Chirocephalus diaphanus* ...	Mr. F. W. Andrew.
Chelifer muscorum	Mr. C. Collins, jun.
Cows Chervel, *Chærophyllum*	Mr. A. L. Corbett.
Head of tree spider, *Philodromus*, showing eight eyes, nat. colour	Mr. F. Enock.
Abnormal concretion on the surface of an egg shell	Mr. H. E. Freeman.
Type slide of selected diatoms, from Mors Island, Jutland	Mr. H. Morland.
Tegenaria atrica (male)	Mr. G. E. Mainland.
Arachnoidiscus ornatus, with $\frac{1}{6}$ objective and dark ground...	Mr. E. M. Nelson.
Pikrite, from Gumbelberg Nassau	Mr. G. Smith.
Spines of Echinus	Mr. W. Watson.

Attendance—Members, 48 ; Visitors, 8.

Note on a New Form of Live Box or Zoophyte Trough.

By C. G. Dunning.

(Read January 22nd, 1886.)

Fig. 13.

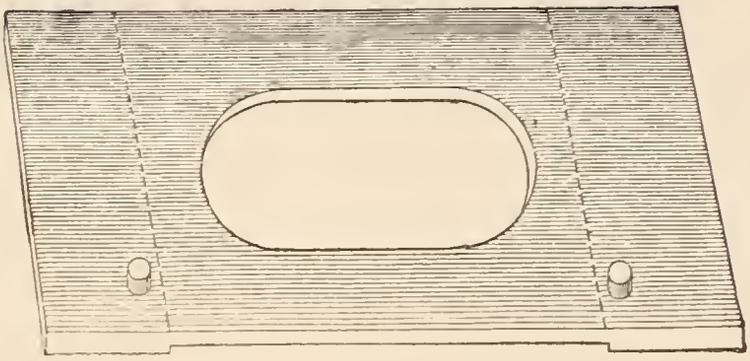


Fig. 14.

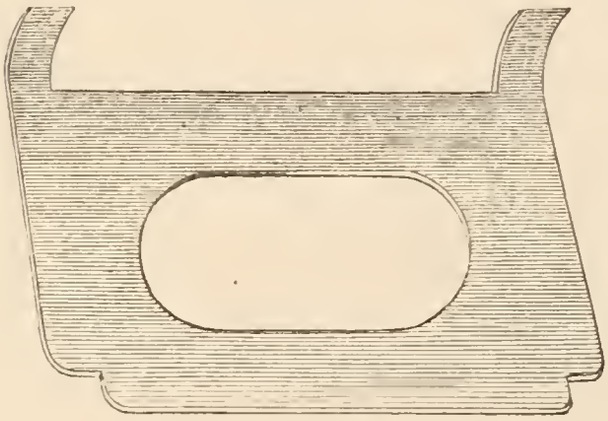
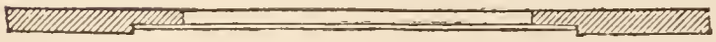


Fig. 15.



All who have occasion to work with the ordinary forms of zoophyte trough are aware of the difficulty and the risk of breakage there is in cleaning them, more especially with the shallower forms.

The apparatus shown above is designed with the view of overcoming this difficulty.

Fig. 13 is a plan view of the trough with the cover removed, Fig. 14 a similar view of the cover, and Fig. 15 a longitudinal section of the trough through the centre of figure 13.

The lower plate, or trough proper, is made of metal, or some other suitable material, 3 inches long, $1\frac{1}{2}$ inches wide, and about $\frac{1}{10}$ inch thick, with an oval or oblong perforation in the centre, and the under-side is recessed as indicated by the dotted lines. In this recess is fixed by means of Canada balsam, or shellac, a piece of stout covering glass, forming the bottom of the cell; the recess being sufficiently deep to prevent the thin glass bottom from coming into actual contact with the stage of the microscope, or with the table when it is not in use. Two pins are provided near the bottom edge of the cell.

The cover (Fig. 14) is formed of a piece of thin brass rather shorter than the trough, but about the same width; it has an opening formed in it to correspond with that in the trough, and under this opening is cemented a piece of cover glass. The cover plate is notched out at the two bottom corners, and at the two top corners are formed a couple of projecting ears.

In order to use this apparatus it must be laid flat upon the table, and filled quite full of water. The object to be examined is then placed in the cell, and may be properly arranged therein; the cover is then lowered gently down, the two notches at the bottom edges being first placed against the pins; in this way the superfluous water will be driven out, and the whole apparatus may be wiped dry. The capillary attraction, assisted by the weight of the cover, will be found sufficient to prevent any leakage; and the pins at the bottom prevent the cover from sliding down when the microscope is inclined.

Although there is, of course, no supply of air, I have had *Vorticella*, zoophytes, &c., under observation for more than two hours at a time, without any change or renewal of the water; but even if it should be deemed necessary to introduce a fresh supply, it can easily be done by carefully lifting the cover by the two ears at the top, and making the addition by the aid of a pipette.

The apparatus is intended more especially for use as a shallow cell, with moderately high powers, but its depth may be readily increased by means of an intermediate trough, either of metal or ebonite, which may be inserted between the trough and the cover, and will be found to be quite free from leakage.

The area of the cell as above described is rather large, as

being more convenient for zoophytes, &c., but should it be thought desirable to restrict the movements of a lively object, such as an *Ephemera* larva, it is only necessary to select a glass ring a little thinner than the depth of the cell, place it in the centre, and fill the *whole* cell with water. The object may then be placed within the ring, and the cover applied as before stated.

On Spongilla fragilis found in the Thames.

By B. W. Priest.

(Read January 22nd, 1886.)

Plate XV.

In November, 1882, I had the honour of reading a paper to you on the Statoblasts of the Fresh-water Sponges, at the same time, as you will recollect, enumerating the different species then known, but I was not aware of the numerous Fresh-water Sponges which were being found and classified, in the United States, by Messrs. Potts, Mills, and Thomas. Through the kindness of Mr. Crisp, I was brought into communication with Mr. Thomas, of Chicago, who was most generous in supplying me with several of the species met with in America.

Among those sent was one which forms the subject of the present communication, viz., *Spongilla fragilis*, so named by Professor Leidy, but previously and first made known by Mr. J. K. Lord, who found it in Lake Osogoos, and other lakes and rivers, tributaries to the Columbia River, on the Eastern slopes of the Cascade Mountains, about 6,000 feet above the level of the sea. Out of compliment to the discoverer, the late Dr. Bowerbank named it *Spongilla Lordii*, the type specimen of which is, I believe, in the Natural History Museum, South Kensington. I can find no record of its being found again until Professor Leidy met with it. Dr. Bowerbank had predicted that it might be found one day in the United States, as he had observed fragments of similar spicules in the infusorial earth collected and sent to him from that quarter.

The Sponge itself is sessile, coating and encrusting stones and pieces of wood and weeds; structure fragile—hence the name given by Professor Leidy—crumbling so much that where there is a dashing of water, as on the banks of the river, most of the skeleton, according to Mr. Mills, of Buffalo, is washed away, leaving in many cases the statoblasts in a bare continu-

ous layer. Oscula simple, dispersed, pores inconspicuous. Colour light brown to green. Skeleton spicule, acerate, sometimes curved, fusiform, gradually sharp-pointed, smooth and sometimes inflated in the centre. Statoblasts somewhat bottle-shaped, congregated on the basal membrane beneath the sponge, with the aperture upwards, chitinous coat hemispheroidal, aperture prolonged by a short tubular extension, the chitinous coat being of a dark amber colour, covered by a thin granular crust, with small curved or fusiform cylindrical, entirely spined spicules, the basal membrane abundantly spiniferous and of the same form as those covering the statoblasts, those on the statoblasts being arranged more or less tangentially.

Now for the subject of this communication. Up to the present time only two species of fresh-water Sponges have been recognised in England, viz., *Meyenia fluviatilis* and *Spongilla lacustris*, the former having the crust of its statoblasts charged with birotulate spicules, one end resting on the chitinous coat and the other protruding more or less on the surface, the other species having curved, minute, stout, fusiform, spined spicules arranged tangentially on the statoblasts. Of course we have several so-called varieties of the same, which to my mind are only caused by the variations of surrounding circumstances, such as the slow or rapid flow of the water, with the different amount of light and shade, accompanied by changes of temperature, all of which conditions must influence the development and colour of the Sponges to a great degree.

On the fourth of September of last year I went to Shepperton, walking over to Walton-on-Thames, and in one of the back waters, called, I am told, Walton Sale, growing on the submerged roots and branches of the willow trees overhanging the stream, I collected a quantity of very good typical specimens of both species. On examining what I had collected the next morning, I discovered about an inch of a branch, on which some Sponge had developed an incrustation, and on examining it under the microscope, it proved to be *Spongilla fragilis*, one layer of statoblasts partly overlying the other, and partially covered with *Meyenia fluviatilis*. It answered exactly to the description I have just now given of that species, also described by Mr. Mills, in having only a very small portion of the Sponge structure remaining, leaving the statoblasts in a more or less con-

tinuous layer, the species being infested with innumerable enemies, which devour the sarcode and other living portions of the sponge.

Now the question is, whether *Spongilla fragilis* is to be accounted a British Species, or has it simply got into the Thames by accident? I do not profess that the sponge is entirely new to England, as it was found, for the first time in 1884, by Mr. Stewart Ridley, of the British Museum, in the River Wye. Perhaps, as we, as a nation, are becoming very much Americanised, the Wye and the Thames have caught the infection. At any rate, it has now been found in two of our rivers, and I am inclined to the belief that other species will be found if sought for, from the fact that a number of fresh-water deposits containing sponge spicules have been met with, belonging to species as yet undescribed, and noticed even as far back as Ehrenberg's time.

No record of *Spongilla fragilis* being found in the Thames until now, I thought this communication would be appreciated by those members of the Club who are interested, like myself, in sponge lore.

Perhaps I may mention that since writing this communication I have received some more Fresh-water sponges from Mr. Thomas, of Chicago, and he calls my attention to one packet containing *Spongilla fragilis*, in which the statoblasts are more or less in a compound or grouped state. On examining the Thames specimen I found several statoblasts in that condition.

Explanation of Plate XV.

Fig. 1. Statoblasts of *Spongilla fragilis* as they appear *in situ*.

Fig. 2. A Statoblast isolated from the mass showing the flask-like shape.

Fig. 3. Spicule of statoblast and basal membrane.

Fig. 4. Skeleton spicule.

Fig. 5. The grouped or compound form of statoblasts.

A. M. Priest del. W. Rhein sc.

Some Remarks on the Interpretation of Microscopic Images with High Powers.

By E. M. Nelson.

(Read January 22nd, 1886.)

The answers to biological questions, or the keys to Natural History puzzles, as they may be appropriately called, are, thanks to the improvements in the microscope, becoming more minute every day. The inch and half-inch objectives have unlocked many of Nature's hard enigmas, but as the ground is being worked over by higher powers there is less left within their range.

It is with guns such as the wide-angled oil $\frac{1}{12}$ that we must pound away at Nature's citadels if we wish to capture her strongholds. The interpretation of a microscopic image under an inch or half-inch presents but little difficulty, but in the use of lenses such as the wide-angled oil $\frac{1}{12}$, two questions have to be answered before you can satisfy yourself that your interpretation of the image is correct. These are: (1) Is the object precisely in the focus of the objective? (2) Is the lens in perfect adjustment?

It is well known that slight variations in either focus or adjustment, or both, will produce a marked effect on the resultant picture. There cannot be, therefore, two more important questions for the microscopist of to-day than: What is focus? What is adjustment?

The difficulty in solving these questions will depend largely on the kind of object under examination.

Bacteria, stained and mounted in balsam, form a class of objects which, perhaps, offers fewer obstacles than any other to the solution of these questions, hence they are suitable for test objects. Even with these easy objects some discussion has taken place with regard to the interpretation of the image. There are those who say, that a certain bacillum consists of a number of elongated spores within a cylindrical hyaline sheath;

others that it resembles a string of sausages with constrictions in it. This difference in the interpretation of the images of the same object is mainly to be accounted for by variations in focus and adjustment. If such differences are present in these comparatively easy objects, we may expect to find them greatly increased when viewing objects that present greater difficulties in the determination of focus and adjustment.

Such are diatoms, owing probably to the transparency of the silex of which they are composed. To find the truth of this one has only to turn to the extensive literature on what may be termed "the resolution of the markings on the diatomaceæ," and he will find such expressions as striæ, checks, areolæ, punctæ, white dots, black dots, hemispherules, pearls, beads, etc., used to denote the same thing. Now let us take the *Pleurosigma formosum*, and, setting aside the striæ and diamond-shaped markings as quite exploded things of the past, apply ourselves to the consideration of the more recent interpretations. There are two kinds of markings which we shall have to discuss thoroughly. I name these the white dot, and the black dot. The white dot is usually accepted as the critical image of this, and other diatoms.

To show that this is so, let me refer you to the photograph of *Navicula rhomboides* by Dr. Woodward, copied in the "Monthly Microscopical Journal" for May, 1876; also to his photograph of *Pleurosigma angulatum*, copied in Dr. Van Heurck's "Synopsis." Both these show the pearls, beads, hemispherules, or what I have called the white dots. I endeavoured to show that these appearances were erroneous, at the demonstration I gave here on March 14th, 1884, but could not, for want of time, go into the matter at sufficient length; I hope you will pardon me therefore, for again referring to it. When examining a *P. formosum*, in balsam, with the black dot resolution, I noticed that one or two of the dots were very pale. It appeared as if those identical dots, or hemispherules had been removed, leaving the plain silex underneath. On changing the resolution for that of the white dot I found all the dots equally perfect. I could not tell where the damaged beads were situated. There is not a shadow of doubt in my mind as to which of the two is the truer picture. The black dot which differentiates between one or two of the markings and the rest

must of necessity be a truer picture than that which shows them all as being precisely similar. I was very much struck on first noticing this differentiation. I carefully noted the valve, and the part of the valve, where it occurred. I have spent, now, upwards of five years working at this same spot, to see if I could get any elucidation as to the cause of these appearances. My work was not without reward, for by increasing the angle of my axial illuminating cone, I found that the black round dot appearance gave place to a reddish square hole in the silex. The dot that was missing showed that that hole had been filled up or coated over with silex. Afterwards I saw a spicule of silex sticking into one of the perforations. Latterly I have discovered a very minute bar of silex stretching across one of the perforations, dividing it into two nearly equal portions. This constitutes probably the smallest, as well as the most difficult, point of detail I have ever seen with the microscope. The apertures count 24,000 per inch in one direction, and 29,100 in the other direction. To find the size of a single aperture is a more difficult matter. If you measure it by the wire micrometer the thickness of the wire renders it difficult to see the edge of the hole. By this means, however, I got a measurement of $\frac{1}{45500}$ inch. I estimate that the diameter of the hole is about equal to the thickness of the intervening silex. This would give $\frac{1}{48000}$ inch as the diameter.

The thickness of the bar has been estimated at $\frac{1}{5}$ of the diameter of the hole. Taking the largest measurement of this, viz., $\frac{1}{45500}$ inch, would give $\frac{1}{227500}$ inch as the thickness of the bar. I have lately very carefully re-examined this object with the view of estimating its size, and I feel confident that this measurement, if it errs at all, is, if anything, too large.

I have previously given it as my opinion that the *P. formosum* was composed of a square grating, but since my discovery of the bar I have modified those views. I now know that I was taking too deep a focus, and I am of opinion that the perforations are circular, or nearly so, on the exterior surface of the valve, and that they cone off to a square grating on the under surface; in other words they are funnel-shaped, with the small end of the funnel circular and towards the exterior of the valve, the large and square-shaped end towards the interior.

Some will say that all this is a work of supererogation, the

proper method being the examination of diatoms such as *Triceratium*, etc., in section. To this I reply that diatoms are of two kinds, those possessing a single structure and those which have two. The *Pleurosigma*, *Navicula*, *Schizonema*, etc., belong to the first class. They are boxes formed by a very delicate silicious perforated membrane. I look on the median line as a girder to strengthen the delicate membrane. All these kinds of diatoms you will notice are small.

When we come to larger diatoms, such as *Triceratium*, *Isthmia*, *Coscinodiscus*, *Actinoptychus*, etc., we find a two-fold structure. I regard the delicate perforated membrane as the structure which is of primary importance to the living organism inside, and the main areolations as of secondary importance, as being girders for the support and protection of that delicate perforated membrane.

With regard to the sections, they only confirm what had been found out before with a half-inch objective and the stereoscopic binocular, viz., the nature of the girder work. I very carefully examined those of the *Triceratium* exhibited by Messrs. Powell and Lealand at the Royal Microscopical Society, under one of their oil $\frac{1}{16}$ N.A. 1·43. The perforations in the delicate membrane were wholly invisible. These perforations when viewed on the ordinary valve, not in section, can be seen as *markings*, with a common half-inch objective (mind, I do not say you can see them as *perforations* with a half-inch) —in section they were invisible under one of the finest objectives ever made. It is committing a grave error to seek for a solution of the nature of the delicate membrane by examining those diatoms which have a double structure, because in those diatoms the perforations in the delicate membrane are very minute.

The very fact of a diatom having a very strong girder framework points to the probability of the perforated membrane being very delicate. It is a wiser plan to examine those diatoms which have a bold single structure, such as the *P. formosum* and the *Tryblionella punctata.*

To return to the bar, a curious feature of this minute object is that it is exceedingly sensitive to focus; the smallest appreciable alteration in focus and it is gone. Until I saw this object I was ignorant of the extreme delicacy of focus of the

oil $\frac{1}{12}$ N.A. 1·43. The so-called transverse striæ on the *A. Pellucida* would remain not only in view, but sharp, under an alteration of focus sufficient to obliterate the bar.

Some may think that these minute points are unworthy of attention, but they are important, as they are the means by which correct adjustment and focus may be found out. When you have objects such as these in view you cannot be focussing and adjusting on a spectral image. Knowing this, I have been able to see that the white dots, hemispherules, beads, or pearls are not the images of the perforations at all, but are caused by the refractions of the cross pieces of silex between four adjacent perforations.

These fine details can only be seen by a direct axial cone of large angle. They are completely obliterated under oblique light. I will now, if you will allow me, sum up the lessons taught by this resolution. They are five in number.

1. There are no such things as markings on the *Diatomaceæ*. The so-called markings on the *Diatomaceæ* are the structure of the *Diatomaceæ*. One might, with equal propriety, call ribs markings on a skeleton.

2. The complete destruction of the hemispherule, bead, and pearl theory.

3. The contradiction of the statement "that you cannot know anything about the structure of the *Diatomaceæ*, because all the diffraction spectra are not taken up.

4. The great superiority of illumination by an axial cone to that by an oblique pencil.

5. The solution it affords to the questions—What is focus? What is adjustment?

Observations upon a Species of Gamasus supposed to be unrecorded.

By A. D. Michael, F.L.S., F.Z.S., F.R.M.S., &c.

(Read March 26th, 1886.)

Plate XVI.

I have already mentioned at this Society that for some years past I have been investigating the life-histories of certain parasites of the mole; and that this inquiry led me last Christmas to examine the nests of the moles, in which I discovered several species of *Acarina* not connected with my original subject, and which I believe to be unrecorded. Amongst these was the fine *Gamasus* which forms the subject of the present paper. Although I have not been able to find any record of the creature, yet in one stage at least it has certainly been found before, because I have in my cabinet a preparation given me some years since by Mr. Freeman, of this Society, which is marked as coming from the mole, and which is an immature stage of this species. A careful examination of such records as I was acquainted with showed me that this species was so similar to the *Gamasus magnus* of Kramer,* that I was at first inclined to think that they were either identical, or so similar as to render it undesirable to devote a paper to its description; for although in groups which have been well worked out, as the *Lepidoptera*, it would be quite worth recording a single new British species; yet amongst the less-known families of *Acarina* I do not usually think it worth devoting a paper to a single new species, unless it has something connected with it that renders it exceptionally deserving of notice. When, however, I came to examine into the structure of this creature, I found that, in spite of the resemblance, it was not Kramer's species, and in the course of the investigation so many points of its anatomy and habits seemed to me interesting and worthy of a record,

* "Zur Naturgeschichte einiger Gattungen aus der Familie der Gamasiden," 'Archiv. für Naturg.,' xlii, Jahrg. (1876), 1 Bd., p. 91.

that I was led to reconsider my intention of abandoning this paper.

The species is a large and handsome one; indeed, the largest and most powerful *Gamasus* that I am acquainted with, and its dorsal plates are divided into small parts, by fine sutures or markings, looking like the scales of a fish, which is also the case with Kramer's species. The form and structure of the second pair of legs in the male is also very remarkable, but here again it resembles Kramer's species. There are, however, numerous more or less important differences from that species; those which have merely a value as distinguishing species I shall leave for the description at the end of this paper, and shall only mention here those which seem to have a wider interest or to be otherwise remarkable.

What struck me first was the form of the so-called oral tube. In Gamasids in the median line of the anterior edge of the body, and lying below the dorsal plate and above the ventral there is a short, wide, chitinous tube (the oral tube), Pl. xvi, Fig. 12. This tube can be nearly retracted within the body, or almost entirely exerted. It is formed below by the maxillary lip, with its parts corresponding to the galeæ of insects, &c., and with the maxillary palpi attached; and above it is formed of what may be considered as equivalent to a labrum or epistome. Through the hollow of the tube (lumen) the protractile mandibles (chelæ) are protruded; or darted would give a better idea of the motion, and the lingula, &c., are within the tube. The epistome is variously shaped in different species, and is often of very quaint pattern. The mandibles also vary greatly, although always chelate in the true Gamasids. This variety of the mandible is chiefly in the male sex, and modern writers upon the group have distinguished species chiefly by the form of these two parts, and in most of their writings these are the only parts figured. It has been fully recognised that the mandibles of the males and females commonly differ, and only those of the male are usually drawn, as there is not much variety in those of the female, but I am not aware that any one has ever remarked any sexual difference in the form of the oral tube, and the epistomal portion of it is usually figured for the identification of species without mentioning which sex it belongs to. In the present species, however, I found to my surprise that the

epistome is quite different in the two sexes, that of the male (Fig. 4) being a triangular or somewhat lancet-shaped blade, nearly as broad as long; while that of the female (Fig. 12) is a long, strong, narrow spine, with two small teeth near the base, and then widening; this is more the form of the epistome in Kramer's species. This seems to me to have a somewhat important bearing on this system of classification, as where one species varies in the two sexes, it is probable that there are others that do the same; therefore, where figures of the oral tube, or epistome, are given, it would probably be desirable to say which sex they belong to, or whether both sexes are alike.

The next part requiring notice is the mandible of the male. It has been mentioned that these organs vary much in form, there being often chitinous appendages to the chela which assume the most singular shapes. In Kramer's *G. magnus* the upper (fixed) limb is about half as long again as the lower (movable) limb, and forms an irregular cone with a blunt, rounded point. Just at the first glance the mandible of the present species looks as though it were an exaggeration of the same thing, as one limb is longer than the other; but it is soon seen that what exists here is exactly the contrary of the arrangement in Kramer's species. The fixed limb here is quite short, and has one terminal bifid tooth, and one large single tooth. The movable limb is immensely prolonged, being more than five times as long as the fixed limb. It forms a great spear-like organ, along the distal half of which in the upper median line runs a thin, sharp blade. The point is extremely sharp, so that the whole structure is a formidable weapon. This brings me to an interesting feature in the use of this mandible. I ventured to assert some time since that some species of *Gamasus* which I had been breeding for the purpose of a previous inquiry* were strictly predatory creatures. My reason for this was that I failed to get them to eat vegetable food, but that they fed eagerly upon cheese-mites, and throve excellently on that diet through several generations. Some of the Italian Acarologists, however, doubted this, and maintained their previous opinion, that all the *Gamasidæ* fed upon decaying vegetable matter. The present species certainly is predatory in

* "Observations on the life-histories of Gamasinæ, with a view to assist in more exact classification," 'Journ. Linn. Soc. Zool.,' Vol. xv. (1881), p. 297.

the most marked and obvious manner. I found it in the moles' nests, and brought home and preserved nests and all in their natural condition. I had plenty of specimens of the Gamasids, and they were amply supplied with the vegetable material in which they lived, but I did not ever find them feeding upon any vegetable matter; whereas, both when I first obtained them, and afterwards during the time I kept them, I was continually finding the Gamasids with small wire-worms and other larvæ of beetles, &c., and small worms, and even mole-fleas in their mandibles. The larvæ were often so large that they dragged the *Gamasus* about while he was devouring them; but the *Gamasus* always held on, and sucked his victim quite dry. Sometimes he would kill it by darting his lance-like mandibles through and through it. All these processes were easily watched under the microscope, and when I wanted to keep a *Gamasus* alive in a separate cell for observation I fed it on soft-bodied larvæ, which answered admirably. For its size, this *Gamasus* is one of the most ferocious creatures I ever had to deal with.

The above-named use is not the only mode in which the mandibles are employed. I was quite unprepared for another purpose to which I found that they were applied. The great difference between the mandibles in the two sexes, and their singular development in the male, naturally lead the observer to suspect that in this sex they might subserve some sexual purpose; but on reflection it seemed, perhaps, more probable that they were merely correlated. I observed in the specimens that I had killed for preparations that the two mandibles were always extruded to the same extent; now, the ordinary, strongly-chelate mandibles of Gamasids are more usually extruded alternately, and then specimens which have been killed are found with the two mandibles unequally advanced. I, therefore, suspected that in this species the mandibles might be protruded at the same instant. I carefully observed the living creature, and found that this was always so. It, however, had not any particular significance for me until after I had made other observations. It so happened that I found a considerable number of males and females *in coitu*. I noticed that the mandibles of the male were bent downward toward the female in a manner which seemed to me singular. On separating one of the males from its com-

panion, I found a flask-shaped, rather egg-like object, semi-transparent and rather opalescent, adhering to both mandibles, and placed between the mandibles near the bases of the chelæ. I at first thought it was some accident, so I separated two or three more, and in each instance found exactly the same thing. It then struck me that, although it seemed highly improbable, yet it was just possible that it might be a poison-sack; the position at the base of the movable chela being suspiciously like that in the spider, although it was not likely that the sack would be outside, unless it were temporarily distended and afterwards retracted. It also seemed improbable that the male would be killing the female; but as the converse readily takes place with spiders, it was not impossible. To decide this question, I firstly separated a male *Gamasus* from a beetle larvæ which it was killing, but there was not any object between the mandibles. I repeated this several times, but always with the same result. Finally, I examined numerous mandibles under different circumstances, but did not ever find the object between the mandibles, except in the cases where the *coitus* had been disturbed, and then I invariably found it; the object being attached to *both* mandibles, so that it could not be withdrawn into either, and should show at ordinary times, whereas the mandibles were usually quite clean and detached, without any trace of a tie between them. I now accidentally separated a pair in which I suspect that the *coitus* had only just commenced, and here I did not find anything on the mandibles; but I found a precisely similar flask-shaped object emerging from the genital aperture of the male; the glutinous matter around it dried, and it remained attached there. I now dissected a male, and found in the hinder part of the body, but communicating with the genital opening, two large sacs filled with these flask-shaped objects. The flasks themselves always showed a granular mass inside, and when this was extracted by any means it broke up into what had the appearance of the motionless semen common amongst the males of the *Acarina*. My conclusion from all this was that, in the present species at all events, the male semen is enclosed in masses, in large capsules or spermatophores, which are stored in what answers to Needham's sac in the *Cephalopoda*, and are extruded singly, and applied to the genital organ of the female by the singular mandibles of the male,

which are also possibly used in lifting the large chitinous flap which covers the female organs.

During the last-mentioned observations I had an opportunity of seeing how the great apophysis on the enlarged second leg of the male was used to retain the female. I found that it was hooked round the leg of the female, giving a very firm grasp.

I may also call attention to a remarkable axe-blade-shaped chitinous projection on the second joint of the first leg of the male. This leg is a tactile organ, but I am not able to give any explanation of the use of this piece.

Finally, I may mention that this is one of those species where the dorsal shield is divided into two in the adult. I fear that Dr. Kramer thought that, in my paper above referred to, I denied that the adults ever had the dorsal plate so divided, and asserted that it was a sign of immature condition. I fear that the language of my paper must have contained some ambiguity which might mislead a foreigner, even when as well acquainted with English as Dr. Kramer is; but certainly I never intended to state anything of the kind. I was well aware that in some kinds the adults showed the dividing line; but what I wished to say was that, in the particular species I was then investigating, the plates were divided in the immature creature, but did not show any division in the adult; and that as some species had the plate divided in the nymph and larva, but not in the adult, and as the division of the plate could often be seen on the cast skin or on a dissection when it could not be seen on the living creature, I thought that the division of the plate was not a character upon which it was desirable to found a classification. As I have not written any paper on the *Gamasidæ* since that as to which the mistake occurred, I have not had an opportunity of correcting it before.

Gamasus terribilis, n.s.

Male.

Average length about					1·72	m.m.
,,	breadth ,,				1·07	,,
,,	length of	1st	pair	of legs about	1·40	m.m.
,,	,,	2nd	,,	,,	1·09	,,
,,	,,	3rd	,,	,,	·95	,,
,,	,,	4th	,,	,,	1·35	,,

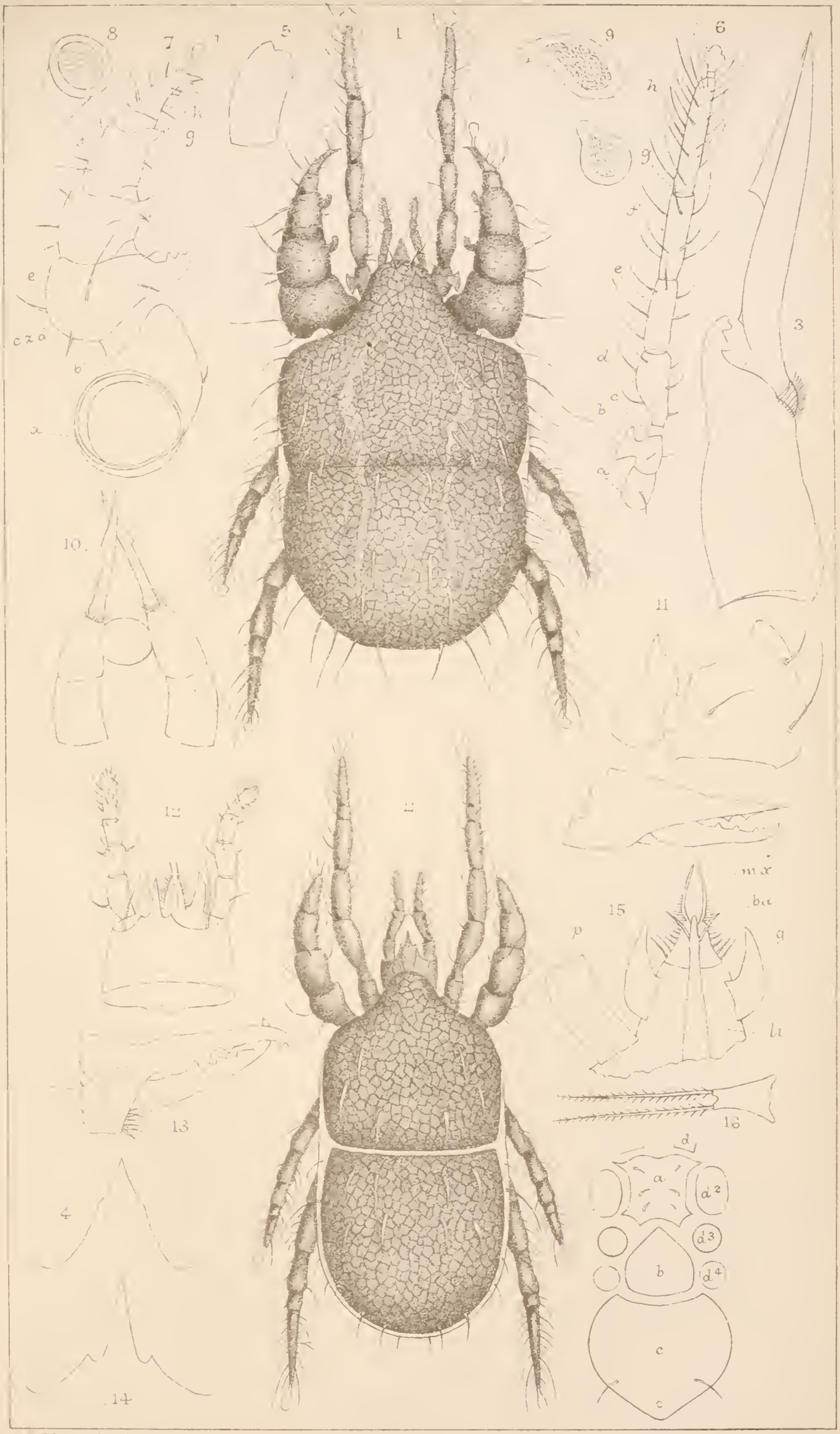
Colour—Yellow-brown, of medium depth, legs darker.

Texture—Smooth, but not polished.

Body—Form almost oblong, except the anterior margin of the dorsal shield, which projects strongly in the centre, above the oral tube, and has a very rounded outline in the projecting portion. Dorsal shield separated from the ventral, and divided in the centre by a transverse line, and slightly indented at that place, showing the membranous margin. Oral tube, with upper part (epistome) simply triangular (Fig. 4) with smooth edges. Mandibles (Fig. 3) with the shaft (first joints) short; the fixed limbs of the chelæ (second joints) short and tridentate, *i.e.*, with one bifid tooth at the end and one large single tooth; the movable limb (third joint) very long, five times as long as the fixed limb; almost straight, spear-like, sharp-pointed, with one large tooth near the base, and a thin, sharp blade, deepest posteriorly, running along the median line of the distal half, and ending quite suddenly. There is a semi-circle of stiff bristles just behind the articulation of this limb of the chela. Some of the hairs on the palpi are pectinated (not strongly). There are four fine, white hairs on the projecting portion of the anterior edge of the dorsal plate, and numerous similar hairs round the periphery, and on the dorsal plate.

On the ventral surface the sternal plate is undivided, and the ventral and anal plates are fused, but separate from the sternal and dorsal plates. There is a chitinous arch over the genital opening.

Legs of moderate length; the first pair (Fig. 6) thin and straight; joints of nearly equal thickness throughout. The second joint (Fig. 11) has a great axe-blade-shaped chitinous projection in the median line above. This leg terminates in a membranous pad in which the shaft of the claws is sunk; the caruncle is very large and broad; there are numerous fine hairs on all the joints. The second leg (Fig. 7) is very greatly thickened, but gradually diminished to a point. The first two joints are very large, then there is a sudden constriction, then the third joint is extremely thick, with a great rounded elbow; from this point the leg diminishes, ending in a strange, slightly recurved, pointed portion, which bears a certain resemblance to the form of the human foot; from the under side of what would be the heel proceeds the long-shaped caruncle and strong



A.D. Michael ad nat. del. W. Rhem sc

GAMASUS TERRIBILIS ♂ & ♀

double-claw. There is a great apophysis with a bifid terminal tooth and one single tooth on the inner side of third joint, with a spike beyond it; a smaller apophysis on the same side of the fourth joint, with a spike behind it; a still smaller apophysis on the fifth joint; and a narrow blade on the terminal part of the tarsus. There are also a few rather strong hairs on the various joints. The third and fourth tarsi end in sharp points, otherwise these legs are not remarkable. There is a pair of spines under each fifth and sixth, and three under the eighth joint, one above the second, and three above the fourth joint, and several fine hairs on all joints.

Female.

Average length about				1·72
,,	breadth	,,		·80
,,	length of	1st	pair of legs	1·30
,,	,,	2nd	,,	1·00
,,	,,	3rd	,,	·91
,,	,,	4th	,,	1·40

Colour and texture as in the male. Form almost similar to the male, but legs broad in proportion, and the anterior margin more sloping, less shouldered.

Body.—Epistome with one long, narrow central lamina, with two paired teeth at the base (Fig. 14). Mandibles with both limbs of the chelæ of about equal length, crossing at their ends, with about six teeth on each chela, provided with a semi-circle of bristles as in the male. On the ventral surface (Fig. 17) the sternal plate is divided into an anterior and a posterior (genital) plate.

Legs.—First pair without the axe-shaped projection; second, legs thickened, but not nearly so much so as those of the male; without apophyses, and the tarsi without the blades or the terminal foot-like hooks.

In other respects the female resembles the male.

EXPLANATION OF PLATE XVI.

GAMASUS TERRIBILIS.

FIG. 1. Adult male × 30.
,, 2. Adult female × 30.
,, 3. Mandible of adult male × 150.
,, 4. Epistome (top of oral tube) of adult male × 100.

FIG. 5. Galea of adult male × 150.

" 6. First left leg of adult male × 50 ; *a*, coxa ; *b*, trochanter ; *c*, 1st femoral piece ; *d*, second femoral piece ; *e*, genual ; *f*. tibia ; *g*, first tarsal piece ; *h*, second tarsal piece ; *i*, caruncle,

" 7. Second left leg of adult male × 50. (Same lettering.)

" 8. Genital opening of adult male.

" 9. Spermatophores.

" 10. The two mandibles of the adult male with a spermatophore attached × 50.

" 11. Second joint (trochanter) of first left leg of adult male × 150.

" 12. Oral tube of adult female × 50.

" 13. Chela of mandible of adult female × 100.

" 14. Epistome of adult female × 100.

" 15. Labial portion of the oral tube of adult female × 100 ; *mx*, maxillæ ; *la*, lacinia ; *g*, galea ; *li*, lingula ; *p*, first joint of palpus.

" 16. Articulated sternal process (the Bauchtaster of Kramer), probably a tactile organ, found in both sexes. The drawing is made from the female.

" 17. Arrangement of the plates, &c., on the ventral aspect of the adult female ; *a*, anterior sternal plate ; *b*, posterior sternal, or genital plate ; *c*, fused abdominal and anal plates ; *d* 1, *d* 2, *d* 3, *d* 4, coxæ of the 1st, 2nd, 3rd, and 4th pairs of legs.

" 18. Chela of mandible of hexapod larva, × 230.

Short Note on the Finer Structure of certain Diatoms.

By E. M. Nelson and G. C. Karop.

(Read March 26th, 1886.)

Plate XVII.

On examining certain Diatoms with the finest oil-immersion objectives, and under conditions of illumination such as are absolutely essential if the full aperture, and, therefore, resolving power, of these glasses is to be utilized, some details of structure are brought into view which are otherwise quite invisible, and, as far as we know, have not hitherto been correctly described or properly figured. Acting on this belief we have ventured to bring before your notice some short observations, accompanied by careful drawings, recently made on a few well-known forms.

1. *Coscinodiscus asteromphalos.* This diatom, although consisting of a single siliceous membrane, has a double structure, viz., coarse and fine areolations, the latter within the former. The coarse areolations are for the most part circular in outline, and the intervening silex is thick. Inside these areolations is a most delicate perforated membrane, the outermost row of perforations being much larger than the rest. This membrane is so thin and fragile that it is often broken out, and when this is the case the coarse areolations appear to have a crenated edge (Pl. XVII., Fig. 1).

2. *Isthmia nervosa.* This is similar in construction to the above, having a single membrane with a two-fold structure, a fine perforated membrane inside coarse areolations. The coarse areolations in this diatom are very large, and the silex correspondingly thick. At the same time the inner membrane is excessively thin and delicate as in *asteromphalos.* The perfora-

tions are large and irregular in shape around the margin, but smaller and circular in the centre. A broken areolation is figured to show the fracture passing *through* the perforations (Pl. XVII., Fig. 2).

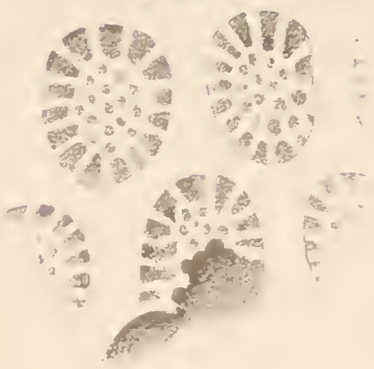
3. *Triceratium favus.* This diatom is very similar to the preceding. The coarse areolations are hexagonal in form and very deep. At the bottom of these is a delicate perforated membrane, the perforations being circular and arranged for the most part in rows. Fig. 3 shows a fracture passing through the minute perforations, the resolution of which may be considered one of the most crucial tests for the microscope of the present day.

4. *Eupodiscus argus.* This diatom differs from the above, inasmuch as it possesses two separate membranes, one containing the coarse and the other the fine areolations. The outer is a strong, coarsely-marked structure, the areolations being for the most part circular or oval in outline. The intervening silex is granulated on the exterior, and has a brownish colour by transmitted light. With reflected light, however, it appears white and sparkling, not unlike loaf-sugar. The interior membrane is very transparent and covered with minute perforations (only lately discovered, and which have been called *tertiary* markings). But in addition to these are what have long been known as the *secondary* markings, viz., white bright spots, which are arranged in rows radiating from the centre. These secondary markings must not be regarded as perforations, as we have not found an instance of a fracture passing through them.

Fig. 4 shows the secondary and tertiary markings on the interior membrane, as seen through the coarse areolations of the exterior membrane. The best way of examining the secondary markings is to use a $\frac{1}{2}$ or $\frac{4}{10}$ objective, with a lieberkühn, the specimen mounted dry, with the concave side uppermost. The tertiary are more difficult to see, and will require a higher power.

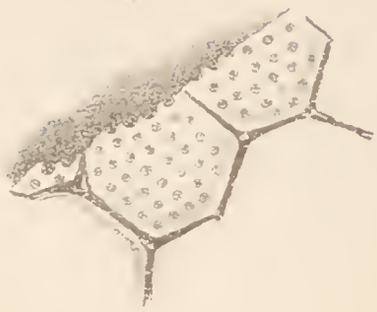
Fig. 5 shows the fracture passing through the perforations in a valve of *Pleurosigma angulatum.* This diatom has but one membrane, and only one kind of perforations. To show this properly a lens must be very well corrected, and have its glasses very perfectly centered.

Fig. 2



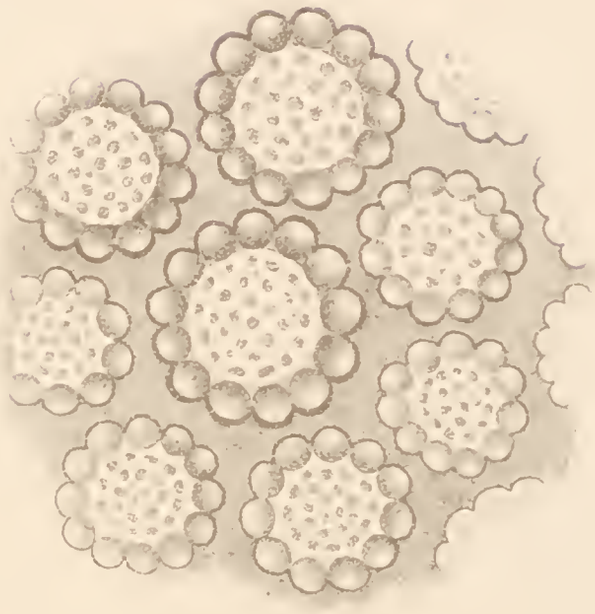
Isthmia nervosa

Fig. 3



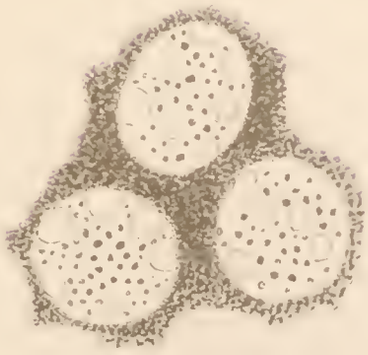
Triceratium favus

Fig. 1



Coscinodiscus asteromphalos

Fig. 4



Eupodiscus Argus.

× 1700

Fig. 5.

Fracture through perforations in P. Angulatum.

× 2330

G. C. K. del.

W. Rhein sc.

Explanation of Plate XVII.

Fig. 1. *Coscinodiscus asteromphalos.* Rom. imm. $\frac{1}{12}$; N.A., 1·43 ×. Perforated membrane within coarse areolations.

Fig. 2. *Isthmia nervosa.* Rom. imm. $\frac{1}{12}$; N.A., 1·43 ×. Perforated membrane within coarse areolations. At lower part of Fig. a fracture is shown passing through the perforations.

Fig. 3. *Triceratium favus.* Rom. imm., &c., &c. Fracture passing through perforations.

Fig. 4. *Eupodiscus argus.* Rom. imm., &c., &c. Secondary and tertiary markings on interior membrane seen through coarse areolations of outer membrane.

Fig. 5. *P. angulatum.* Rom. imm., &c., &c. Fracture passing through perforations.

Q.M.C. EXCURSIONS, 1885.

List of Objects Found on the Excursion to Totteridge, by Messrs. Dadswell and Nevins.

April 25th.

* *ALGÆ.*

Volvox globator, containing *Notommata parasita.*

CHARACEÆ.

Nitella flexilis.

PROTOZOA.

Carchesium polypinum.
Dinobryon sertularia.
Trachelius ovum.
Bulbochæte polyandra (?).
,, *setigera.*
Characium ornithocephalum.
Coleochæte scutata.
Conferva bombycina.
Glœocystis ampla.
Mesocarpus recurvus.
Œdogonium longatum.
,, *Petri (?).*
Olpidium ampullaceum.
Pediastrum Ehrenbergii.
Raphidium falcatum.
Scenedesmus quadricauda.
Sirogonium sticticum.
Spirogyra flavescens.

VERMES. Rotifera.

Notommata parasita, in volvox.
Stephanoceros Eichhornii.

ENTOMOSTRACA.

Daphnia, very large.
Diaptomus castor.

INSECTA. Dipterous larva.

Corethra plumicornis.
Spirogyra longata var. communis.
Spirogyra nitida.
,, *tenuissima.*
Zygnema cruciatum.

Desmidiaceæ.

Arthrodesmus incus.
Closterium acerosum.
,, *Liebleinii.*
Cosmarium curtum.
,, *margaritaceum.*
Hyalotheca dissiliens.
Staurastrum polymorphum.
Xanthidium fasciculatum.

Ten members of the Club, one visitor, and a member of the Hackney Society attended the Excursion.

* The following *Algæ* collected by Mr. Parsons were determined by Dr. M. C. Cooke.

List of Objects Found on the Excursion to Keston, by Messrs. Dunning, Mainland, J. T. Powell, W. W. Reeves, and Wildy.

May 9th.

ALGÆ.

Chætophora elegans.
Drapernaldia glomerata.
Nostoc commune.
Pandorina morum.
Raphidium falcatum (=Ankistrodesmus falcatus).
Spirogyra longata, var. communis.
Staurospermum viride (=Staurocarpus gracilis).
Stigeoclonium protensum.
Volvox globator.
Zygogonium ericetorum.

Desmidiaceæ.

Closterium acerosum.
,, *lunula.*
,, *setaceum.*
Cosmarium crenatum.
,, *margaritiferum.*
,, *tetraophthalmum.*
Docidium baculum.
Euastrum oblongum.
Hyalotheca dissiliens.
Micrasterias denticulata.
,, *rotata.*
Penium Brebissonii.

Diatomaceæ.

Diatoma vulgare.
Himantidium pectinale.
Pinnularia nobilis.
Surirella bifrons.

PHANEROGAMIA.

Arabis Thaliana.
Cardamine hirsuta.
Draba verna.
Mœnchia erecta.
Myosotis collina.
,, *versicolor.*
Vaccinium Myrtillus.

PROTOZOA.

Actinophrys Eichhornii.
,, *sol.*
Amœba diffluens.
Chætonotus larus.
Difflugia proteiformis.
Dileptus folium.
Dinobryon sertularia.
Stylonichia mytilus.
Trachelius ovum.
Urocentum turbo.
Uvella virescens.

VERMES. Rotifera.

Anurea aculeata.
Dinocharis tetractis.
Euchlanis triquetra.
Microdon.
Monocerca rattus.
Noteus quadricornis.
Rotifer vulgaris.
Salpina redunca.

Nineteen members of the Club, four members of other Societies, and five visitors attended the Excursion.

List of Objects Found on the Excursion to Whitstable by Messrs. Hembry and Sibert Saunders.

May 23rd.

PORIFERA.
Cliona, sp.
Grantia, sp.
CŒLENTERATA. Hydrozoa.
Campanularia, sp.
,, *neglecta.*
Halecium halecinum.
Laomedia geniculata.
Sertularia pumila.
Tubularia indivisa.
VERMES.
Serpula triquetra.
Spio seticornis.
CRUSTACEA.
Caprella.
MOLLUSCOIDA. Polyzoa.
Alcyonidium gelatinosum.
,, *parasiticum.*
Bicellaria ciliata.
Membranipora, sp.
Pedicellina Belgica.
Tunicata.
Molgula tubulosa.

List of Objects Found on the Excursion to Staines, by Messrs. Rousselet and Western.

June 13th.

ALGÆ.
Bulbochæte, sp.
Coleochæte scutata.
Cylindrospermum macrospermum.
Oscillaria, sp.
Rivularia, sp.
Spirogyra quinina (?).
Volvox globator.
Desmidiaceæ.
Closterium acerosum.
,, *lunula.*
,, *setaceum.*
Cosmarium margaritiferum.
PHANEROGAMIA.
Utricularia, sp.
PROTOZOA.
Actinophrys, sol.
Epistilis plicatilis.
Ophrydium versatile.
Urceolaria mitra, parasitic on planaria.
Vorticella chlorostigma.
CŒLENTERATA.
Hydra viridis.
,, *vulgaris.*
VERMES. Rotifera.
Asplanchna Brightwellii.
Euchlanis triquetra.
Noteus quadricornis.
Œcistes crystallinus.
Pterodina patina.
Scaridium longicaudum.
Planariæ.
Two curious species.
INSECTA. Dipterous larva.
Corethra plumicornis.

Ten members of the Club, three members of the South London Society, and two visitors attended the Excursion.

No lists were received of the Excursion to Watford on July 11th, and only four members of the Club attended the Excursion. Nothing of interest was found.

List of Objects Found on the Excursion to Walton, by Messrs. Nevins and Parsons.

July 25th.

PROTOZOA.
Anthophysa Mülleri.
Cothurnia imberbis.
Stentor cœruleus.
„ *polymorphus.*
Vaginicola crystallina.
Zoothamnium arbuscula.
PORIFERA.
Spongilla fluviatilis.
„ *lacustris.*
VERMES. Rotifera.
Floscularia ornata.
Lacinularia socialis.
Limnias ceratophullum.
Melicerta ringens.
Stephanoceros Eichhornii.
Annelida.
Ælosoma, sp.
Stylaria (=Nais) proboscidia.
MOLLUSCOIDA.
Alcyonella fungosa.
Fredericella sultana.
Plumatella, sp.
MOLLUSCA.
Valvata piscinalis.

Eleven members of the Club, three members of the South London Society, and six members of the Richmond Athenæum and Field Club attended the Excursion.

List of Objects Found on the Excursion to Caterham and Godstone, by Messrs. Hardy, Nevins, Parsons, J. T. Powell, and Rousselet.

August 29th.

ALGÆ.
Pediastrum Boryanum.
Scenedesmus obliquus.
PHANEROGAMIA.
Aira cæspitosa.
Atropa belladonna.
Calamintha clinopodium.
Campanula trachelium.
Carduus acaulis.
Carex hirta.
Carlina vulgaris.
Epipactis latifolia,
Erythræa centaurium.
Gentiana amaretta.
Inula conyza.
„ *pulicaria.*
Juncus acutiflorus.
Mentha arvensis.
„ *hirsuta.*
„ *pubescens.*
Pimpinella saxifraga.
Scutellaria galericulata.
Sparganium neglectum.
Typha latifolium.

PROTOZOA.
Amœba, large specimens.
Vorticella nebulosa.
VERMES. ROTIFERA.
Anurea aculeata.
Polyarthra platyptera.
Synchæta baltica.
Triarthra longiseta.
ENTOMOSTRACA.
Daphnia mucronata.
,, *pulex.*
Diaptomus castor.
INSECTA.
Zygæna filipendula.
MOLLUSCOIDA.
Alcyonella fungosa.

Seven members of the Club and ten members of the Croydon and other Societies attended the Excursion.

LIST OF OBJECTS FOUND ON THE EXCURSION TO RICHMOND, BY MR. ROUSSELET.

September 12th.

ALGÆ.
Pediastrum, sp.
DESMIDIACEÆ.
Closterium, sp.
CHARACEÆ.
Chara fragilis (?).
PROTOZOA.
Amœba villosa.
Anthophysa Mülleri.
Cothurnia imberbis.
Dendromonas virgaria.
Stentor polymorphus.
Vorticella campanula.
CŒLENTERATA.
Hydra fusca.
VERMES. ROTIFERA.
Floscularia cornuta.
Limnias ceratophylli.
Melicerta ringens.
Rotifer vulgaris.
Stephanoceros Eichhornii.
PLANARIÆ.
Planaria, sp.
ANNELIDA.
Piscicola geometrica (?).
ENTOMOSTRACA.
Sida crystallina.

Six members of the Club attended the Excursion.

LIST OF OBJECTS FOUND ON THE EXCURSION TO HALE END, BY MR HARDY.

September 26th.

ALGÆ.
Cladophora, sp.
Oscillaria, sp.
Volvox globator, containing parasitic rotifers.
Trichelius ovum.
VERMES. ROTIFERA.
Limnias ceratophylli.
Mastigocerca carinata.
Synchæta baltica.

PROTOZOA.
Difflugia, sp.
Dinobryon sertularia.
Paramecium bursaria (?).

INSECTA. DIPTEROUS LARVA.
Corethra plumicornis.

Ten members of the Club and four members of the Hackney Society attended the Excursion.

LIST OF OBJECTS FOUND ON THE EXCURSION TO MITCHAM COMMON, BY MR. ROUSSELET.

October 10th.

PROTOZOA.
Actinophrys Eichhornii.
CŒLENTERATA.
Hydra viridis.
Hydra vulgaris.
ENTOMOSTRACA.
Daphnia, various sp.
Diaptomus castor.

The day was wet, and only five members of the Club attended the Excursion.

FREDK. A. PARSONS,
Hon. Sec. Excursions Sub.-Com.

New Books.

An Introduction to Practical Bacteriology, based upon the methods of Koch. By Edgar M. Crookshank, M.B., F.R.M.S. (London, H. K. Lewis.)

It is only a few years since the discovery was made that certain diseases were marked by the presence of specific forms of Bacillus, and already the study of these organisms has grown into a science—"Bacteriology"—the introduction to which science is sufficiently far advanced to furnish matter for a volume of some 250 pages. This volume is only an introduction in the sense that we are as yet but just beginning to know something of the subject. The book is really a complete and exhaustive treatise on all that is at present known of the history and classification, and of the modes of cultivating and studying the Bacteria. It is illustrated with numerous woodcuts, and also with thirty beautifully-executed plates, drawn by the author and his wife, most of the plates being coloured, and showing the appearance of the different species as seen by the unaided vision, and also under the microscope.

The first part of the book is devoted to descriptions of the apparatus employed for sterilizing the instruments and nutrient materials, the isolation and cultivation of the various species, the examination of the living organisms, and the various methods of staining and permanently preserving them. It also explains the method of experimenting upon living animals, and testing the result of such experiments.

The second part of the book comprises the history and classification of all the known genera and species of Bacteria, and an appendix contains a description of some of the yeast fungi and moulds.

The experiments of Dr. Cantani, of Naples, and Dr. Salama, of Pisa, will probably give a fresh impetus to the study of the science of Bacteriology; and those who are disposed to take up

the subject will find the road well cleared for them by Mr. Edgar Crookshank.

The Rotifera, or Wheel Animalcules. By C. T. Hudson, LL.D., Cantab., assisted by P. H. Gosse, F.R.S. (London, Longmans and Co.)

This, the finest and most comprehensive book that has appeared since the publication of Ehrenberg's "Infusions Thierchen," 48 years ago, will supply a want that has long been felt.

It is needless to say that the work is well done, for the ability of Dr. Hudson and of Mr. Philip Henry Gosse, as artists and observers, is too well known to admit of question.

The two parts now before us contain eleven large double plates and three single ones, drawn and coloured from life by the authors.

The work is to be completed in six parts, and will form two handsome imperial 8vo. volumes, embracing the life history of the whole of the Rotifera; and, when complete, the book will be one of the most useful natural history monographs that has appeared for some time.

It is with great regret that we have to announce the death of Dr. John Matthews, which took place on the 22nd April, from acute pneumonia.

Dr. Matthews was elected a member of the Quekett Microscopical Club in 1866, and was a regular and constant attendant at the meetings of the Club. In 1869 he was elected on the Committee, where his business ability and quiet good sense rendered him a valuable acquisition. He was chosen Vice-President for the years 1872 and 1873, and President for 1874 and 1875.

By his amiability and readiness to assist those less informed than himself, he gained the affectionate esteem of all who knew him, and by whom he will long be missed.

PROCEEDINGS.

January 8th, 1886.—Conversational Meeting.

The following objects were exhibited :—

Meteoric dust from Bute, Scotland	Mr. E. Carr.
Section of *Eozoon canadense*	Mr. C. Collins.
Foraminifera, abnormal forms of *Peneroplis*	Mr. A. Durrand.
Head of wasp, nat. form and colour, with explanatory drawings	Mr. F. Enock.
Diatoms, *Eupodiscus argus*, from Florida ...	Mr. H. Morland.
Platino-type prints of Photomicrographs ...	Mr. J. M. Offord.
Hydrachnida	Mr. C. Rousselet.
Diatoms, n.s., *Navicula Durrandii*, *Scoliopleura contorta*, and *Navicula Zanzibarica*	Mr. G. Sturt.
Diatoms, *Actinoptychus splendens*	Mr. C. Upton.
Diatoms, Type slide of Diatoms from Santa Monica	Mr. W. Watson.

Attendance—Members, 33; Visitors, 2.

January 22nd, 1886.—Ordinary Meeting.

A. D. Michael, Esq., F.L.S., F.R.M.S., President, in the Chair.

The minutes of the preceding meeting (Nov. 27th, 1885) were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club :—Mr. C. W. Covington and Mr. A. W. Lyons.

The Secretary read a letter received from Dr. P. Herbert Carpenter in acknowledgment of the vote of condolence passed at the last meeting in reference to the lamented death of Dr. W. B. Carpenter.

The following donations to the Club were announced :—

"Journal of the Royal Microscopical Society"	From the Society.
"Proceedings of the Botanical Society of Edinburgh"	" "
"The American Monthly Microscopical Journal"	In exchange.
"Proceedings of the Royal Society"	From the Society.
"The American Naturalist"	In exchange.

"The Microscopist," by Dr. Wythe	From the Author.	
Two Photomicrographs	,,	Mr. Offord.
Two slides, Sand, and Meteoric Dust	,,	Mr. Carr.
Two slides in illustration of his paper ...	,,	Mr. Priest.

The Secretary said that the members would, no doubt, remember that some time ago they had a visit from Dr. Wythe, of San Francisco, who made an interesting communication on the subject of the Microscopical characters of Handwriting. The doctor appeared to have been pleased with his reception, and had, in remembrance of it, sent a copy of the 4th edition of his work, "The Microscopist" as a present to the library. This book was of interest as being the first work on General Microscopy published in America. He also called attention to the slides of sand presented by Mr. Carr, as showing very clearly the perforations in calcareous particles of sand, which had been referred to by Mr. Waller in his paper of March, 1884.

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

Mr. Dunning exhibited and described a new form of Zoophyte trough, made in two or more sections, which were held together, when in use, by simple cohesion, so that they could be taken apart in a few minutes for the purposes of cleaning, &c., without risk of breakage. Specimens were handed round for the inspection of the members.

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

Mr. B. W. Priest read a paper on *Spongilla fragilis*, illustrating the subject by diagrams.

Mr. J. G. Waller thought the paper was a particularly interesting one. It had always seemed to him, that they ought to possess more varieties of fresh-water sponges than the two which had hitherto figured as their only examples. It was, at least, very singular, that the Thames *Spongillæ* should not have been better known to such authorities as Dr. Bowerbank and Mr. Carter, both of whom converted into a new species the specimen found by Mr. Parfitt in the river Exe. This showed him the necessity for making a protest against the formation of new species, except upon the most complete evidence that they were such: because in the Spongillæ of the Thames he had found every variety of spicule from that with no spines at all to that completely spinous. He thought it very singular, that Dr. Bowerbank, who lived in London, should not have studied the specimens from the Thames in various parts; had he done so he would not have fallen into the error now noticed. Dr. Bowerbank's specimen came from Rotherhithe, and was taken from the interior of a dock where the water was nearly always smooth and stagnant; the fact being that it was always found, that specimens with smooth spicules came out of still water. The spinous condition had been found in other parts of England, but in all cases in running water. To show how fond some people were of making new species he might mention, that some time ago he described a specimen discovered at the manor of Ditchleys, near South Weald in Essex, some of which he sent to Mr. Carter and to Mr. Priest. Mr. Thomas found a

specimen of the same variety in America, and at once it was called a new species, and a name was given to it, or, at least, Mr. Thomas suggested a name by which it should be called, Calumetica, derived from the name of the river it came from. Then Mr. Carter wrote to say, that the sponge he had was the same as this one from America. He (Mr. Waller) thought if they must give a name to it at all—as he himself had declined to do—it should certainly be from Ditchleys. He thought these things ought to be stated, for in his opinion they did no good to science, but had quite an opposite effect. In the sponge, however, which Mr. Priest had described that evening they had a distinct variety, and he believed it to be an English species, and one which had also been found in the Ouse. It was quite his opinion, that if they had more persons studying this group of organisms they should soon have many more additions to the list.

Mr. E. T. Newton thought they were very much indebted to Mr. Priest for the paper which he had read, and he was very glad to hear that Mr. Waller could justify the specimen as a new species. He was particularly struck by Mr. Waller's remarks on the remarkable variations which had been found to occur in the case of this sponge, and it seemed to be more and more borne upon them that many of those things they had been calling new species were not strictly so, and that the divisions between them were being broken down as they discovered that the differences arose from gradual changes in the outward conditions. With regard to the remarkable fact that whenever this sponge was found in smooth water it had smooth spicules, which in running water were spined, he would venture to ask was this due to the fact that in running water they had a more vigorous growth because of the greater need for protection against the force of the surrounding stream, or was it that in this case there was in the flowing river a greater quantity of material to be gathered out of which spicules could be made? He thought it would be well for all of them to bear these things in mind, and certainly they ought to be very careful as to burdening science and one another with new names for old species.

Mr. Waller said that the first variety of the entirely spined kind was found under rather peculiar circumstances. It was in very bad weather at Surbiton, and from some cause he was detained for a long time on the barge at which the boats landed their passengers. To employ his time he fished between the barge and the mooring-board, a position where the water was in a great state of agitation, and from this place he obtained his specimens. Mr. Carter had suggested that the spiny condition might have something to do with the rapid motion of the water.

The President was sure the members of the Club would return a hearty vote of thanks to Mr. Priest for his paper, and also to those gentlemen who had spoken upon the subject. Mr. Priest's paper also raised the question as to whether species found here under certain conditions could be properly regarded as native or introduced? This was a very difficult question to decide, more especially when, as in the present case, they were found in a tidal river, such as the Thames, which was also somewhat slow as well as

tidal; and it would, therefore, not do to lay too much stress upon the native character of what was found in such a river, which was open to the traffic of all the world. This would, of course, largely depend upon what portion of the river the specimens came from, but if from the lower part he thought such a situation to be a very likely one for the introduction of foreign forms.

Mr. Waller said that the spot where Mr. Priest had found his specimens, was a part of the river beyond the reach of the tidal water.

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

Mr. E. M. Nelson read his paper "On the Rev. Jas. Campbell's Form of Fine Adjustment."

Mr. E. M. Nelson also read a paper "On the Interpretation of Microscopic Images with High Powers," illustrating the subject by diagrams.

Mr Crisp said he quite agreed with Mr. Nelson as to the importance of arriving at a proper understanding of this subject, but he thought that his summary was a little more extensive than his premises justified. It was interesting to see the results of Mr. Nelson's latest observations as to the true nature of the markings on diatoms, and he was quite prepared to hear that he had come to a clear conclusion on the matter. But whilst fully recognising the great value of investigations of this kind, and not agreeing with many of those cautious scientific men who often asked the question, "What was the use of knowing all about it?" he still thought that, in the present state of their knowledge on the subject, Mr. Nelson was not quite entitled to say that there were no such things as markings.

Dr. Matthews thought it should be borne in mind in examining objects of this kind that they were looking at something that was not flat, and in consequence of viewing them obliquely, rows of dots or perforations would be apt to fall into series of lines. It was, therefore, quite possible that a great deal of error in interpretation might arise from overlooking the fact that they were not dealing with a flat surface. The markings were also not of the same size in different parts of the same valve; this might also tend to give rise to some amount of confusion.

Mr. Nelson said it might be interesting to state that the diagram which he exhibited was drawn to scale, but it was just the reverse way to the Ordnance Maps—they were on a scale of 1 in. to the mile, whereas his diagrams were to a scale of 8 feet to $\frac{1}{1000}$ inch.

The President said that Mr. Nelson's exposition of this subject was of the highest possible interest, and he thought the details which had been given, as to the minute portion of silex projecting over the round spot, formed distinctly a ground to work upon in carrying out these difficult inquiries. At the same time he did not think he could quite agree with Mr. Nelson as to the generalities of his conclusions. He had, in fact, rather a horror of generalizing, for in the course of his own more particular line of investigation he had found that it was a general thing for an external dermal covering to be formed of three layers, and that the middle one was the supporting layer,

but if he began to generalize that the markings were on one particular layer, he was sure to meet with another specimen which would upset his generalizations. It required great caution before they could come to a conclusion that anything was a universal structure, because general observation showed them that the variety in such things was infinite. It might be quite true that in this instance the visibility of the supporting grating was what gave the appearance of markings, but if it were so he should be by no means prepared to admit that this proved there were no markings either on the external or, if there should be one, on the internal coverings of this grating. It was a matter which required great caution in dealing with, but undoubtedly Mr. Nelson's paper would be of material assistance in enabling any one to arrive at a conclusion.

The thanks of the meeting were unanimously voted to Mr. Nelson for his papers.

Announcements of meetings, &c., for the ensuing month were then made, and the proceedings terminated with the usual Conversazione, and the following objects were exhibited :—

Ichneumon and its pierced aphis	Mr. F. W. Andrew.
Phora rufipes (Window-fly)	Mr. F. Enock.
Hydrachnida	Mr. C. Rousselet.
Mantle of *Terebratula caput-serpentis* ...	Mr. J. Slade.
Section of Carboniferous Limestone from the Polyzoa Bed at Clifton	Mr. G. Smith.
Section, Ovary of Orchid	Mr. A. C. Tipple.
Spicule of *Chirodota* from Chalk	Mr. C. Upton.

Attendance—Members, 56 ; Visitors, 7.

February 12th, 1886.—Conversational Meeting.

The following objects were exhibited :—

Hydrozoa, *Campanularia flexuosa*	Mr. F. W. Andrew.
Head of Beetle, *Silis Madagascariensis* ...	Mr. C. Collins.
Plant Bug, *Mymus miriformis*	Mr. F. Enock.
Horizontal section, tongue of Wasp	Mr. F. Fitch.
Labrum of Wasp...	,, ,,
Hippocampus embryo	Mr. H. G. Glasspoole.
Cocoon of House-builder Moth...	Mr. J. D. Hardy.
Sponges from River Lea...	,, ,,
Menthol	Mr. G. E. Mainland.
Diatoms, *Cocconeis costata* var. *pacifica* ...	Mr. H. Morland.
,, *Nav. cuspidata*	Mr E. M. Nelson.

Fructification of Fern, *Davallia canariensis* ...	Mr. J. A. D. Parker.
Sponge, *Ectyon sparsus*...	Mr. B. W. Priest.
Spicules of fresh-water sponge, *Spongilla purbeckensis*, in flint	Mr. G. Smith.

Attendance—Members, 46 ; Visitors, 5.

February 26th, 1886.—Ordinary Meeting.

A. D. Michael, Esq., F.L.S., F.R.M.S., 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. N. J. Swanson, Mr R. T. Holt, Mr W. J. Butcher, and Mr. R. White.

The following donations to the Club were announced:—

"Proceedings of the Royal Society" ...	From the Society.
Dr. Hudson's "Rotifera," Part I.	Purchased.
Wilson's "Bryologica Britannica"	"
Buckler's "Larvæ of British Butterflies and Moths," Ray Society...	"
"American Monthly Microscopical Journal"	In exchange.
"The American Naturalist"	" "
"Proceedings of the Hertfordshire Natural History Club"...	" "
"Annual Report of the Sidcup Literary and Scientific Society"	From the Society.
"Proceedings of the South London Entomological and Natural History Society"	In exchange.
"Journal of the Royal Microscopical Society"	" "
"Proceedings of the New York Microscopical Society"	" "

The thanks of the Club were voted to the donors.

The President called special attention to the last volume issued by the Ray Society "On the Larvæ of British Butterflies and Moths," which was considered to be by far the most reliable work on the subject ever published. The illustrations gave the larvæ not only in the adult stage, but also in the early and intermediate stages, in which, it was well known, they often differed very considerably in appearance from the full-grown creature. The drawings had been made with very great care, from life, by the late Mr. Buckler.

Mr Karop said he had brought with him a slide for the Cabinet, and should like to say a few words concerning it. The specimen was a fungus which grows upon the common orange, and was, he believed, very injuri-

ous to the crops of this fruit in Italy and Spain, but he did not like to speak much of its structure and ordinary life history in the absence of Dr. Cooke, who would have rectified his probable errors in this direction. It belonged to the Pyrenomycetes, a family of the order Ascomycetes, in which the receptacle opens by a pore. Its name was *Capnodium citri*, B. and Des., and in its perfect state may be often seen on the rind of oranges, looking rather like a piece of black shoddy cloth fastened to it, and usually at one of the poles of the fruit. A portion of this, slightly separated and examined in glycerine jelly or balsam, showed a densely matted substratum, from which arose the curious, often compound, flask-shaped receptacles, which when ripe burst at the apex and discharged a large number of very minute oval spores. Among the receptacles are some curious clubbed and twisted structures, which are probably barren asci or paraphyses. He presumed the fungus was injurious mainly in its mycelial condition, when it permeated the pulp of the fruit and converted it into a black rotten mass, as those oranges on which he had seen it in its spore-bearing state were perfectly sound inside. On this point, however, he was not competent to give an opinion, and it was in regard to another supposed effect of this fungus which induced him to bring it to the notice of the Club. Some two years ago a physician in the South of France, while examining some expectoration from a severe case of whooping-cough, of which there was an epidemic in his locality, found in it some minute spores, and as the orange fungus was also very prevalent at the time, he, after further observation, came to the conclusion that its spores and those in the expectoration were identical. He then obtained some quantity of the spores of the fungus and insufflated them into his own larynx and trachea, with this result, that after a short period of incubation his temperature went up, and a spasmodic cough came on, which ran the same course and had every appearance of being true whooping cough. He (Mr. Karop) was not aware that these observations had been substantiated or that the matter had ever been followed up since, and simply gave these statements for what they were worth.

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

Mr E. M. Nelson exhibited a model of a diatom—*Navicula Durandii*—as an illustration of the structure which he described at the preceding meeting. This diatom was one which he had only recently seen; it was very coarse, and might be considered as a plate perforated with a number of holes. The model was made of a piece of board with holes in it showing the ideal of the back and front view—it was like a perforated membrane with a strengthening girder which was called the median line. The other diatoms might also be described as strong girder work arranged to support a thin perforated membrane.

The President, in proposing a vote of thanks to Mr. Nelson for his communication and for the trouble he had taken in making a model, remarked upon the advantages of this method of illustration in conveying a clear

idea of what was meant, and recommended it to the attention of other members.

The President said it had been discovered that April 23rd was printed upon their list as the date of the ordinary meeting for that month, and that being Good Friday it would not of course be possible to hold it then. He therefore announced that in consequence of this coincidence the ordinary meeting would be omitted in April. He also wished to announce that the Committee had been considering a proposition brought before them for making an alteration in the bye-laws, with reference to the time for holding their annual meeting, and in accordance with the resolution which they had passed he gave notice that their next ordinary meeting would be made special in order to take the matter into consideration. It had been thought that July was an inconvenient time at which to hold their anniversary, occurring, as it did, at a period when so many of their members being absent for their holidays, there was generally but a thin attendance. It had therefore been considered desirable, on this account, to alter the period from summer to winter, with a view of obtaining the attendance of a larger number of members.

The President described at some length a slide he had brought for exhibition in illustration of the life history of a parasite of the mole, specimens of which had been found in the nests of these animals. A description was also given of another slide of *Anguillulæ* which he had found to be the chief cause of an apparent disease seriously affecting the cucumber crop in Cornwall during last summer.

Mr C. Stewart proposed the best thanks of the Club to the President for his interesting remarks concerning a class of creatures in which it was well known that it took a special interest. He also hoped that as the cause of the destruction of so many excellent cucumbers had been discovered, that some practical attention would be directed towards the best means of stopping its ravages

The thanks of the meeting were unanimously voted to the President for his communication.

The Secretary informed the members that amongst the other objects exhibited in the room Mr. Nelson was showing a microscope fitted with Mr. Campbell's fine adjustment described at the last meeting.

Announcements of meetings, &c., for the ensuing month were then made, and the proceedings terminated with the usual Conversazione, and the following objects were exhibited :—

Section, Bud of Lily	Mr. F. W. Andrew.
Skin of *Synapta digitata*	Mr. C. Collins.
Crystals, Malate of Ammonium	Mr. H. A. Crowhurst.
Ichneumon fly, *Utetes testaceus*	Mr. F. Enock.
Dysdera, erythrina ♀	Mr. G. E. Mainland.
Acari, *Glyciphagus dispar*, (n.s.,) ♂ and ♀ *in coïtu*	Mr. A. D. Michael.

Eggs of *Anguillulæ* from the sound tissue of root of cucumber	Mr. A. D. Michael.
Bacillus anthracis, $\frac{1}{8}$ oil imm. of Zeiss', Campbell's fine adjustment	Mr. E. M. Nelson.

Attendance—Members, 50; Visitors, 6.

March 12th, 1886.—Conversational Meeting.

The following objects were exhibited:—

Alga, *Vaucheria*...	Mr. F. W. Andrew.
Anther and pollen of *Lavatera trimestus* ...	Mr. C. Collins.
Antenna of Moth, *Smerinthus populi*, natural form and colour	Mr. F. Enock.
Palpi and falces of gossamer spider, *Walckenæra*	Mr. H. E. Freeman.
Chelifer, Obisium, Dermestes, &c.	Mr. J. D. Hardy.
Spider, *Theridion quadripunctatum* ♂ ...	Mr. G. E. Mainland.
Diatoms, *Plagiogramma nankoorense* ...	Mr. H. Morland.
" *Eupodiscus argus*, showing secondary markings, and drawing showing tertiary markings	Mr. E. M. Nelson.
Volcanic ash from Borrowdale...	Mr. G. Smith.
Diatoms, *Surirella*, n.s., ...	Mr. G. Sturt.
Glass rope sponge, from Hayti	Mr. W. Watson.

Attendance—Members, 44; Visitors, 5.

March 26th, 1886.—Ordinary Meeting.

A. D. Michael, Esq., F.L.S., F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

Mr. H. Sercombe was balloted for, and duly elected a member of the Club.

The following donations to the Club were announced:—

"Proceedings of the Royal Society"... ...	From the Society.
"Proceedings of the Botanical Society of Edinburgh"	" "
"Proceedings of the Belgium Microscopical Society"	" "
"Proceedings of the New York Microscopical Society"	In exchange.

"The American Monthly Microscopical Journal"	In exchange.
"Proceedings of the Geologists' Association"	,, ,,
"Proceedings of the Canadian Institute" ...	,, ,,
"Proceedings and Memoirs of the Manchester Literary and Philosophical Society"	,, ,,
Cabinet Portrait of the late Dr. W. B. Carpenter	From Mr. Enock.
Two Photo-micrographs of Diatoms... ...	,, Mr. J. M. Offord.
Two Slides and some Photo-micrographs ...	,, Mr. Smithson.

The thanks of the meeting were voted to the donors.

The President called the attention of the members to the fact that the fourth Friday in April would this year be Good Friday, in consequence of which there would be no ordinary meeting in that month.

A letter from Mr. Smithson, with reference to the slides and photographs which he had presented, was read to the meeting.

The President said that the members had no doubt seen in the newspapers an announcement of the death of Dr. T. Spencer Cobbold, in reference to which the Committee had that evening passed the following resolution:—"That the members of the Quekett Microscopical Club having heard with deep regret of the death of Dr. T. Spencer Cobbold, a past President of their Society, and one who was pre-eminent in his own branch of science, desire to express their sincere sympathy with his family." He asked the meeting to approve of the same for transmission to the relatives of the deceased.

The proposal was unanimously adopted by show of hands.

The President said that, in pursuance of notice given at the preceding meeting, the meeting would now be made special for the purpose of considering the desirability of making an alteration in the rules with respect to the date for holding their annual meeting. It was suggested at the last meeting of the Committee that it would be desirable to alter the date to a winter month, and the Committee, whilst passing no resolution on the matter, thought it of sufficient importance to call for a special meeting for its consideration. Notice was therefore given at the last meeting, and as the excursion cards were going out a circular was printed and sent to every member informing them of what was about to be proposed. He should much prefer that a proposal of this kind should be brought forward by the gentleman who had proposed it in Committee, and, therefore, he would only point out one or two things which occurred to him, and which he hoped they would consider as the voice of a private member of the Club. If, on consideration, they thought it would be better to alter the date of the meeting they must bear in mind that the subscriptions came due in July, and that if the date of the annual meeting were altered then the rule as to the date of payment of subscriptions must be

altered also, in order that they should hereafter fall due at the date of the annual meeting. They would, therefore, have to consider if any difficulty would be likely to arise on this account, sufficiently serious to prevent the possibility of making the alteration. One way of meeting such a difficulty would be by paying 10s. as usual in July, and then another 5s. in December, thus covering the period of 18 months. As regarded his own individual view of the proposition, it was that a winter month would be more convenient to the majority of the members, because it was difficult to get a good meeting in the summer when so many members were away for holidays, and no doubt there were many amongst those who would like to have the opportunity of proposing members for election on the Committee, and of otherwise taking part in the business of the annual meeting. He should not, however, have brought the matter forward himself, but as this had been done independently by another member, he thought he might say a few words about it. He would now call upon the Secretary to read a letter from the Treasurer on the matter, since most of the trouble arising from the change would in the first instance fall upon him, and then he would call upon the proposer of the motion to lay it before the meeting.

The Secretary then read a letter from the Treasurer, stating that he perfectly agreed as to the desirability of making the proposed alteration, though it would no doubt add to his work at first.

Mr. E. M. Nelson said he had much pleasure in proposing that an alteration be made in the rules, to enable them to shift the date of the annual meeting from a summer to a winter month; he did this mainly on the ground that by so doing they would be acting for the convenience of a large number of members, who were at present unable to attend at the end of July. It so happened that, from the fact of his having always been out of town at the time, he had never yet been able to attend an annual meeting, and having remarked this fact to another member, he found that from the same cause this member also had never been present at an annual meeting. Finding that there were others similarly situated, he thought something ought to be done, and, therefore, he brought the matter before the Committee in order to see if they would be willing to sanction the change, and he found on mentioning it, that the members present seemed to agree that the change was desirable. One point the President had not mentioned, and that was that it seemed scarcely fair to drag a President up from the country in the middle of the summer for the purpose of presiding at the annual meeting. He thought there need be no trouble about the payment of subscriptions; it would be a very simple matter for members to pay 5s. in July for the rest of the current year, and then 10s. at the annual meeting in the winter for the whole of the year following.

Mr. Morland said as a non-official member of the Club, he should be glad to second this proposal; he had attended some annual meetings and remarked on the smallness of the attendance.

Dr. M. C. Cooke said that although he did not propose to move any amendment to the motion which had just been brought before them, his intention was to meet it with a direct negative. He was glad at least to find that the proposal had not been a subject emanating from the Committee, and as the President had given them his own views respecting it, he on his part should not hesitate to state plainly what he thought also. He was by this time rather an old member of the Club, and, unlike the gentlemen who had been alluded to, he had never been absent from one of its annual meetings. The only argument he had heard in favour of the proposal was that it might be more convenient to some of the members, but he thought it was quite likely that if they found six people who were pleased at the idea of a change, they might find half a dozen who would not be pleased to have an alteration of this kind introduced. This was, he believed, the third time the proposal had been brought forward either in the Committee or at an ordinary meeting—and it had also been sometimes raised at annual meetings, but always up to the present time it had been met by a strong feeling on the part of the members that it was better not to interfere with an established feature of the Club, unless for very strong and sufficient reasons. He thought that before they decided to make any speculative alterations in a course of things which had existed since the Club was first formed, they ought to be quite sure that they were sufficiently warranted by circumstances in so doing. No reason had at present been given for making this change, except that it might suit the personal convenience of a few of the members.

Mr. T. C. White said that the subject was one which no doubt they all had their own ideas about, and, speaking for himself only, his opinion was that July was a most unfortunate time of year at which to hold the annual meeting. He had been ashamed sometimes to see how few members there were present to hear the address of the President, prepared with great care for the occasion; besides which it did not seem right that a number of members should from this cause be unable to take any part in the election of their officers. He had listened attentively to the remarks of Dr. Cooke, who, as one of the original members of the Club, was entitled to be heard with great respect for his opinions, but he had not been able to see that there was any very strong argument used. He should at least like to hear the reasons against the change when they found on the other hand that the present date had proved a failure so far as numbers in attendance were concerned. For his own part he had always thought it was the wrong time of year at which to hold the annual meeting.

Mr. E. T. Newton said that in one respect he agreed with Dr. Cooke, and that was that it was most undesirable to make any change in the rules of the Club unless a very good reason could be shown for the alteration. Dr. Cooke himself had not given them any strong reason against it, and it seemed clear that two or three of the chief officers of the Club were anxious to have the change made. He thought that there had been reasons shown

in favour of the adoption of the proposal before the meeting, and he should himself certainly vote in favour of it.

Mr. Goodwin said that so far as he could understand from the remarks of previous speakers the chief reason for wanting the change was the fact that many of the members had either gone or were just going into the country at the time when the annual meeting was held. It struck him that there might be many other reasons besides this. They had a great many country members who, it might be supposed, would like to attend the annual meeting, and who would not be very well able to do so if it were held in the winter. Persons from the country often made a practice of visiting London in May or about that time of year, and, if his memory rightly served him, he thought he was correct in saying that May was a month in which they generally had a very good attendance at their meetings. He thought, therefore, that it would be more convenient both to town members and to country members if the annual meeting were in future held in May.

Mr. Epps thought it might guide them in forming an opinion if they knew at what time the meetings of other similar societies were usually held.

The President said that the generality of them held their meetings in January or February. The Linnean held theirs in May, but that was because their anniversary was always held on the birthday of Linnæus.

Mr. Funston thought January was a most inconvenient month to select for the purpose. The weather was nearly always bad, preventing all but very robust persons from going out in the evening, and domestic and social arrangements would be very likely to interfere with attendance at that time of year. He thought that May would be much more convenient than an earlier month.

Mr. Parsons said he was just about to make the same remark, that the winter seemed a bad time to choose if the object was to secure a better attendance. In addition to the unfavourable nature of the weather, there were a great many other attractions at that time which would be likely to affect them adversely. Like Dr. Cooke, he felt very much averse to changes in the rules, and did not like to support making a change like this for the reasons named. He thought perhaps one reason why they had a small attendance at the annual meetings might be that members found them rather too dull to entice them to come.

Mr. Hardy said there seemed to be a difference of opinion as to the best time at which to hold the meeting. He would, therefore, propose that a show of hands should be taken, one in favour of January and one for May.

The President pointed out that the first question they had to decide was, whether or not it was desirable to make any change; when they had settled that, the fixing of a convenient date could be managed as a matter of detail.

Dr. Cooke thought the best thing to be done was to put the question to the meeting—should there be a change or not?

Dr. Matthews had one little suggestion to make before the resolution was put, and that was that an important matter like this should not be too hastily considered. It would be a great pity to do anything without due deliberation, and, therefore, he would move that the special meeting should be adjourned, so as to give the members an opportunity of thinking the matter well over before they were called upon to decide, as there seemed to be so many things to be said both for and against the proposal.

Mr. Nelson asked if there was time enough to do this before the arrangements for the meeting had to be made?

Mr. Hind doubted whether they would get any better opportunity than the present.

The President reminded the meeting that there would be no ordinary meeting after that one until May, in consequence of Good Friday falling upon their usual date in April.

Mr. W. J. Brown said he had great pleasure in seconding the proposal of Dr. Matthews for an adjournment of the question for further consideration. As an old member of the Club of 16 years standing, he thought that before anything was done in a matter of this kind the subject should be thoroughly ventilated. He should like amongst other things to have reference made to the numbers attending the meetings at different times of the year, so that before they decided anything they might have the facts before them.

The President said that unless they sent out a special notice to every member it would not be possible to make this proposed adjournment.

Mr. Morland said that having been called together for the purpose, why should they not decide upon the matter at once—everyone had notice about it beforehand already?

Mr. Buffham said without suggesting a special meeting, could not the present meeting be adjourned for a fortnight?

The President said they must in either case send out notices, and this was rather an expensive matter when they considered the question of printing and postages. In the case of the present meeting there had been no extra cost for postage, because the notices went out with the excursion cards. The rules required them to give a month's notice of a special general meeting, and though it might be competent for them to do so, he thought that to adjourn the present meeting to a gossip meeting without special notice would only give room for complaint.

Dr. Matthews said that being so, he would, with the consent of his seconder, be glad to withdraw his amendment.

Mr. W. J. Brown cordially assented to its withdrawal, but he should not support the question unless it appeared that some great possible good was likely to be derived from it.

Mr. Morland said he could not say he liked the idea of adjournment; he would rather be beaten at once than have the matter stand over longer.

The President was about to put the original motion, when

Mr. Goodwin moved "That the annual meeting be held on the fourth Friday in May."

Mr. Epps had much pleasure in seconding the motion.

Mr. Waller thought their proper course was, first of all, to take the opinion of the meeting as to whether any change should be made.

The President said that as they had a definite amendment before them, he thought the best course would be to take a vote upon it in the first instance. He therefore formally put to the meeting the proposal, "That in future the annual meeting of the Club be held on the fourth Friday in May." On counting the show of hands, he declared the amendment to be lost.

Mr. Hardy said he would propose next, "That the date of the annual meeting be altered to the fourth Friday in March"

The President thought the best thing to be done was to put to the meeting Mr. Nelson's original motion, "That the date of the annual meeting be changed to a winter month." On a show of hands being taken, it was announced that the motion was carried by 36 votes to 8.

Mr. Nelson then proposed, "That the date of the winter month to be decided on be considered in committee, and be brought by them before another meeting of the members."

A Member asked if the Committee were prepared to suggest any month as being more convenient than another?

Mr. T. C. White thought it was a matter which would require some consideration; they would want to know what was the average number attending the different meetings at that time of year.

Dr. M. C. Cooke thought the only legal way of proceeding was to give notice in proper form, and to consider the matter at the next annual meeting in July.

The President said that after the passing of the resolution to alter the date there would, of course, be no annual meeting in July; the meeting had just resolved that there should be none. What they had to do next was to decide at what other time the meeting should be held instead, and they could either fix a date at once or adjourn the further consideration, as they thought best.

Dr. Cooke inquired if proper notice was given of an intention to bring this matter forward at the previous ordinary meeting?

The President—Certainly.

Mr. Hardy thought it would be well to take the sense of the meeting at once as to the most desirable date for the future holding of the annual meetings.

Mr. Spencer thought it would not do to fix the fourth Friday in March, because that might occasionally fall on Good Friday.

Mr. Reeves thought it would be very much better to settle the matter at once if they could do so.

Mr. Vesey then moved, "That in future the annual meetings of the Club be held on the fourth Friday in February."

Mr. Spencer having seconded the motion,

The President put it to the meeting, and declared it to be carried by 37 votes to 2. Rules 7 and 8 were therefore ordered to be altered accordingly.

Mr. E. T. Newton thought that as the changes made would necessitate an alteration in Rule 7, so as to make their financial year end in future at the period of the annual meeting, it would be necessary to make some arrangement for carrying out the alteration as regarded their future subscriptions, which would at present become due in July next.

The President said that the necessary alteration in Rule 7 would have the effect of shifting the date for payment of subscriptions six months, so as to make them come due in future at the annual meeting.

Mr. Epps asked how they proposed to do this, seeing that there would be no annual meeting during the current year?

The Secretary having, at the request of the President, read Rule 7,

The President said that the additional six months which would intervene before their annual meeting, could be provided for either by paying 10s. at Midsummer and 5s. more at Christmas, or 5s. at Midsummer and 10s. for the whole year following in January; or members could, if they pleased, pay the 15s. at one time. He then put the proposal to the meeting, "That Rule 7 should be altered so as to provide that subscriptions come due in future at the altered date of the annual meeting."

Carried unanimously.

Mr. Hind said that as matters stood at present the officers and Council were only elected to serve until next July, and asked if it would not be desirable to pass another resolution, so as to enable them to continue in office until the date of the next annual meeting?

The President thought this would be necessary under the circumstances, and was of opinion that it could be done by an ordinary resolution.

It was then moved by Mr. Hind, and seconded by Mr. Snelgrove, "That the present officers of the Club be requested to continue their services for a further period up to the date of the next annual meeting, and that they are hereby elected for such period."

The President having put it to the meeting, declared it to be carried unanimously.

The business of the ordinary meeting was then resumed.

Mr. Hailes called attention to one of Sugg's new inverted gas-burners, "The Cromartie," which with a consumption of 1·9 cubic feet of gas per hour gives a light equal to 11·03 candles, and from its brillancy and steadiness was, he thought, particularly adapted for use with the microscope.

Mr. E. M. Nelson exhibited and described a new oil immersion achromatic condenser.

The chair having been taken *pro tem.* by Dr. Matthews, the President gave a description of species of a *Gamasus* found in a mole's nest, and supposed to be unrecorded. He illustrated his remarks by drawings on the board, and by slides exhibited under microscopes in the room.

A vote of thanks to the President for his communication was proposed by Dr. Matthews, and carried unanimously.

A short note "On the Finer Structure of certain Diatoms," by Mr. E. M. Nelson and Mr. G. C. Karop, was, in consequence of the lateness of the hour, taken as read.

The President again announced that owing to the occurrence of Good Friday on the fourth Friday in April, the ordinary meeting in that month would be omitted.

The excursions, &c., for April and May were then announced, and the meeting terminated with the usual Conversazione, and the following objects were exhibited:—

Stentor polymorphus	Mr. F. W. Andrew.
Diatoms, *Arachnoidiscus oratus*	Mr. C. Collins.
Tick *Argas persicus*	Mr. F. Enock.
Lung of spider	Mr. F. Fitch.
Dipterous fly, *Hemerdromia raptoria* ♂	Mr. H. E. Freeman.
Spider, *Linyphia montana* ♂ & ♀ ...	Mr. G. E. Mainland.
Acarus, *Gamasus terribilis*	Mr. A. D. Michæl.
Diatoms, *Arachnoidiscus Ehrenbergii*, var. *Montereyana*	Mr. H. Morland.
Diatoms, *Eupodiscus argus*	Mr. R. T. G. Nevins.

Attendance—Members, 66; Visitors, 4.

On Diatom Structure.

By Henry Morland.

(Read May 28th, 1886.)

It will be remembered that at the ordinary meeting of this Club, held on February 26th last, Mr. Nelson exhibited a model, showing the structure of the valve of *Navicula Durrandii*, Kitton, and also added a few remarks on the structure of diatom valves in general. Although the members of this Club were so invited, there was no discussion, and the matter dropped. In inviting discussion, our President mentioned my name, but at the moment I did not feel equal to the occasion, more especially as I had never paid any particular attention to the structure of *N. Durrandii*, besides which, as far as my judgment went, I was perfectly in accord with Mr. Nelson's theory, viz., that the "dots" seen on this particular diatom were nothing more nor less than so many minute perforations. I have since examined the diatom more carefully, and if Mr. Nelson's model exhibited the channels, from perforation to perforation on the inner surface of the valve, as running crossways to the length, then he and I are as one so far as relates to the model itself; but I cannot agree with his views regarding the median line, or "raphe," which, so far as I understood him to say, he looks upon as merely a thickening for strengthening the valve generally. With regard to this point, I may state that certain diatomists consider that true "raphes" are simply clefts with thickened borders, and in the "texte" of Dr. Van Heurck's "Synopsis of the Belgian Diatoms," page 37, there is a figure of a section of *Navicula Dactylus*, prepared by M. W. Prinz, which shows this cleft very distinctly. I must not, however, confine myself to quoting authorities, but, if possible, give my reasons for acknowledging such authorities. In the present instance, I have sometimes noticed, when examining this "raphe," that it has two borders, in consequence of the cleft being slightly oblique, one of which, under a high power, will be seen to be on the "upper" surface, whilst the other is on the "inner,"

but if the ends of these borders be examined it will be found that they join each other, provided the fine adjustment be carefully worked whilst they are under examination. But in addition to what I have just stated, I can add that I have a slide of *Pleurosigma Balticum* in which one of the valves, in consequence of a side fracture near one of the ends, is split right up the centre of the median line from one of the end nodules to the centre one. Now, it must be evident that if the median line, or "raphe," were a simple thickening of the valvular structure, it would be the last place where a fracture could occur along its length. Beyond all this, I have a valve of a *Navicula* which I happened to slightly fracture whilst washing it free from adherent dirt in a drop of water before placing it into position in a "selected" mount. It got fractured near one of the end nodules, and this fracture ran right along the whole length of the valve, through the centre nodule to the one at the other end. At the moment when I touched it with my mounted bristle it opened out just like a pair of scissors, but on removing the bristle, as the other end still remained intact, the two halves sprang back again into their original positions, and under a low power the valve still looks perfect. I have mounted this valve by the side of an unbroken one, in which the centre nodule is seen to be perfect between the two central ends of the two halves of the "raphe," whilst in the broken valve the two halves of the "raphe" are seen to join each other right across the centre nodule. It is not at all an uncommon thing to come across valves of *Naviculæ* halved along the "raphe" when looking over ordinary "spread" diatom slides.

Last summer, being in Jutland, I obtained a quantity of the well-known Jutland "Cementstein," from both the islands of Mors, and Fur. As I had already had this material in my hands for some time past, it was, so far as cleaning it for diatoms in the ordinary way was concerned, of little or no use to me; but noticing under a Coddington lens that, as a general rule, the larger *Coscinodisci* lay parallel to the stratification, I determined to prepare sections in which I could cut these *Coscinodisci* in any direction I chose. I accordingly sent some pieces of this material to a lapidary for slicing—first marking with ink the direction in which the material was to be cut up. I may here remark that this "Cementstein" is simply perfection so far as regards texture and hardness. With care, sections can be prepared of exceeding

thinness. I think I can safely affirm that some of my sections are in parts not more than $\frac{1}{3000}$ of an inch thick, and even less; in fact, I should consider a section $\frac{1}{1000}$ inch thick by no means thin. But to obtain these very satisfactory results it is as well to prepare a number of sections and then select the best. It can be readily understood that when we have to deal with such exceedingly thin sections the slightest amount of grinding at the finish, one way or the other, will mean either a comparatively thick section or none at all.

To resume, on receiving my slices of "Cementstein" I smoothed one side on a piece of thick glass with a little "Wellington knife powder" and water. The powder, although fine, is too coarse to finish off with, but being brittle it breaks up finer and finer as the grinding proceeds, and eventually becomes quite fine enough for our requirements, provided no fresh powder be added towards the finish. I generally prepare some half-dozen slices at a time; when one has all the needful apparatus ready it is as well to make full use of it. The slices being thin, say $\frac{1}{25}$ of an inch, by pressing the tip of one of the fingers on the centre of them they can be finished off pretty level, as they spring and get ground down rather more in the centre than they otherwise would, and thus is counteracted the rubbing away at the sides and corners which usually takes place when sections are rubbed down by hand. When the slices are duly finished off on one side, I then attach them with balsam, prepared side downwards, to the slips on which they are finally mounted. And here a few words of caution are necessary, viz., "the balsam *must* be hard," for if it were not so the section, as it approached the final grinding, would, in spite of every care, begin to break up for want of a steady support, in consequence of the balsam being soft and yielding. It is also necessary to avoid bubbles under the section, as bubbles mean breaking away of the section in those parts for want of proper support, but better, by far, a bubble than soft balsam. I fix the slices with balsam slightly hardened, and then harden off gradually by putting the slips in a very cool oven for a week or ten days; by so doing I get the balsam hard throughout, and without bubbles. The second side of the slice of "Cementstein" can now be rubbed down similarly to the first side, with "Wellington knife powder" and water on glass. As the section approaches completion, care and very light pressure must be employed, and the "Coddington"

used every minute or so. I generally grind till, in spite of all my care, the section begins to break away at the edges. I now wash the slip with section attached in clean water, wipe same and dry off with a very gentle heat, not sufficient to soften the balsam. Having got a cover glass ready, I place a very small quantity of thickish balsam on the section, put on the cover, and press down hard. If the right quantity of balsam has been added, there is only sufficient to fill up under the cover, and, if done *at once*, the cover can be adjusted to one side or the other, as may be found necessary; but this cannot be done later on, as by that time the small amount of softer balsam under the cover will have attacked and slightly softened the hard balsam under the section, and moving the cover to one side or the other will have a tendency to break up the section. I now place the slide in a cool oven for a few days, and when labelled it is finished, unless I add a ring of Bell's cement, which will enable the section to be examined under an oil immersion lens without fear of the oil attacking and softening the balsam.

Thus far I have only described how very thin sections of "*Cementstein*" can be prepared; I will now proceed to describe how the *diatom* sections can be separated and isolated. After preparing one side of the slice of "Cementstein," I attach it to a piece of glass some $1\frac{1}{4}'' \times 1''$, instead of to an ordinary $3'' \times 1''$ slips and rub it down to the necessary thinness. I then immerse it, still attached to the glass, in benzole. After a little time, say half-an-hour, it can be brushed off with a camel-hair pencil on to a glass slip and cleaned of all balsam by being brushed with the camel-hair pencil charged with benzole. I then transfer the slice to some methylated spirit to get rid of the residue of benzole, and after a short time to a little clean water in a watch-glass. I now pour off the water and add a few drops of hydrochloric acid, which at once separates the diatoms contained in the section of "Cementstein." I fill up the watch-glass with distilled or filtered rain-water, allow to settle, draw off the liquid as close as I can venture by means of a fine pipette, and fill up with water again; this I repeat several times, until I feel satisfied that I have got rid of the hydrochloric acid. I next give the diatoms a boiling in sulphuric acid in the watch-glass, which I place on a small piece of wire gauze and apply the spirit lamp underneath. After washing away the acid I have the clean diatom sections ready for selecting

and mounting; I may say that it is not a case of "embarras de richesses," far otherwise, and it is a question after all if it is worth while to go through so much to obtain so little, more especially as the diatoms show up very well in the sections of "Cementstein," in addition to which sections of extreme tenuity can be found in the "Cementstein," more particularly at the edges of the section, which it would be impossible to lift on account of their really being in pieces with the fragments still kept in position.

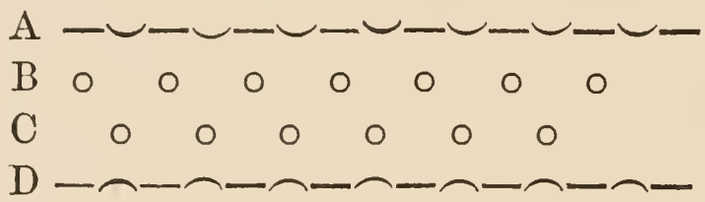
Messieurs W. Prinz and Van Ermengem in their work on the structure of diatoms contained in this "Cementstein," adopt another method of isolating the diatoms; they do not attempt to select them, but merely immerse the finished section on the slip in a weak solution of hydrochloric acid, which attacks and dissolves out the lime, still leaving the sliced diatoms attached by the balsam to the slip. After washing gently in fresh water and drying, they then mount in a watery solution of biniodide of mercury and iodide of potash, which does not dissolve the thin stratum of balsam by which the diatoms are fixed. This medium has a high refractive index, 1·68, but this plan of mounting necessitates the diatoms being on the slip instead of on the cover.

Having shown how diatoms in "Cementstein" can be sliced and isolated, perhaps some of our members may be able to extend the process to other diatoms; I have tried to do so myself, but as I did not succeed to my satisfaction I need not trouble you with an account of what I did and what I did not. If diatoms can be cemented in bulk into a material having the texture and characteristics of "Cementstein" the problem is easy.

However, I do not think there is really any occasion whatever to trouble about preparing sections of diatoms, as their structure can be very well studied from broken valves, often found in much larger quantities than desirable in the cleaned material. When selecting diatoms I constantly come across broken valves or parts of valves suitable for mounting for the study of their structure, and, provided that not more than *one* piece be required to be set "on edge," I can generally place such piece in such position, adding other pieces lying flat. I cannot now enter into particulars of how I manage this, but could do so at length on some future occasion.

Supposing I have found a portion of a diatom valve, and have set it so that the edge is in contact with the covering glass; it

may be objected that such a piece does not present the advantages of a section; perhaps not entirely, but still a great deal can be learnt from such an examination, for, if diatom valves are riddled through and through with perforations as, in general, I maintain they are, it follows that sections would necessarily fall to pieces if they were cut exceedingly thin, and if they were left somewhat thick then the very object of a thin section would be lost, as it is the rows of perforations immediately under the uppermost row under examination which cause all the ambiguity and interference of images. The following sketch will fully explain my meaning:—



Here are four rows of perforations, the upper one, "A," being under examination. If the objective be of wide aperture it is possible that this row alone will be observed, there being in such case, practically speaking, no depth of focus whatever; but should the objective have less aperture, it is the row "B" which will cause most of the confusion and interference of images, and the further one recedes from the upper row, "A," the less the interference becomes. If my views be correct, why, then, be at the trouble of attempting to cut a *section* of a diatom unless it can be cut so thin that the row "B" would have no existence whatever? But this I have no hesitation in saying would be impossible unless the section were ground down on the slip on which it was to be finally mounted.

Although diatom sections and broken valves afford a great deal of information relative to their structure, yet it must also be allowed that much can be learnt from the examination of the perfect valves themselves, if properly mounted, as well as from defective valves. I think I may say that no one valve will afford *every* information; it is necessary to examine a number in all sorts of stages and conditions, and to make your own deductions therefrom.

Proceeding now to the question of the structure of diatom valves, I purchased not long since a copy of Messrs. W. Prinz and Van Ermengem's work on the structure of diatoms contained in the Jutland "Cementstein." I have nothing to add to their observa-

tions further than to say that, so far as I have been able to judge, my observations are fully in accord with theirs. They maintain that the markings on the diatom valves are "perforations," but that the structure differs in different forms; for instance, that of *Coscinodiscus oculus-iridis* may be likened to an india-rubber door-mat with hexagonal holes, laid upon and joined to a thin sheet of rubber, with a small circular hole in this sheet opposite the centre of each hexagonal cell in the door-mat; a valve cut obliquely shows this very distinctly, and that the round marks at the bottom of the cells are holes is clearly proved by an examination of the edges. I have a section of *Coscinodiscus* which shows these holes very distinctly under a $\frac{1}{5}$ inch objective; they are comparatively large, about $\frac{1}{12000}$ inch in diameter. With respect to *Trinacria Regina*, one of the most common forms in the "Cementstein," the structure is much more simple, being nothing more than simple perforations; the edges of the cut valves in all directions show this very plainly. But besides this there are little specks of iron pyrites here and there in this "Cementstein;" if in very small quantity, and coating any part of the diatom valves, it will always be found between the dots, never on them unless in larger quantity, in which case it is found all over the surface; in no case are the dots covered with iron pyrites and the intervening spaces left free. Very thin sections of *Pyxidicula cruciata*, on which the markings are comparatively large, will sometimes show the framework of the valve in separate pieces, but still held in position by the balsam.

The word "framework" reminds me that that is how we ought to regard the siliceous valves of the Diatomaceæ. In my view the whole purpose of these valves is simply to support the living substance of the diatom. If the solid "dot" theory were correct, it would follow that the outer and inner portions of the living diatom are completely shut off from one another with no communication whatever between them; if, on the other hand, the valves be perforated, there would then be a continuity between the two parts, besides which there would also be economy of material used in building up this framework or skeleton. For my part I cannot see the object of dots, but the case is very different if we find these markings are really perforations.

According to Dr. Van Heurck's "Texte" to his "Synopsis of the Belgian Diatoms," in that part treating on the structure of diatom valves, it would seem he implies (not actually stating it)

that the normal structure of diatom valves consists of an inner layer, more or less perforated, strengthened by an outer frame of tubes more or less hexagonal, and that this upper framework of tubes may be found in various stages, either very fully developed (with even an exterior layer somewhat similar to the interior) or slightly wanting, or reduced to spines only, or even entirely wanting. If I judge Dr. Van Heurck rightly, he takes a highly developed structure as his type.

On the other hand, I would prefer taking a very simple structure as my type, and working upwards, and this I would do because I come across structures which cannot be explained upon the theory of working downwards.

In my view the simplest structure would be well represented by taking a piece of perforated sheet zinc; this I consider to be the structure of the *Pleurosigmæ*, with a sigmoid cleft down the centre, strengthened with a nodule at each end, and a larger one in the centre, this cleft having thickened sides and being called the "raphe."

A little higher structure is that of the *Stictodisci* and some of the *Triceratiæ*, where the perforations have thickened borders, sometimes further strengthened with minute veins, like those of a leaf, running from hole to hole as can be seen in the valves of *Stictodiscus Jeremianus*. I have a slide of what I believe to be *Triceratium venulosum*, in which I have mounted a frustule on edge; by careful focussing perforations can be seen running through the substance of the valves. I have also what may be called a skeleton valve of some species of *Auliscus*, selected from a deposit which I had to subject to very severe treatment with caustic potash in order to disintegrate it; it appears as if the thinner portions of the valve had been dissolved by the potash, but that the thick veins or ribs, having more substance in them, had been able to resist the action of the potash to a certain extent.

I will next take the case of what I consider to be a highly developed structure, viz., that of *Aulacodiscus margaritaceus*. This was one of the forms of which I *did* manage to cut some sections, but not to my satisfaction; however, I mounted a section with the cut edge in full view, and examined it under my microscope. I could see that the section had thin lines running across, and at first I thought it was a case of simple structure where the valve was strengthened by means of extra depth or thickness. However, more careful examination of perfect valves and fragments of

valves soon showed me that the structure was of the most complete kind, according to Dr. Van Heurck's views. Most young microscopists looking at a valve with the outer surface uppermost under a lowish power, say a $\frac{4}{10}$ inch objective, would regard the markings as solid dots, but I could soon convince him to the contrary by showing him a valve under this low power, wherein the balsam has failed to duly penetrate several of the cells, the valve showing bubbles of air most distinctly in the body of the structure, each bubble being contained in a separate cellule. So much for the solid dot theory; however, this is only one step towards getting a proper knowledge of what we are examining. I have another slide on which are two broken valves, one with the "inner," the other with the "outer" side uppermost. I have mounted these valves thus, as I find that when using high powers it is better to have the surface which is being examined uppermost, and not with any structure above it, which interferes considerably with proper definition. On examining the "inner" surface, I find that it has a small perforation with thickened edge in the centre of each larger cell in the structure above (or rather underneath as examined), but on examining the "outer" surface on the other valve the "dots" appear circular, but not so definitely as to enable me to decide exactly upon their nature; however, I have yet another slide of this diatom, with fragments only of the valve mounted in various positions and one of these fragments is broken in such a manner that I can examine the inner surface, interior structure, or outer surface separately, which enables me to give the following description of the structure of this valve:—The inner surface consists of a layer with small perforations, some $\frac{1}{12000}$ inch across, with thickened borders (in fact, I find thickened borders and rounded edges very common to perforations); above this is a framework of tubes (one to each perforation below), with more or less straight-sided borders. Some of these tubes have 4, 5, or 6 sides, and they are by no means regular in shape. As the outward surface is approached the angles get filled up, and the irregularly shaped cells end in circular openings rather smaller than the cells themselves.

The next diatom I shall describe is *Arachnoidiscus Ehrenbergii*, and here the structure is totally unlike those of which I have already been speaking. This valve is composed, firstly, of an outer layer, with large, slightly angular perforations, radiating from the centre to the circumference. That these markings *are* perforations

is evident on examination of broken valves. This thin layer is strengthened, unlike certain of the *Coscinodisci*, *Triceratiæ*, and *Aulacodisci*, on the interior instead of the exterior surface, by means of radial plates set edgewise from a central ring to the circumference, and these plates themselves are strengthened on the inner edge by its being formed somewhat like an ordinary railway rail. The ends of the plates widen considerably, and join each other with graceful curves, uniting also with the inner ring and outer circumference. The interior plates are still further strengthened by being joined to the outer layer by little brackets, placed either between the perforations or on the inner side of the circumference. There are also shorter radial plates of simple construction springing about half way between the central ring and the circumference, and, joining the outer border. I have endeavoured to explain this structure as clearly as I can, but I feel I have not done it justice. All I can say is, that the more clearly I began to understand the structure of this diatom, the more was I lost in admiration.

Amongst my diatomaceous material I have some from Tampa Bay, Florida, which contains a number of *Eupodiscus Argus*, having the outer substance of the valve very much corroded. Looking at ordinary valves of this diatom, it is very difficult to make out what its real structure is, the outer portion being dense, with irregularly-shaped openings all over it; but in the Tampa Bay forms this outer substance is entirely wanting in the central part, gradually becoming perfect towards the circumference. An examination shows that the inner substance, or plate, has minute markings radiating from the centre; above this is an hexagonal structure (somewhat resembling that of *Triceratium favus*), but which is wanting in the centre. In ordinary forms it would seem as if there were a redundancy of silex, which granulated on and around the hexagonal framework, which covers the outer surface of the valve. Not long since I promised a correspondent a slide of this form from the Tampa Bay material, and one day I selected a quantity for mounting on a future occasion. When, however, I came to mount them, I found that a number of them had got smashed (the very best ones, of course; "it is always so"); certainly there were some left, but they were not so good as I could have wished. I did not care to search for more, knowing that the really good valves required some looking for, so I had reluctantly to make up my mind to send my correspondent a slide of the

valves remaining of those I had already picked out. It is a rule of mine when mounting "selected" diatoms, if I find them in any way dirty, to wash them by passing them in and out of a drop of water on a glass slip. I was doing this with these diatoms and as they were drying, concave side downwards (and consequently. holding down tight on the glass slip, like suckers, as it were), I touched them slightly with my mounted bristle, and found that, with very little trouble on my part, I could remove nearly the whole of the upper and outer structure of the valve, which appeared to me as if it were rotten; I took advantage of this circumstance, and in a very short time prepared a number of valves meeting my requirements. In due course my correspondent received a slide of these "tampered with" diatoms from Tampa Bay, with which he was very well pleased. I may say that this material also contains *Eupodiscus radiatus*, Bailey, which appears to be similarly affected in the outer substance of the valve, but I have not yet either mounted it or given it a proper examination under the microscope,

I should just like to ask one question, viz.: How many hoops does a frustule of *Pleurosigma* have? In washing such a frustule (which has broken up at once on being drawn or pushed out of the water) I have observed quite a number of hoops peeling off one after another. I think that many persons must have noticed an extraordinary number of hoops on some of their slides of Pleurosigmæ, in fact, more hoops than valves.

In conclusion I will venture to remark that it is not always the best workers that have the longest purses, and as the examination of the structure of diatoms requires a somewhat high power, it is possible that some such workers may feel a little discouraged and unwilling to undertake the study of this branch of microscopy. To these fellow-workers I have a word of comfort, and that is that the cost of a suitable objective is not quite so high as they may probably think; my highest objective is only a Zeiss's G water-immersion, which cost me £5 10s., and is really a very nice lens, giving a power of over 1,000 diameters with a "D" eyepiece of Swift's. There is still a further comfort for some of our poorer members; I understand that a new optical glass has lately been produced which will throw all lenses hitherto manufactured completely into the shade. This may possibly cause a number of $\frac{1}{12}$ inch oil immersion lenses of 1·43 N.A. to be disposed of at an alarming sacrifice. I should like then to pick up one for a five-pound note.

On the Microscopical Structure of the Diatom Valve.

By Julien Deby, F.R.M.S.

(Read May 28th, 1886.)

I have lately been carefully studying the minute structure of the Diatom valve, with a view, if possible, of reconciling the various conflicting opinions entertained on this difficult subject by some of the best living microscopists, and although my researches are still incomplete, I have reached the conclusion that many fallacies are being propagated regarding the Diatom cell-wall, especially in connection with the existence or non-existence of orifices or perforations of the Valve.

My belief is that the outer shell of the frustule of the living form is the perfect homologue of the ordinary cell-wall of other plants, and that it is impervious, *i.e.*, free from visible openings, while the so-called "secondary valves," the "Regenerationshülle" of A. Smidt, are homologous with the scalariform and similar thickenings observed in many vegetable cells and vessels formed by these. Although I must reserve for a future occasion a complete and elaborate account of my observations, I will lay before the Club a few of my methods of investigation, and some of my principal results.

I.

I have had recourse, in the first place, to the method of thin sections of Messrs. Prinz and Van Ermengem. The difference between their conclusions and my own I attribute to the fact of my having almost invariably employed recent diatoms for my investigations, whereas these gentlemen made use of fossil shells, the external films of which had disappeared either by abrasion or by slow chemical action. Messrs. Prinz and Van Ermengem truly represented what they saw, namely, a sieve-like membrane, showing real orifices, but this in the living frustule does not, according to my views, exist.

I have used as imbedding media, chloride of zinc or chloride of magnesia, mixed with their respective oxides, an idea which was given to me by Mr. Hartmann, formerly of Swansea. As soon

as the mixtures have become hard, thin sections of them can be made in the same way as with ordinary rock. If sufficient care is taken it is not difficult to obtain sections of a less diameter than the areola of a *Triceratium* or of a *Coscinodiscus*. These sections have been corroborative of my general conclusions as detailed further on.

II.

I have repeated, on several occasions, the experiment first tried by the late Prof. J. W. Bailey, of West point, as early as 1851, namely, of dissolving the diatoms, under the microscope, in hydrofluoric acid. My results have been identical with those obtained by this very excellent observer. Prof. Bailey's paper not being easily accessible, as it was published in the "American Journal of Science and Arts," 2nd Series, Vol. xi, I have thought that a reproduction of it here might not prove out of place on account of the interesting demonstrations it gives of various points in diatom structure. Some of these, however, relating to the nodules and rachis, are at the present day acknowledged by all naturalists, and as such are somewhat irrelevant with the subject under discussion.

"*On the real nature of the so-called 'orifices' in Diatomaceous shells.*—It is well known to naturalists that several of the most distinguished writers on the Diatomaceæ have asserted the existence of 'apertures,' 'orifices,' or mouths in the ventral surfaces of many shells belonging to this family, and have even founded classes and genera upon the supposed presence of these openings. Some years ago I expressed in this Journal my disbelief in the existence of the apertures in the following words:—

"'There are three rounded spaces on each of the ventral faces (of *Naviculæ*), which, I think, have been mistaken for openings but which appear to me to be thicker portions of the carapace.'

"This opinion was founded upon a careful observation of various fragments as seen in clean fossil specimens, and I still think that by the inspection of such fragments full evidence of the truth of my opinion may be obtained. I now offer proof of another kind which removes all doubt, and shows that these markings are neither apertures nor depressions, but are in reality the thickest parts of the shell. If the shells are placed in dilute hydrofluoric acid and watched by aid of a microscope as they gradually dissolve, the thinnest parts, of course, dissolve first, and apertures, if any

exist, should become enlarged. Now, the very parts which have been called orifices by some and depressions by others, are the last of all to disappear as the shell is dissolved. This mode of observation, besides establishing the fact that these are really the thickest parts of the shells, reveals many interesting particulars of structure in the various genera of Diatomaceæ. Thus in the large species of *Pinnularia* it may be seen with even a low power, that the two parallel bands (separated by a canal) which reach from the central knob to the terminal ones, and which appear smooth before the application of the acid, become distinctly striated after their surface is dissolved off, as does also the central spot itself, showing that striæ which existed in the young shell are covered up and nearly obliterated by subsequent deposits.

"In *Stauroneis* the Cross-band and the two longitudinal bands are the last to dissolve, and these last bands, as in most of the family, appear separated by what is either a canal or a very thin portion of the shell.

"In *Grammatophora* the undulating lines are internal plates which are the last to dissolve. In *Heliopelta*, *Actinoptychus*, &c., the polygonal central spot is the last to disappear. In *Isthmia*, *the spots on the surface, which at first appear like granular projections, are in reality thin portions of the shell, and under the action of the acid they soon become real holes.** The acid also proves that the larger spots at the transverse bands are really a series of large arcuate holes in the siliceous shell, and the piers of this series of arches remain some time after all the rest of the shell has vanished. Many other interesting facts are revealed by the action of this acid on these shells, and no one can use it without learning much with regard to their true structure.

"A few directions with regard to the mode of manipulation in these experiments will probably be useful. As the fumes of the hydrofluoric acid, if they reached the lenses, would greatly injure them, I would advise experimenters (even if they have a microchemical stage) to protect the front face of their objectives by temporarily cementing to them a thin plate of mica by means of Canada balsam. This can be attached or removed in a few moments, and completely protects the lens without materially affecting its optical power. As mica resists the action of hydrofuoric acid much better than glass does, I prepare the cell in which

* The italics are my own.—J. D.

the solution is to take place by cementing a bit of mica to a glass slide, and then cover all its surface except a central cell with wax.

"In this cell the shells are put with a little water, and after adding a drop or two of the acid by means of a dropping rod of silver or platinum, the cell is covered with another plate of mica, and the action watched under the microscope.

"If hydrofluoric acid is applied to recent Diatomaceæ, the silica soon dissolves leaving distinct, internal, flexible cell-membranes retaining the general form of the shells. These may sometimes, but not generally, be detected even in the fossil specimens.

"When present they materially interfere with the examination of the true nature of the markings of the siliceous shell, and should be destroyed by nitric acid and heat before the hydrofluoric acid is employed, unless it is desired to study the cell-membrane itself. There is a curious difference in the action of hydrofluoric acid of the same strength upon specimens of Fossil Diatomaceæ from different localities. Some dissolve with even too great rapidity in an acid which is slow and tedious in its action on other specimens. The Bermuda and Richmond Tripoli, and some specimens of fluviatile origin, resist the action much longer than is usual with most specimens, whether they are recent marine, or either recent or fossil fluviatile ones. This difference is probably due to different degrees of hydration."

III.

My direct observations have been made on a series of special type-slides, all of which are open to inspection to any persons interested in the subject. These slides were mostly prepared for me by Mr. E. Thum, of Leipzig, with unparalleled care, patience, and dexterity, and I am highly indebted to him for my very best material and for many very remarkable diatoms, mounted in various media, and showing structure better than any I possessed before.

All critical cases I have examined under dry objectives, water-immersion glasses, and the homogenous lenses in my possession, namely: one-twenty-fifth and one-sixteenth hom. imm., by Powell and Lealand; one-tenth and one-fourth hom. imm., by Spencer, of Geneva, N.Y.; and one-eighth hom. imm., by Zeiss; all glasses of most recent make and of very great excellence.

Every diatom, or fragment of a diatom, has been examined by me both by transmitted and by reflected light, by direct and

oblique light; mounted dry or in media of refractive indices varying from that of ordinary Canada balsam to the celebrated 2·4 of Prof. H. L. Smith.

It is only by thus varying all the conditions of microscopic vision and *reasoning* upon the various images produced, that any hope can be entertained of forming a definite opinion, such as I have formed, as to the real ultimate constitution of the Diatom valve, one of the most difficult problems which the microscopist can be called upon to solve.

IV.

The careful examination of good photographs has in many cases been of great help to me in the interpretations of minute details.

V.

The presence of bubbles of air within the valves of a frustule, or covered over by a single isolated valve standing on its free edge, while fluids such as benzine are gradually poured upon it, and which I have frequently noticed, preclude the existence of orifices clear through the valve by which the gas would freely escape. I have also never noticed bubbles of air within the areolæ of any *recent* diatoms, while I have many slides of *fossil* diatoms with corroded surfaces, where this phenomenon can be shown frequently without any difficulty.

VI.

I have in my collection a series of well-mounted slides, which have proved to my satisfaction the following facts most of which are corroborative of previous observations by others:

(*a.*) That the shell of most diatoms consists of a double plate.

(*b.*) That between these two plates there exist a greater or lesser number of cavities surrounded by solid walls of silica. These cavities are circular or hexagonal in outline.

(*c.*) That in all recent *living* and perfect valves the cavities are closed at the top by the upper plate, and at the bottom by the lower plate, and that these plates show no signs of orifices, but only of thinnings over the cavities, except in abnormal cases where the organic cuticle has been partially or totally destroyed by accidental causes.

(*d.*) That the external membrane is in most cases so slightly silicious that even slight contact with acids promptly destroys it and opens up the cavities at the back of it. That in other cases

this membrane, which is generally thinner in the middle portion of the areolæ, does really occasionally become highly silicified, and may support particles or granules of highly refractive silica placed over the so-called "eye spots," in which case the cavities must be hermetically sealed on both sides to all but osmotic influences.

(*e.*) That the lower closing membrane of the areolæ frequently carries various designs, the nature of which, on account of their minuteness, has not yet been well established, but which must depend upon structure, as no diffraction images produced by any organisation lying at a lower level can be the cause of them, as no such lower organisation exists below this bottom or closing internal diaphragms.

(*f.*) That the thin upper membrane of the areolæ forms the extensions of the edges of the so-called "nail-headed" bars which form the limiting walls of the areolæ as figured by Otto Müller, by Dr. Flogel, and by Messrs. Prinz and Van Ermengem.*

(*g.*) That the cavities in the valve are bounded by walls of solid silica. That these walls often extend beyond, above, or below the closing membranes of the areolæ, and that they frequently run into points or spines of various shapes and lengths, which project beyond the valve between the areolæ.

(*h.*) That the median slit or fissure, which is observed to run through the *rachis,* or thickened median line of most of the *Naviculæ,* is also closed top and bottom by a very thin organic slightly silicified membrane in recent normal valves. I believe, however, that minute apertures may exist in these narrow closing membranes in the neighbourhood of the central and of the terminal nodules, but this is a subject requiring further elucidation.

(*i.*) That the so-called "secondary" or internal valves—"Regenerationshülle"—of some Diatoms do not exist in the very young valves, a fact which gives us the reason why the frustules, which are formed of an old and of a younger valve, generally split up into an *odd* number of secondary valves, either three, or five. It is my belief that the *young* secondary valves are always perforate at first, but that as they grow older succes-

* In most fossil diatoms and in nearly all specimens boiled in acids, the external film closing the areolæ has disappeared, and the valve has in consequence become really perforate on the upper surface. In some cases the lower plate has also ended by presenting orifices, so that the sections examined by the above-named microscopists really showed what they have figured in the plates accompanying their various papers.

sive depositions of silica generally take place, which end by obliterating the orifices, and in some cases fill these quite up by dense and projecting masses of silica of a higher refractive index than the substance proper of the surrounding shell, so as to appear as red or pink coloured granules on a greenish ground under the best immersion lenses.

(*k.*) That the connective zones or bands of some genera, such as *Isthmia,* are really and truly perforate.

(*l.*) That the so-called "areolæ," "beads," "pores," "orifices," "granular projections," "depressions," "hexagons," "moniliform dots," "puncta," etc., of authors are all one and the same thing under varying microscopical interpretations, idiosyncrasies, or preconceived ideas.

VII.

If I may be allowed the free expression of my opinion on the vexed question of the real structure of the Diatom valve, I would say that I attribute to diffractive images the existence of the appearances seen by many observers in the Diatom valve, and that I further believe the perpetuation of erroneous views on the subject resides in the nearly insurmountable difficulty which exists of rightly interpreting, or, in other words, of *reducing to their true meaning,* optical phenomena of a most bewildering and complex character.

Prof. Abbe's statement should never be lost sight of by the *Diatomo-microscopist* when he tells us (and proves it) that what we actually see through our instruments in looking at very minute objects is not what the *eye* should see, but a something generally very different indeed from it.

VIII.

HISTORICAL.

As over two hundred different papers have been published on the structure of the Diatom valve, I hope I may be excused if I confine myself in these pages to a few words regarding what has been written on the subject of my present communication, and if I limit what I have to say to the history of the valve of *Triceratium*, which, of all others, I consider the easiest of demonstration and of verification, and which may, I think, be taken as typical of all Diatom structure in general.

Omitting mention of work done more than fifteen years back, we

have, in 1872, Dr. J. J. Woodward * expressing his views, substantiated by photographs, on the structure of *Triceratium*, but his written description proves that he had but a very indistinct idea of the real nature of what he had under his eye, and, in fact, that he confounded the inner with the outer surface of the valve.

Dr. Woodward had not then seen Otto Müller's nearly exhaustive treatise † on the valve of *Triceratium*, published one year anteriorly, in which the German author gives his opinion that the areolæ are closed at the bottom (or internally to the valve) by a dotted membrane; that the sectional view of the partitions separating the hexagonal alveolæ are "nail-headed," as subsequently also figured by Prinz and Van Ermengem, and better still by Flogel, and that the upper diaphragm which closes externally the areolæ is pierced by a central circular orifice. All these details are exhibited in the plate accompanying O. Müller's instructive memoir.

At about the same time we find Prof. Adolf. Weiss reading a paper before the Academy of Sciences of Vienna,‡ in which he exhibited the complex structure of the valve of *Triceratium*, which he considers as really "multicellular," each hexagon forming for him a distinct organic cell, and where he tries to explain certain of the microscopical appearances as due to variations in hydration of the cellular substance. These views and others expressed by him cannot seriously be entertained at the present day, and I shall dismiss them here without any discussion.

At this period, Mr. J. W. Stephenson,§ by a most admirable comparison of the valves of *Coscinodiscus* mounted dry and in the highly refractive bisulphide of carbon, arrived at the conclusion that the "eye spots" were perforations of the "inner" plate, and that these "eye spots" could be neither concave nor convex films of silica, in which last conclusion he is no doubt right.

In 1874 Mr. J. W. Morehouse describes the valve of *Triceratium* as formed of two films, and expresses his belief in their continuity, and that fine markings exist on both the upper and lower diaphragms of the areolæ. This last opinion must have resulted from an excess of penetration of the objectives used, which showed both films at a time.

* "The Lens," Chicago, 1872, Vol. i, p. 100.
† "Archiv. f. Anat. u. Physiol.," 1871, Vol. xv, p. 618.
‡ "Sitzb. d. Akad. d. Wiss." Vol. lxiii, Pt. 1.
§ "Month. Micr. Jourl.," Vol. x, 1873, p. 1.

We next come to the researches of Messrs. Prinz and Van Ermengem,* who studied in particular the fossil Diatoms from the Cement Stone of Jutland and the London Clay. These observers being experienced microscopists, but unfortunately not special students of the Diatomaceæ, omitted to compare the fossil with the recent analogous forms, and were thus led to generalize upon insufficient data when they stated that the Diatom valve is a sieve-like organism. These really conscientious observers would, I feel confident, have come to other conclusions had they had an opportunity of examining some of the typical slides of recent Diatoms in my possession.

The most elaborate of recent researches on the Diatom valve are those published and copiously illustrated by Dr. J. H. L. Flogel,† in which the results coincide in almost every point with those previously arrived at by Otto Müller.

During the same year Mr. J. D. Cox ‡ undertook a careful study of the Diatom valve and its fragments. I cannot, however, fully endorse all his conclusions, but give them here in his own words :—

"We have thus been led to the conclusion that the *Triceratium* is formed of two laminæ connected by a hexagonal network, of which the areolæ are about as deep as the diameter of the hexagons ; § that the inner of these laminæ is finely dotted with lines of punctæ radiant from the centre of the triangle ; *and that the outer lamina is very thin over the centre of each hexagon, to which it is firmly connected by the walls of the areolæ,* which are thickened so as to give a hemispherical interior form to the upper end of each."

Further on ‖ Mr. Cox adds :—

"I have received from Mr. Thomas Christian, of Richmond, Va., a slide containing a valve of *Triceratium Favus,* which, whilst he was endeavouring to pick it up, split into two films, the inner with its markings of dots in radial lines wholly separating from the outer, which had deep hexagonal cells closed with the exterior film, with markings or 'eye spots.' The inner film has also the outline of the hexagons upon it, being the mark of the attachment

* "Amer. Soc. Belz. Micr.," 1884 and 1885.

† "Jourl. Roy. Micr. Soc.," 1884, Vol. iv, p. 665.

‡ "Amer. Jourl. of Micr.," 1884, Vol. iv., p. 837 ; Vol. v, p. 54.

§ This assertion I cannot accept in a general way, as the depth is most variable in different species of the same genus.—J. D.

‖ "Amer. Jl. of Micr.," p. 108.

to the hexagonal cells. Mr. Christian's specimen of *Triceratium* is the first example of the entire separation of the laminæ which I have met with in that species." His later papers confirm his previous opinions.

My friend, Dr. H. Van Heurck, of Antwerp, in his synopsis of Belgian Diatoms * supports the views of Mr. Cox.

Judging from the beautiful plates of the genus *Triceratium* in the last numbers published of A. Smidt's Atlas, I believe this acute observer and admirable draftsman must hold similar opinions as Mr. Cox and Van Heurck.

Last year Dr. G. C. Wallich † refers to the views of Dr. Flogel and of Mr. Cox, and tries to oppose, upon physical grounds, and not without force, the opinions of the latter author when he states that the alveolæ are in all cases hermetically sealed cavities.

From all I have said above, it may be inferred that I reject the "porous theory" of the Diatom valve if the orifices are to be understood as perforating *the whole substance* of the valve so as to allow of contact between the living matter of a Diatom and the exterior through properly so-called, and visible, apertures. I consider the "eye spots" to consist in the *living valve* of an *organic cuticle* which is seldom highly silicified. This cuticle is very readily destroyed, in which case the orifices in the thickness of the valve become open at *one end* at the place where the "eye spot" existed, while in all cases where great corrosion has not taken place these cavities or areolæ in the valve are closed at the bottom by a stretched and continuous siliceous film of considerable thickness as compared with the upper one, and which precludes the protrusion of protoplasmic filaments and all direct admission of external solid substances into the cavity of the frustule.

I regret I cannot concur in all that has been lately said on the subject of the orifices in the Diatom valve by some of the sharpest and certainly most skilful, if not the most philosophical, of microscopical manipulators, both at the Quekett Club and at the Royal Microscopical Society's meetings.

To all microscopists interested in the final solution of this long-debated question, I tender an invitation ‡ to come and satisfy

* "Synop. des Diat. de Belgique," Text., p. 35.

† "Engl. Mech.," xl, 1885, p. 496; and "Jourl. R. Micr. Soc.," 1885, Vol. v, p. 286.

‡ Microscopists will generally, when I am not, as occasionally happens, absent upon professional business, find me at home from 10.30 a.m. to 5 p.m., and from 7 to 10 p.m. on Saturdays.

themselves by the examination of both recent and fossil slides in my possession, and plates and photographs accompanying various papers on the subject. I have full confidence that they will, after such an examination, form a definite opinion, coinciding with my own. It is very difficult and rather perilous to exhibit such delicate subjects at a public meeting under a $\frac{1}{25}$ or $\frac{1}{50}$ inch objectives, and for these reasons I should much prefer a private exhibit in my own studio.

Note on a Salt-Water Monad.

By E. M. Nelson.

(Read June 25th, 1886.)

Last year I placed some jelly-fish in a 12oz. bottle of fresh sea-water. In about a week all the jelly-fish were dead with the exception of one, which kept alive for three or four months. The bottle was not touched, and on examination this year I found a brownish growth on the sides and bottom of the bottle, and a slight growth of a green alga. Microscopical examination revealed the presence of an enormous quantity of amæbæ, and small uni-flagellate monads. The monads swam rapidly with a wavy, rotary motion. After a little while the motion became jerky, a monad bounding forward short distances, frequently stopping for an instant to change its direction. The distance of its forward movement gradually shortened, till at length it did not leave the field of a high power (1,000 diam.). During all this time the flagellum could be easily seen. The linear motion now became changed to a rotary motion, the flagellum was much shortened and was difficult to observe. The organism, moreover, gradually assumed a spherical form. When the rotary motion had well set in it was very rapid, and nothing more could be seen of the flagellum. During the rotary motion the organism did not travel about, but kept to one place. The rotary motion gradually slowed down until it stopped. The monad was a reddish-brown colour and contained a spot like a cell nucleus, rod-shaped bodies like bacteria, and minute dots like micrococci. A moment after the rotary motion of the monad had stopped a movement among a few of the micrococcal forms began. This movement was soon communicated to the rest, and also to the rod-shaped bodies. The organism gradually lost its colour and consistence, soon becoming nothing more than a transparent globe filled with moving bacteria. In some instances it burst, when a portion of the bacteria escaped and swam off. On one occasion, when one burst, I saw the flagellum—which appeared to be of full length—thrown

out; but it as quickly disappeared. I had no means of measuring an object at hand, but the organism in its spherical form was about the size of a salivary corpuscle. I regard the motion of the particles inside these monads as due to free-swimming bacteria and not to Brownian movement; for when a salivary corpuscle bursts the movement ceases, and the particles do not swim away as in the case of this monad. There are, moreover, no rod-shaped bodies in the salivary corpuscle.

On a Fossil Marine Diatomaceous Deposit from Oamaru, Otago, New Zealand.

By E. Grove and G. Sturt, F.F.R.M.S.

PART I.

Plates XVIII, XIX.

(Taken as Read July 23rd, 1886.)

This very interesting deposit was first brought to our notice by H. Morland, Esq., a member of this Club. We are indebted to him not only for the first supply of the material, but also for the assistance he has rendered in furnishing many beautiful picked slides of the rarer forms. For a further supply of the deposit we have to acknowledge the kind aid of Sir Julius von Haast, K.C.M.G. The deposit consists mainly of diatomaceous remains, with a small proportion of Radiolaria, and Sponge spicula. Further information is necessary before the geological age and position of the deposit can be ascertained, but from the information at present before us, we understand that it was found in the Cave Valley, Oamaru, situated immediately beneath a series of Limestone strata known as the Otatara Limestone series belonging to the Lower Tertiary (Oligocene) age. There is a remarkable similarity between this deposit and the well-known one from the Cambridge Estate, Barbadoes. Several of the forms occurring here have, we believe, hitherto only been met with in that deposit. The family Biddulphiæ, as in the Barbadoes, is strongly represented by the genus Triceratium, which, for the sake of convenience, we still retain. Of this genus alone we have noticed over 30 species or distinct varieties. There also seems to be a connection between the Simbirsk deposit and this, as some of the Simbirsk forms occur with only a slight variation. Several of the species, notably those of Mastogloia and Amphora, still exist in the Indian Ocean.

For the drawings from which the plates are engraved we are indebted to the valuable aid of A. M. Warner, Esq., of Saltburn-by-Sea, and H. F. Hailes, Esq., our editor, to both of whom we

tender our hearty thanks. We have also to acknowledge the kind aid and assistance rendered by Dr. Stolterfoth, of Chester, and by Mr. F. Kitton, in the examination and identification of species; and of Mr. Rattray, of Dundee, in the preparation of magnificent picked slides.

In the course of a careful examination of many slides we have observed the following genera and species. In addition to these, some extremely doubtful forms occur, which for the present are omitted, as they require considerable further investigation :—

Cymbelleæ.

Amphora labuensis, Cleve ("Vega Exp.," p. 493, Pl. 35, Fig. 10).—Scarce.

A. cingulata, Cleve ("W. I. D.," p. 9, Pl. 3, Fig. 15).—One specimen observed closely resembling the figure in A. Schm. Atl., Pl. 26, Fig. 17, but with a less clearly developed "cingulum."

A. crassa, Greg. ("G. D. C.," p. 52, Pl. 6, Fig. 94).—One specimen observed.

A. sp.? sp.?—Some doubtful fragments detected.

Cocconeideæ.

Cocconeis barbadensis, Grev. ("T. M. S.," 1864, p. 14, Pl. 11, Fig. 10).—Occurs sparingly, and is smaller and more lanceolate than Greville's figure. The median line is undulate, and the form is probably an Orthoneis. Longest diam., about ·003″.

C. pseudo-marginata, var. *intermedia*, Grun. ("Nov. Exp.," p. 13, Pl. 1, Fig. 6).—Not uncommon.

Campyloneis (*Grevillei* var.?) *argus*, Grun. ("V. H. Syn. Belg. Diat.," Pl. 28, Fig. 16).—Not uncommon.

Mastogloia reticulata, Grun. (Honduras Diatoms, in "M. M. J.," 1877, p. 175, Pl. 195, Fig. 4).—Closely resembles Grunow's form, but is much longer (up to ·007″). Three specimens observed.

Naviculaceæ.

Navicula apis, Ehr. (Donk., "Brit. Diat.," p. 48, Pl. 7, Fig. 3). —A small form, exactly resembling Donkin's figure. Two or three larger specimens have occurred up to ·004″ in length; rather less constricted, and approaching *N. didyma*, Ehr.

N. Smithii, var. *nitescens*, Greg. ("G. D. C.," p. 15, Pl. 9, Fig. 16).—Scarce.

N. gemmata, Grev. ("Ed. New Phil. Journ.," Vol. x, p. 30, Pl. 4. Fig. 7; vars. A. Schm., "Atl.," Pl. 8, Figs. 38.42).—Rare.

N. prætexta, Ehr. (Greg., "D. C.," p. 9, Pl. 9, Fig. 11).—Small and scarce. Some specimens closely resemble *N. Californica*, Grev. ("Ed. New Phil. Jour.," Vol x, p. 29, Pl. 4, Fig. 5).

N. sparsipunctata, Gr. & St., n. sp.—Valve broad, oval; ends subacute. A line of closely-set puncta on each side of the raphe, leaving a narrow clear space, slightly enlarged around the central nodule. Margin furnished with a line of oblong puncta, within which is a narrow clear band. The rest of the surface dotted over with puncta, forming sparse, irregular, radiating lines. Not very scarce. Length, ·006″; breadth, ·004″. (Pl. XVIII, Fig. 1.)

N. interlineata, Gr. & St., n. sp.—Valve broad, oval; ends subacute and slightly produced; surface covered with dotted, subradiant striæ, about 17 in ·001″, interrupted by a narrow clear space on each side at about one-third of the distance between the central line and the margin, extending symmetrically with the margin nearly to the ends of the valve. Scarce. Length, ·005″; breadth, ·003″. (Pl. XVIII, Fig. 2.)

N. (Alloioneis?) Grundlerii, Cleve & Grun. (Cl., "Diat. of W. I. Archipelago," p. 7, Pl. 11, Fig. 10).—Length, ·004″; breadth, ·0017″. Striæ radiant, dotted, 30 in ·001″. The median line not so eccentric as in Cleve's figure, and the striæ more radiant, but in all other respects agreeing closely. One specimen observed.

ENTOPYLEÆ.

Gephyria incurvata Arnott ("Pritch.," p. 809, Pl. 4, Fig. 50).—Scarce.

FRAGILARIEÆ.

Glyphodesmis marginata, Gr. and St., n. sp.—Valve lanceolate with rounded ends, and distinct centre and end projections. There is a clear longitudinal central space, and the margin is bordered with two rows of small cellules. Length, ·0026″; breadth, ·00057″. (Pl. XVIII, Fig. 3.)

SYNEDREÆ.

Synedra crystallina (Ag.), Kütz ("S. B. D.," p. 74, Pl. 12, Fig. 101).—Scarce.

RUTILARIEÆ.

Rutilaria radiata, Gr. and St., n. sp.—Valve with parallel sides for a short distance at centre, then tapering more or less rapidly to the subacute ends. Centre and ends clear, remainder of valve covered with sparse radiating lines composed of dots, about 35 in ·001″. Central process large, spiral. Marginal setæ. Length

from ·0022″ to ·0067″; breadth about ·0017″. Not rare. (Pl. XVIII, Figs. 4 and 5.)

R. lanceolata, Gr. and St., n. s.p.—Valve narrow, lanceolate, tapering finely to the subacute ends. Centre and ends clear, remainder covered with somewhat irregular transverse dotted lines, about 30 in ·001″. Central process small but distinct. Marginal setæ. Length, ·0065″; breadth, ·0007″. Very rare. (Pl. XVIII Fig. 6.)

Pseudo-rutilaria. Nov. subgenus.

We have formed this subgenus for the reception of the species described below, which, while resembling *Rutilaria* in other characteristics, is without the central clasping process, so important a feature of that genus. Perhaps *R. recens* Cleve ("On some New Diatoms," Stockholm, 1881, p. 19, Pl. 4, Fig. 7) may be placed here.

Ps.-rutilaria monile, Gr. and St., n. sp.—A very novel and interesting Diatom. Valve composed of circular or nearly circular cells, the central being the largest, and furnished with a few scattered spines. On each side are a number of similar cells (in our specimens from 8 to 11), which gradually diminish in size to the end. Length about ·005″. The margins of the cells project on each side in small cusps, each of which bears one or two setæ. The surface of the valve is faintly dotted. In the frustular view the valves are seen to be in connection at the centre and ends, and the processes appear to grasp each other as in *Hemiaulus*, the intermediate space being occupied by the setæ. (Pl. XVIII, Figs. 7 and 8.)

Note.—In all the specimens observed we have found that the number of cells on the one side of the centre exceeds that on the other side by one.

Striatelleæ.

Grammatophora oceanica, Ehr.—One fragment observed. Striæ 50 in ·001″.

Isthmiæ.

Isthmia enervis, Ehr. ("V. H. Synop.," Pl. 96, Figs. 1, 2).—Fragments not unfrequent—corresponding with the recent form.

Biddulphiæ.

Biddulphia Tuomeyii, Bail (Roper, "T. M. S.," Vol. vii, Pl. 1, Figs. 1 and 2; "V. H. Synop.," Pl. 98, Figs. 2, 3).—Frequent.

B. elegantula, Grev. ("T. M. S.," Vol. xiii, p. 50, Pl. 6, Figs. 12).—Scarce, but identical with Greville's species.

B. punctata, Grev. ("T. M. S.," Vol. xii, p. 83, Pl. 11, Fig. 10).—Resembles closely Greville's form, but more oval. Rare.

B. Oamaruensis, Gr. and St., n. sp.—Valve elliptical-oval, with a central elevation; the whole valve covered with fine-radiating lines of granules and numerous interspersed minute puncta. On each side of the centre opposite to one another are two large spines; processes inflated at the base, truncate. Distance between the processes, ·0053″; breadth, ·0023″. (Pl. XVIII, Fig. 10.) Rare.

B. elaborata, Gr. and St., n. sp.—Valve broadly oval, convex. At the centre, which is inflated, is a circle of small close-set papillæ surrounded by a clear space, from which radiating lines of round cellules run to the margin. The cellules near the centre are smaller, but become larger towards the margin. Between each row of these large cellules is a line of small dots. Two long stout stalks terminating in a cup-like striated expansion project from the valve, starting from circular clear spaces on each side. Length, ·0083″; breadth, ·0054″; length of stalk, ·0025″. (Pl. XVIII, Fig. 9.)

We have some hesitation in classing this very remarkable form as a *Biddulphia*. It is allied to Greville's *B. gigantea* ("T. M. S.," Vol. xii, p. 13, Pl. 2, Fig. 9) from Barbadoes. The two forms might well form a new genus.

B. virgata, Gr. and St., n. sp.—Valve small, oval, convex, with two well-defined transverse clear spaces, becoming inflated towards the ends. Processes formed by two stalks, projecting from clear spaces at the extremities of the valve. The stalks terminate in a large spherical expansion, the surface of which is delicately punctate. Surface of valve furnished at the centre with a transverse band of scattered granules; before each process is a similar band of granules, but more crowded. Length, ·0033″; breadth, ·0024″. (Pl. XVIII, Fig. 11.)

In the specimen we figure, the expansions are broken off.

Cerataulus subangulatus, Gr. and St., n. sp.—Valve subtriangular with rounded angles; inflated, with three submarginal processes resembling those of *C. turgidus*, and 2-4 strong spines, sometimes curved, or with forked ends between each process. Surface composed of rough radiating granules, over a closely

reticulated structure. Not rare. Breadth over widest part, ·0053″. (Pl. XIX, Fig. 12.)

C. Johnsonianus (Grev.), Cl. (*Biddulphia Johnsoniana*, Grev., "T. M. S.," Vol. xiv, p. 6, Pl. 2, Figs. 14, 15).—Small, rare, about ·003″ in diameter.

Triceratium capitatum, Ralfs. (Grev. in "T. M. S.," Vol. ix, p. 43, Pl. 4, Fig. 10).—Frequent and more robust than Greville's form. Distance between the angles, about ·0027″.

T. parallelum (Ehr.), Grev. (*forma trigona*, A. Schm. "Atl.," Pl. 75, Fig. 13, and Pl. 76, Fig. 14-17. Quadrangular form = *Amphitetras parallela* (Ehr.), Grev., "T. M. S.," Vol. xiii, p. 104, Pl. 9, Fig. 22).—Triangular form frequent, attaining a length between the angles of ·0077″. The quadrangular form is also not uncommon, and we have also observed the pentagonal variety. Not unfrequently a triangular form occurs with very convex sides, in outline closely resembling *T. Harrisonianum*, Grev. in "T. M. S.," Vol. ix, p. 76, Pl. 9, Fig. 9, but smaller, and without the characteristic veining. It can be distinguished as "*var. gibbosa.*" The figure in the "Atlas," Pl. 81, Fig. 8, is very similar.

T. Harrisonianum, Norm. and Grev. (*loc. cit supr.*).—Our form closely resembles the figure in the "Atlas," Pl. 75, Fig. 16, and should, we think, be classed with *Stictodiscus*.

T. favus, Ehr.—The type form occurs rarely, but the quadrangular form *T. favus var. quadrata*, Grun. (Schm. "Atl.," Pl. 84, Fig. 4,) is frequent, attaining a distance between the angles of ·008″.

T. favus var. *maxima*, Grun. ("V. H. Synop.," Pl. 107, Fig. 5 = *T. grande*, Bright, "Q. J. M. S.," Vol. i, p. 249, Pl. 4, Fig. 8).—The triangular form is not uncommon in the heavier density, and nearly approaches *T. Grunovii*, Jan., "Atlas," Pl. 85, Fig. 5. Distance between the angles, ·012″; cellules, 3 to 3½ in ·001″. Surface entirely covered with lines of granules 25 in ·001″, which radiate from a central point. In some forms the cellules are smaller, not two-thirds of the usual size.

T. arcticum, Bright ("Q. J. M. S.," Vol. i, p. 250.—Quadrangular form (*T. arcticum* var. *californica*, Grun. Schm., "Atl.," Pl. 81, Fig. 4) not rare. The triangular form ("Atl.," Pl. 79, Fig. 6) also occurs, attaining a length between the angles of ·013″.

T. castellatum, West ("T. M. S.," Vol. viii, p. 147, Pl. 7, Fig. 3). —Frequent. Some forms closely resemble *T. umbilicatum*, Ralfs.

("Pritch.," p. 854. Schm. "Atl.," Pl. 94, Fig. 11). It would seem that these two cannot be specifically distinguished.

T. rotundatum, Grev. ("T. M. S.," Vol. ix, p. 75, Pl. 9, Fig. 6).—Rare, but identical with Greville's figure.

T. venosum, Bright ("Q. J. M. S.," Vol. iv, p. 274, Pl. 17, Fig. 5).—Occurs sparingly.

T. coscinoides, Gr. and St., n. sp.—In outline this form, which is very common, resembles *T. cinnamomeum*, Grev. ("Q. J. M. S.," Vol. iii, N. S., p. 232, Pl. 9, Fig. 12 = *Cestodiscus cinnamomeus*, Grun. "V. H. Synop.," Pl. 126, Fig. 1), but in other respects is quite different. The surface is covered with small hexagonal cellules, which are larger at the centre but gradually decrease in size towards the margin. Greville's form is a true *Cestodiscus*, with puncta and distinct marginal spines, entirely wanting in our form. Distance between the angles, ·0022″ to ·004″; cellules about 12-13 in ·001″. (Pl. XIX, Fig. 13).

This form seems only to be a three-angled *Coscinodiscus*. Grunow, in the "Franz. Jos. Land Diat.," p. 31, mentions a similar form from the Mors deposit, for which he proposes a subgenus "*Pseudo-triceratium*"; to this our form would belong.

T. partitum, Grev. ("T. M. S.," Vol. xii, p. 14, Pl. 2, Fig. 8).—Differs from Greville's form in its larger size and greater convexity of the sides, which in his description are stated to be "slightly concave"; but in other respects resembles it so closely that it would hardly be advisable without further investigation to create a fresh species. Distance between the angles, ·005″.

T. divisum, Grun. ("V. H. Synop.," Pl. 113, Fig. 8).—Rare. Distance between the angles, ·0021″. A well-defined species, differing from *T. partitum*, Grev., in the septa being continuous, without the faint interruption in the middle, and in the absence of the second septa, cutting off the angle itself.

T. Kinkerianum, Witt ("Simbirsk," p. 33, Pl. 8, Fig. 10).—Not unfrequent. A variety of Witt's species, closely resembling the figure in the "Atlas" (Pl. 95, Fig. 17), but larger and more robust, with prominent angles, covered with fine puncta. Distance between the angles, ·0054″. As this, on further investigation, may require to be separated from Witt's species, we give a figure at Pl. XIX, Fig. 14.

T. venulosum, Grev. ("T. M. S.," Vol. xii, p. 90, Pl. 13, Fig. 21). —Very much larger than Greville's species, and might be distin-

guished as "var. *major*"; in other respects similar. From five to seven vein-like lines in pairs are given off from the margin, and the pseudo-nodules are distinct. The valves exhibit, most strikingly, the peculiar areolar appearance. Distance between the angles, ·0067″. Frequent. (Pl. XIX, Figs. 15, 16.)

T. lobatum, Grev. ("Q. J. M. S.," Vol. iii, N.S., p. 233, Pl. 9, Fig. 13).—Rare, but identical with Greville's form.

T. denticulatum, Grev. ("Q. J. M. S.," Vol. iii, N.S., p. 233, Pl. 9, Fig. 14).—Rare, closely resembling the type.

T. inelegans, Grev. var. ("T. M. S.," Vol. xiv, p. 8, Pl. 2, Fig. 21).—This variety closely resembles the var. *micropora* Grun. (in "V. H. Synop.," Pl. 110, Fig. 3), but the granules are fewer and more scattered. Distance between the angles, ·0022″. Rare.

T. unguiculatum, Grev. ("T. M. S.," Vol. xii, p. 85, Pl. 11, Fig. 9).—Frequent. The processes are very slender, and bent outwards, giving, in some positions of the valve, the appearance of the claws delineated in Greville's figure.

T. nitescens, Grev. ("T. M. S.," Vol. xiii, p. 8, Pl. 2, Fig. 19). —Very rare, but identical with Greville's species.

T. Weisii, Grun. (Witt "Simbirsk," p. 34, Pl. 7, Fig. 9, and Pl. 12, Fig. 3).—A small form, very scarce in the lightest density.

T. americanum, Ralfs. ("Pritch.," p. 855; Schm. "Atl.," Pl. 76, Fig. 27). (N.B. In the "Atlas" *T. americanum* and *T. condecorum* have been transposed, Fig. 27 being *T. americanum*, Fig. 28 *T. condecorum*.)—A variety of this form occurs sparingly, and has great affinity with *T. parallelum*. Some valves have very concave sides. A quadrangular form, "var. *quadrata*," also occurs with concave sides, and an umbilicus of small puncta arranged in a circle. Distance between the angles, ·0036″. This variety in its appearance closely approaches *Stictodiscus*; for the present we leave it here.

T. cælatum, Janisch (Schm. "Atl.," Pl. 81, Fig. 19).—The original example we have not seen; so it is with hesitation that we identify this form, which is somewhat rare, with Janisch's species. The valve is nearly flat, with straight sides and radiating granules, which are scattered at the centre, but at the margin are arranged in close-set parallel lines. Distance between the angles, ·0083″.

T. Dobreèanum, Grev., var. *nova Zealandica*, n. var., Gr. and St.—This form, not uncommon in the deposit, is more ornate than

Greville's type form in "T. M. S.," Vol. xiii, p. 6, Pl. 2, Figs. 23 and 24. From three to nine vein-like lines project from each side, the granules are more numerous and closer set, and the processes are not so elongated. The connecting membrane is similar. Distance between the angles, ·0094″; a smaller form also occurs. (Pl. XIX, Figs. 17, 18.) This may, perhaps, on further consideration require separation from Greville's species.

T. cancellatum, Grev. ("T. M. S.," Vol. xiii, p. 9, Pl. 2, Fig. 17).—This form, which occurs not unfrequently, corresponds to Greville's description, but not to his figure. The sides of the valve are nearly straight; the six alternate radiating elevations and depressions are distinct in some forms, while in others they are scarcely, if at all, perceptible. The commencement of two vein-like lines, projecting inwards from the sides, are usually quite distinct. As we are in doubt whether our determination is correct, we give a figure at Pl. XIX, Fig. 19.

T. spinosum. Bail, var. *ornata*, n. var. Gr. and St. (*T. spinosum*, Bail, A. Schm. "Atl.," Pl. 87, Figs. 2, 3).—This form has a great resemblance to *Amphitetras ornata*, Shabbolt, "T. M. S.," Vol ii, p. 16, Pl. 1, Fig. 10, the quadrangular form of, and identical with, *T. pentacrinus*, Wallich "Q. J. M. S.," Vol. vi, p. 250, Pl. 12, Figs. 10-14. (As Greville has a *T. ornatum*, in order to prevent confusion Wallich's specific name, though later in date, had better be adopted.) In other respects, however, this form is nearer to *T. spinosum*. We have only observed the triangular form, which has straight or slightly concave sides and horn-like processes at each angle; the centre is slightly inflated, and the surface of the valve is covered with markings resembling those of *T. pentacrinus*; but with the addition of four or more spines, which are usually broken off. Distance between the angles ·0032″. (Pl. XIX, Fig. 20.)

DESCRIPTION OF PLATES.

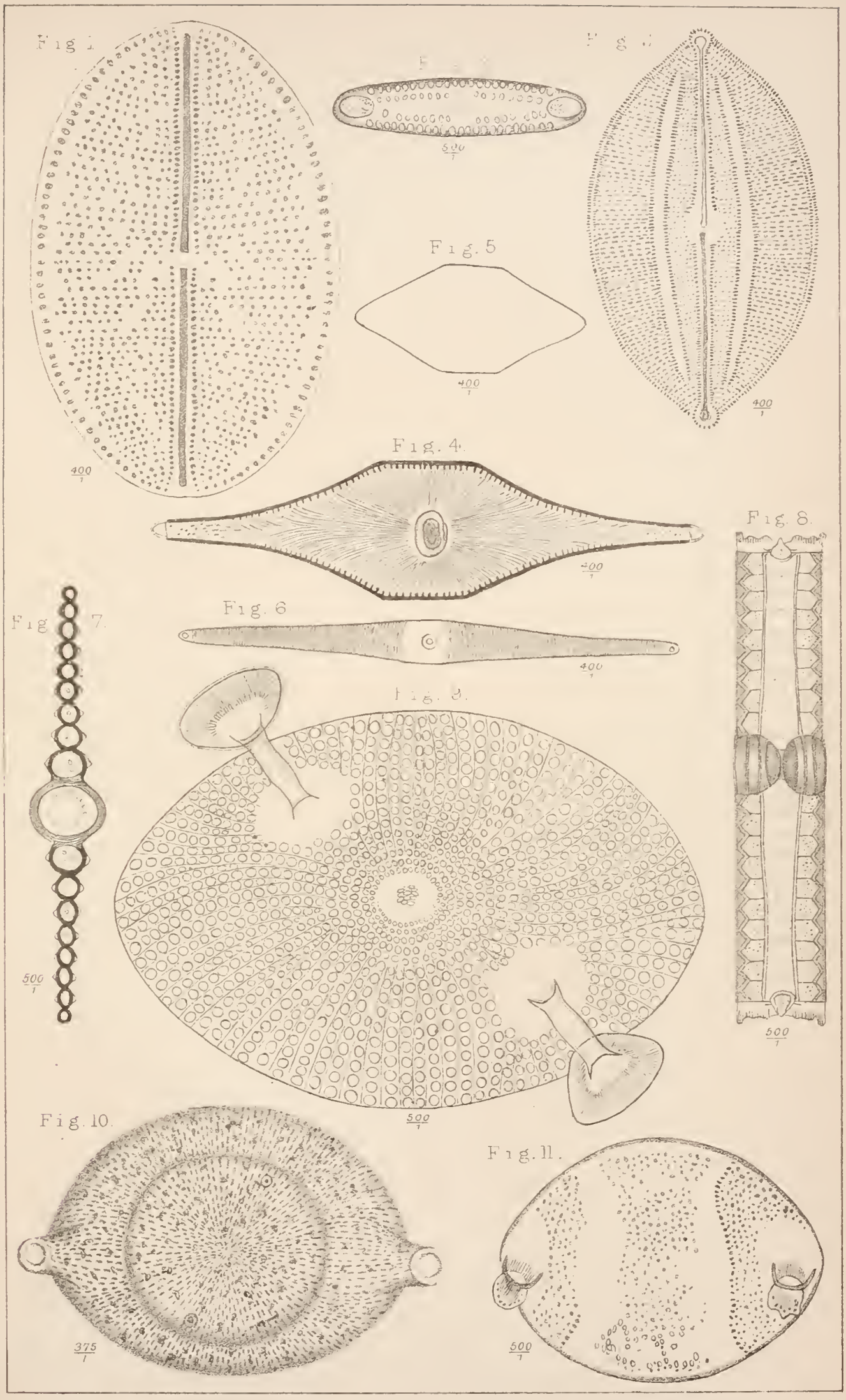
Plate XVIII.

Fig. 1. *Navicula sparsi punctata*, Gr. and St., n. sp., $\frac{400}{1}$.
" 2. " *interlineata*, Gr. and St., n. sp., $\frac{400}{1}$.
" 3. *Glyphodesmis marginata*, Gr. and St., n. sp., $\frac{500}{1}$.
" 4. *Rutilaria radiata*, Gr. and St., n. sp., $\frac{400}{1}$.
" 5. " " outline of small form showing variation in the shape, $\frac{400}{1}$.
" 6. " *lanceolata*, Gr. and St., n. sp., $\frac{400}{1}$.

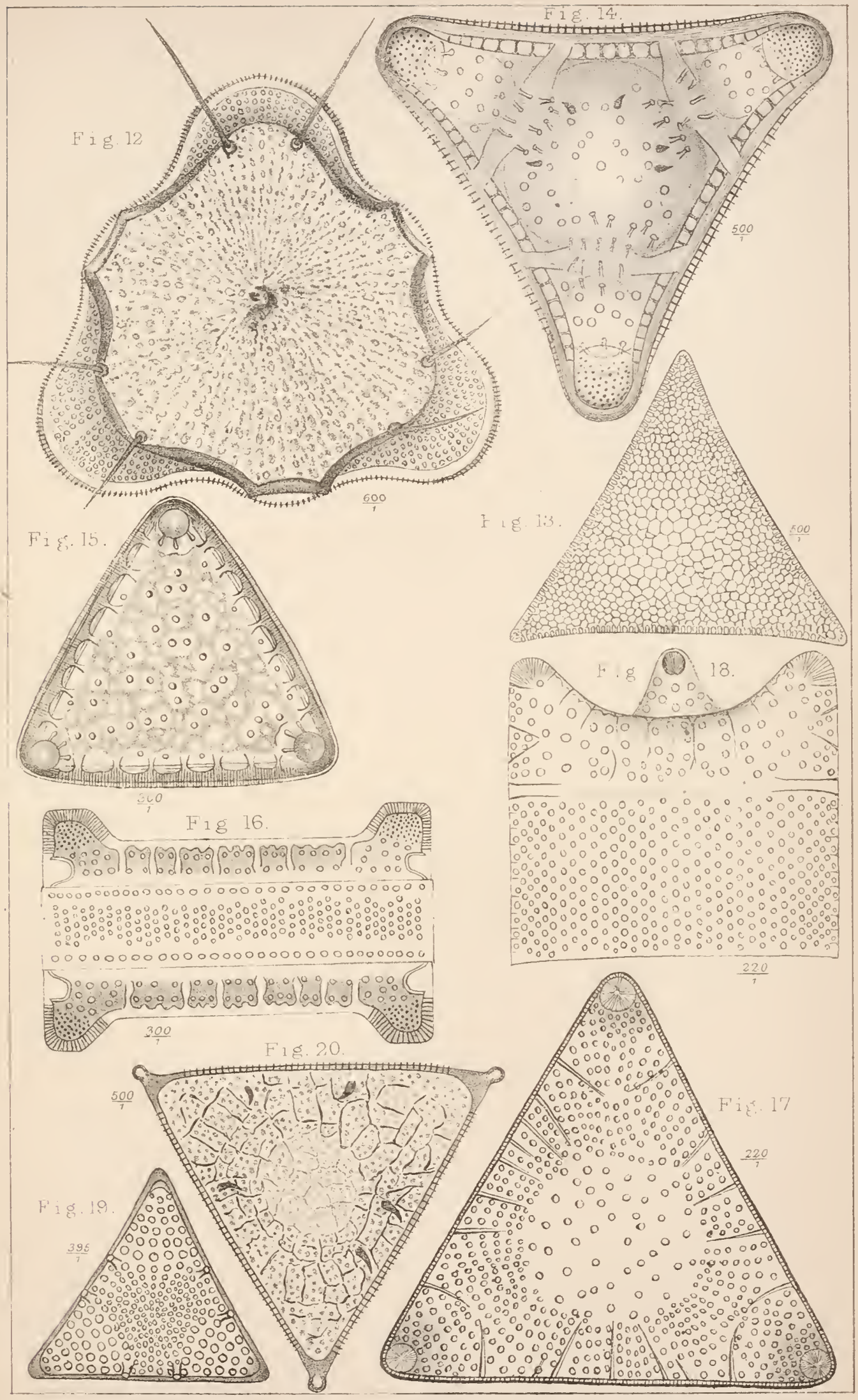
FIG. 7. *Pseudo-rutilaria monile*, Gr. and St., n. sp., valve, $\frac{500}{1}$.
" 8. " " frustular view, $\frac{500}{1}$.
" 9. *Biddulphia elaborata*, Gr. and St., n. sp., $\frac{500}{1}$.
" 10. " *Oamaruensis*, Gr. and St., n. sp., $\frac{375}{1}$.
" 11. " *virgata*, Gr. and St., n. sp., $\frac{500}{1}$.

PLATE XIX.

" 12. *Cerataulus subangulatus*, Gr. and St., n. sp., $\frac{600}{1}$.
" 13. *Triceratium coscinoides*, Gr. and St., n. sp., $\frac{500}{1}$.
" 14. " *Kinkerianum*, $\frac{500}{1}$.
" 15. " *venulosum* var. *major*, Gr. and St., valve, $\frac{300}{1}$.
" 16. " " " frustule, $\frac{300}{1}$.
" 17. " *Dobreèanum* var. *nova Zealandica*, Gr. and St., valve, $\frac{220}{1}$.
" 18. " " frustule, $\frac{220}{1}$.
" 19. " *cancellatum*, $\frac{395}{1}$.
" 20. " *spinosum* var. *ornata*, Gr. and St., $\frac{500}{1}$.



West, Newman & Co lith.



West, Newman & Co lith.

PROCEEDINGS.

April 9th, 1886.—Conversational Meeting.

The following objects were exhibited :—

Larva of caddis fly	Mr. F. W. Andrew.
Antenna of a moth, *Pygæra bucephala*, nat. form and colour	Mr. F. Enock.
Pycnogonideæ, from Naples	Mr. F. Fitch.
Cast skin of pupa and image of *Tanypus*, sp.	Mr. J. D. Hardy.
Aglaophenia pluma	Mr. A. D. Michael.
Section of "Cementstein"	Mr. H. Morland.
Tubulipora, from Australia	Mr. B. W. Priest.
Hydrocampo	Mr. C. Rousselet.
Section, Nummulitic Limestone from Eisenbach, Hungary...	Mr. G. Smith.
Diatoms from Simbirsk deposit	Mr. G. Sturt.
Pollen of Mallow	Mr. W. Watson.

Attendance—Members, 50 ; Visitors, 4.

May 14th, 1886.—Conversational Meeting.

An exhibition was given, in the Mathematical Theatre, by Messrs F. H. Evans and George Smith, with the oxy-hydrogen lantern, of a large selection of microscopic objects, photographed direct from nature, and prepared as lantern slides by the Woodbury type process. The series embraced a wide variety of subjects for the purpose of showing the suitability of the process to this kind of illustration.

The following address by Mr. Evans was read :—I had the pleasure last Wednesday evening, of exhibiting before the Royal Microscopical Society the photo-micrographical lantern slides presently to be shown to you; and I was much gratified at finding the spontaneously expressed opinion of those who spoke after the exhibition, was, that the chief merit of the slides consisted in their educational value, from their great truthfulness to nature, both in detail and general aspect.

The point I want you to notice especially this evening is this: drawings, however exact as to detail generally, fail in giving an air of naturalness to the representation, and suffer from a lack of depth, roundness, relief, I might almost say perspective, and are consequently flat in result. One

feels instinctively that it is the work of the draughtsman, and not of Nature. Of course, to overcome these difficulties, and give a natural representation by photography of objects that have various focal planes, is exceptionally difficult, for opticians have not yet given us object glasses that will show even moderately deep objects in a fairly sharp-all-over focus; and any lantern slide showing an object sharp in one plane, and blurred out of focus in the rest, is, of course, utterly valueless. Now that the optical lantern is coming so much more into use as an educational accessory, as so many can at one time and so effectively be taught by its aid, I cannot but think that a series of photo-micrographs, adequately exhibiting the wonders of Nature in her minute conditions, must be of great value educationally. Drawings and diagrams, however accurate, have not that hold upon the imagination and memory, especially in the young and untrained mind, that a forcible and truthful photo-micrograph direct from Nature would have, provided always that such photographs are the very best that the process can be made to yield, and what that best is has not been demonstrated yet.

The objects that pleased most on Wednesday at the "Royal" were those in the neglected fields of illumination by spot lens or reflected light. When some years ago I began this fascinating work, I was somewhat discouraged by finding all the authorities on the subject agree in saying that no good work had been, or could be expected to be, done in these directions, from the great and inherent difficulties to be overcome. As, however, the objects I most wanted photographs of were in these classes, I determined to try and disprove this opinion of the experts; with what success I shall leave you to decide; perfection is by no means claimed for these slides, but they are shown as evidence of what can be done in the valuable field of photo-micrography. Allowance must be made for the amount of magnification, which varies from 480 diameters in the lowest to 29,100 in the highest. With regard to some of the slides, I do not think they could be improved upon, but in this matter I am like the Scotsman who was perfectly willing to be convinced, but added: "Show me the mon that can convince me!" I really am very desirous of seeing better slides. They have all been taken with the usual microscope accessories, in all cases using the A eyepiece; the O.G.'s were of the finest quality, but not specially corrected for this purpose, and no account has ever been taken of the difference between the visual and actinic foci. What success I have achieved has been mainly due to exceeding great care in the quality and quantity of the illumination, using the ordinary oil lamp and bullseye condenser; and to a constant resolve to be satisfied with nothing that did not do full justice to the object as seen at its ideal best under the microscope; also to be content with nothing that seemed capable in the least degree of improvement. The photographic image has in no way been "retouched" on the negative; the only treatment the negative has undergone in some few instances has been the legitimate one of removing dirt marks, etc., arising from imperfection in the micro mount, these being necessarily photographed with the object; and an absolutely clean micro mount, it will be admitted, is not a common thing.

These efforts to reach as close as possible to a natural representation of the objects would quite have failed, as regards lantern slides, had I not been seconded by the great skill and patience of Mr. George Smith of the Sciopticon Co.; for, after all, however good a negative may be, it is not the goal, but only the means to the end,—the perfect positive. I found that, particularly in the opaque and spot lens objects, no purely photographic positive process could do full justice to the delicate detail in the negative, without sacrificing beauty and truth of result in the general representation; but in the perfection to which Mr. Smith has brought lantern slides by the Woodbury type process, these difficulties have disappeared, and the finest details are adequately represented, while the general beauty of the result is enhanced by the rich colour and pure transparency of the pigment employed by him. Mr. Smith has a half-dozen or so of landscapes and other studies, which may be shown you after the micro slides have been put through, and thus give you an idea of the excellence of the ordinary lantern slide. A great feature special to the Woodbury process is, that any number can be printed identical in excellence with each other; this again, is quite impossible by any purely photographic process. The following is a complete list of the slides shown:—

The diameters given are those of the magnification on the lantern slide.

No.		Diam.	No.		Diam.
1.	Foraminifera, grouped ...	14	23.	Echinus Spines—Sections, group	9
2.	Foraminifera from Porto Seguro	19	24.	Echinus Spines—Section ...	34
3.	Foraminifera from Porto Seguro	21	25.	„ „ „ ...	21
			26.	„ „ „ ...	22
4.	Foraminifera from Porto Seguro	26	27.	„ „ „ ...	26
			28.	„ „ „ ...	18
5.	Ditto from Connemara ...	12	29.	„ „ „ ...	18
6.	Ditto, *Lagenæ*	27	30.	Coralline; *Acarmarchis plumosa*	14
7.	Ditto, *Operculina*	23			
8.	Ditto, Section of Nummulite	34	31.	Coralline; *Acarmarchis flabellata*	12
9.	Ditto, *Quinqueloculina* ...	27			
10.	Ditto, *Dentalina*	30	32.	*Bicellaria grandis*	14
11.	Ditto, Siliceous Casts ...	16	33.	„ *ciliata*	20
12.	*Ophiocoma Rosula*	12	34.	Head of Butterfly	10
13.	Ray of ditto	19	35.	„ Tipula	11
14.	Dental Apparatus of ditto...	10	36.	Antenna Vapourer Moth ...	10
15.	Dental plates of ditto ...	25	37.	*Synapta*, Anchors and Plates	33
16.	*Ophiocoma neglecta* ...	8			
17.	*Urasta rubens*		38.	Pinna Shell—Section ...	66
18.	Polycistina, grouped ...	35	39.	Eider Down...	13
19.	„ „ ...	28	40.	Scales of Fern	38
20.	„ *Ceratospyris ateuchus*	62	41.	Fairy Fly	43
21.	„ grouped	17	42.	Cecidomyia	32
22.	„ „	42	43.	Oak-apple Fly	10

No.		Diam.
44.	Exuvia or Cast Skin of *Cercopsis* on leaf	17
45.	Scale of Perch	14
46.	Sponge Spicules	31
47.	„ „	40
48.	Winged Parasite of Indian Bat	18
49.	Section of Chalcedony ...	14
50.	„ „ *Lapageria rosea*	18
51.	Diatoms on Coralline ...	17

Most of the above objects were taken as illuminated by Spot Lens or by Reflected Light (opaque objects), except Nos. 38, 39, 40, and 45, these being taken by Polarized Light.

The following, to end of list, were taken by Transmitted Light.

No.		Diam.
52.	Flea (human) Male.	
53.	„ „ Female.	
54.	„ of Cat	
55.	„ „ Wild Rabbit.	
56.	Parasite of Ox.	
57.	„ „ Elephant.	
58.	Ovipositor of Saw-Fly.	
59.	Foot of House-Fly.	
60.	Proboscis Blow-Fly (portion of)	124
61.	Palpi of Spider	25
62.	Jaws of ditto	21
63.	Spinnerets of ditto... ...	135
64.	Claws from small House-Spider	240
65.	Trachea of Silkworm ...	34
66.	Pro-leg of Moth-larva ...	24
67.	Cirrhi of Barnacle	14
68.	Spiracle of *Dytiscus* ...	32
69.	Eye of ditto	160
70.	Pygidium of Flea	248
71.	*Leiosoma Palmacinctum* ...	60
72.	*Glyciphagus plumiger* ...	147
73.	Maple aphis...	63
74.	*Nycteribia*—small	13
75.	„ of Indian Bat...	14
76.	Abdominal fringe of *Nycteribia*...	104
77.	Parasite of Vampire Bat ...	28
78.	Mange Insect of Horse ...	100
79.	Foot of Parasite of Queen Bee, *Braula cæca*... ...	164
80.	Section of Sugar Cane	
81.	„ „ Ovary of Poppy	19
82.	„ „ „ of Tiger Lily	13
83.	Diatoms.	
84.	*Arachnoidiscus ornatus* on Coralline (opaque object)...	17
85.	*Triceratium favus*	485
86.	„ *quadratum* ...	357
87.	„ *septangulatum*	192
88.	*Licmophora flabelleta* ...	154
88.	*Auliscus cælatus*	216
90.	*Gephyria*	338
91.	*Pinnularia*	389
92.	*Aulacodiscus margaritaceus*	192
93.	*Coscinodiscus radiosa* ...	343
94.	*Heliopelta metii*	208

At the close of the series Mr. Smith showed a variety of rustic scenes, architectural subjects, machinery, &c., in order to show the suitability of the process for other classes of subjects.

The President said that after the hearty approval expressed during the exhibition, it was hardly necessary to move a formal vote of thanks to the exhibitors. He congratulated Mr. Evans on the excellent results he had shown. The slides were a marked advance in that class of photographs, especially those illuminated on a dark ground, and by reflected light. He could not agree with Mr. Evans in thinking that these slides were, in every case, superior to diagrams, because it was not only possible, but necessary sometimes, to render details, for purposes of explanation, more

distinctly than could be seen in a photograph or in the natural object, which could be done without departing from truthful representation. In fact there was a tendency in diagrams to bring out details, while in a photograph details were rendered less distinctly. He was struck, while looking at these specimens, with another fact often ignored by artists, —the irregularity of natural objects. How seldom natural objects presented a perfectly uniform figure, yet artists in making a drawing would represent every part exactly symmetrical. The photographs showed that natural objects were generally more or less unsymmetrical. He considered that objects with well-defined outlines, and which were nearly in one plane, such as sections of echinus spines, were best suited for lantern photographs. It was impossible to give the true effect of some objects, such as the fine hairs fringing the wings of *Polynema*. Anyone seeing the broadened image of these hairs on the screen would suppose such hairs were very stout, almost rods, while in reality they were of the most delicate and graceful character. In the case of diatoms, with the microscope it was easy, by focussing up and down, to differentiate between the upper and lower surfaces of the valve, but in the lantern slide the two surfaces came into focus together, which interfered somewhat with the clearness of the effect. On the whole he congratulated the exhibitors on their excellent work, and concluded by moving a hearty vote of thanks to them for the exhibition they had given, and he would include Mr. Freeman, who had read the address, and given the names, &c., of the slides as they were shown.

The vote of thanks was carried with applause.

In answer to questions, Mr. Smith gave a short explanation of the Woodburytype process.

The following objects were exhibited in the library :—

Ovipositer of dragon fly	Mr. F. W. Andrew.
Flea of wild rabbit ♂ ♀	Mr. C. Collins.
Section of coal	Mr. A. L. Corbett.
Coccus of orange, showing Ichneumon *in situ*	Mr. F. Enock.
Section of lichen, *Lecanara*	Mr. H. E. Freeman.
Photo-micrographs, diatoms	Dr. R. L. Maddox.
Spider, *Thomisus audax* ♀	Mr. G. E. Mainland.
Type slide of diatoms from Oamaru, New Zealand...	Mr. H. Morland.
Diatoms, *Cestodiscus pulchellus*	Mr. E. M. Nelson.
Young perch, seven days old	Mr. R. T. G. Nevins.
Diatom, *Actinoptychus Wittianus*, n. s. ...	Mr. G. Sturt.

Mr. J. M. Offord also exhibited some photographs of diatoms, and Mr. Edgar Crookshank brought a large series of photographs of Bacteria.

Attendance—Members, 57 ; Visitors, 13.

May 28th, 1886.—Ordinary Meeting.

A. D. Michael, Esq., F.L.S., F.R.M.S., 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:—The Right Rev. Bishop of Peterborough and Mr. Wm. Hughes.

The following donations to the Club were announced:—

"The American Naturalist"	In exchange.
"The Journal of the New York Microscopical Society"	" "
"The American Monthly Microscopical Journal"	" "
"Proceedings of the Belgian Microscopical Society"	" "
"Annals of Natural History"	Purchased.
"British Petrography"	"
Dr. Hudson's "Rotifera," Part 4	"
Six slides	From Mr. C. Collins.

The thanks of the Club were voted to the donors.

The President thought that the subject present in the minds of most of the members above all others would be that of the great loss they had sustained since last they met. When he took his seat in that chair for the first time as their President, he did not anticipate that it would fall to his lot to have to refer to the deaths of no less than three of their past Presidents, as having occurred during his short tenure of office, and to ask for votes of condolence to be passed in connection with them. Dr. Carpenter and Dr. Cobbold had passed away from them, and now, as they were aware, they had to deplore the removal of Dr. Matthews, whose loss would go home to most of them more deeply still. Dr. Matthews was so old a member of the Club, and so constant an attendant at their meetings, at which his universal kindness and readiness to assist every one who desired to draw upon his store of information, that he ventured to think they would regard him with something more than the feelings of an acquaintance, but rather with those of personal attachment and regard. Those who came into contact with him felt that his kindness was not due to mere urbanity of manner, but that it was the result of a genuine desire to help others with whom he was brought into connection; and although it would not, perhaps, be quite correct to put him forward as an example of a first-rate man of science, yet the store of knowledge which he had to draw upon was by no means small. In his own profession he occupied a good position, being very skilful in it, and thoroughly well informed in all that related to it, and this knowledge he kept up to the very last, taking the keenest interest in every advance that was made. He was an excellent chemist, a skilful and thoughtful mechanician, and many of his devices were justly appreciated by those who became acquainted with them. The micro-megascope and the machine for cutting hard sections could, perhaps, hardly

be expected to come into general use, though exhibiting a large amount of intelligent ingenuity, but his parallel object-holder for the turntable had been well received, and had obtained a very wide use, whilst many of his other inventions were worthy of much praise. All would remember his introduction to "Davies on Mounting," and there was no one who would not recall with pleasure the memory of papers in which Dr. Matthews had shown himself to be far above the average of ordinary writers. He was an excellent classical scholar, and if any one was in difficulty as to a classical quotation he was always ready to supply the need, but beyond all that there was a kindness and benevolence about the man which endeared him to all with whom he came in contact. He died very rapidly of acute pneumonia. It must have been noticed by all that during the last few years his health had been failing, and that he had never been the same man since the severe rheumatic attack which prostrated him about three years ago, though he still retained considerable vigour, and could walk his twenty miles when occasion required. He had been attending a child who was suffering from pneumonia, and about whose case he was very anxious. On Friday, after a very hard day's work, he went to see this child in a bitterly cold east wind then blowing. He took a chill, and on returning home told his wife that he felt he was going to be seriously ill, and at once took to his bed. He (the President) did not hear of the doctor's illness until the following Monday, when he went up to see him, and found him in bed and very ill, but still with good hope of recovery. He went again on the Tuesday. On Wednesday he heard that matters had taken an unfavourable turn, and on Thursday when he went again to the house he found there was no longer any room for hope. There would for a long time to come be a vacant chair amongst them where Dr. Matthews used to sit. The funeral took place on April 29th, at the Islington Cemetery, Finchley, and although, owing to the suddenness of the event, and the time of its occurrence, it was not possible to make arrangements for the official attendance of a deputation from the Club, it may give satisfaction to know that three members of the Committee were present to pay a last tribute of respect to the memory of one whose loss we all so much deplore. The Committee had that evening passed a resolution of condolence, which he submitted to the meeting for its adoption, in order that it might be transmitted to the family. The following resolution was then moved from the chair :—

"The members of the Quekett Microscopical Club desire to record the deep regret with which they heard of the death of their valued fellow-member and past President, Dr. John Matthews, whose universal kindness, and the readiness with which he placed his scientific knowledge at the service of others less well informed than himself, have endeared him to every one who attended meetings of the Club, and will cause his memory to be preserved with grateful and affectionate regard."

Mr. J. E. Ingpen said he should be very sorry if such a resolution as the one they had heard read was put to the meeting for its adoption, without having been seconded by someone who had a deep and heartfelt interest in so doing. Many of the words which he might otherwise have uttered had

been already said, and it needed no references from him to recall to their minds their dear friend Dr. Matthews, for no one was better known, he had been so much amongst them, and was so conspicuous in his endeavours to advance the cause that brought them together, for with him knowledge seemed to be regarded almost as a sacred trust, as something which he held for the purpose of communicating to others. For his own part he could say that he knew him so well that the loss was a personal one. His friendship had gone on so long, having sprung up in that room, where, perhaps, a hundred others had their origin also, and it had continued to be just the same throughout, and was happy and pleasant to the end. Dr. Matthews possessed acquirements of no ordinary kind; they were, indeed, far higher than most persons would have been likely to suspect, for they seemed almost to be obscured by an extreme modesty which prevented him from bringing forward many things which had occurred to him. For a considerable period he had himself been very closely connected with Dr. Matthews, and especially so during the period when he was President of the Club, and he could say that none of their Presidents had shown a deeper, more constant or more intense interest in everything which had to do with its welfare. There was one word which always in his mind connected itself with Dr. Matthews, and that was the word "Honour"—that he should do honour to any position he was called upon to fill. He was ever ready to do honour to good work done by any one else, and to any cause with which he became connected. This, in fact, seemed always to be his main-spring of action. During the many years he had known him he had ever proved himself to be the noblest of friends, and he felt sure that his memory would be always held in honour by them all. He had great pleasure in seconding the proposal before the meeting.

The resolution was then submitted to the meeting and unanimously approved.

Mr. Deby exhibited and described a convenient form of field microscope of German manufacture, which he thought would most likely be of use to those who desired something better than the ordinary Coddington lens. It gave a good flat and achromatic field, and was made in various sizes; the eyepiece screwed on one end of the tube, and there was a little condenser at the other. The specimens he had brought with him were fitted for the narrow slips which were used abroad, but they could be made to take the ordinary English slides. As regarded price, he thought they were moderate considering their quality, the one magnifying 100 diameters costing 6s., one 150, 8s., and the highest, magnifying 250 diameters, 10s. They were manufactured by Bœcker, of Wetzlar, in Germany, from whom no doubt they could be obtained.

The thanks of the meeting were voted to Mr. Deby for bringing this very useful and practical invention under the notice of the Club.

Mr. Morland read a paper "On Diatom Structure."

Mr. E. M. Nelson was sure that all must have thought it a great treat to have heard such a paper as that which had been read by Mr. Morland. It showed evidence of a great amount of work, and he might say that he could follow it in every detail, and could corroborate the opinions advanced, though

he felt himself at a great disadvantage through not being himself a mounter. He quite agreed as to the utter uselessness of sections of diatoms as contributing at all to a knowledge of their structure. The proper thing was to take some ordinary broken portions, and to make what they could out of them. The best lens for the purpose of these investigations was one in which the correction was such as to show a slight rose colour. This would show the thicker membranes coloured red or rose colour. He had been looking at a specimen that day on the surface of which were a number of exceedingly minute spines; these all looked rose colour. He quite agreed with the remarks as to the exceeding beauty of specimens of *Arachnoidiscus*. It was, he thought, one of the most lovely objects that could be found; the beautiful dove-tailing in of the various parts of the pattern was a structure the perfection of which was marvellous.

Mr. Deby said he did not know that there was to be a discussion upon this subject, but he had prepared a short note "On the Structure of Diatom Valves," which he proceeded to read.

Prof. Stewart said that perhaps the remark which Mr. Deby had just made would apply to himself, and it might be that others had led him into error upon this subject. It was a good many years since Mr. Stephenson made some preparations of diatoms, in phosphorus dissolved in bi-sulphide of carbon, and the appearance which they presented was something like that which he drew upon the black board. If it really had that form he should have thought it would have produced the same effect as a bi-convex lens, and that it should alter materially in its focus according to the medium in which it was placed. But what they really found was that, whether they examined it in a medium of high or low refractive index, the effect was that of a number of little lenses, and so far as he was aware only a series of holes could act in this way. Certainly they did act as if they were a series of convex lenses, each one producing an image. He had never tried the experiment with hydro-fluoric acid, but from what he had seen and heard he was under the impression that they were actual holes.

Mr. Deby said that these spaces were never filled by air or by dirt, and if they were holes he should expect them to be so frequently; but as a matter of fact there never was any. There was a flat top not curved on either side or thickened at the corners, and there was a hole in the bottom membrane, as he drew it on the board III. Could Prof. Stewart say what would be the diffraction effect of such an arrangement?

Prof. Stewart imagined that an image would be formed by it.

Mr. E. M. Nelson thought this was hardly the point at issue. The question was not one of diffraction effects, but of making images. With *Pleurosigma* images could be made, as he had himself shown in that room.

Mr. Deby said it seemed to be a matter of facts, and therefore he would bring down some of his slides, and would show them at the next meeting.

Prof. Stewart said perhaps Mr. Deby would do them the favour to bring also some of those which showed the shape he had drawn upon the board.

Mr. Deby said he should be very pleased to do so.

Prof. Stewart said as a matter of probability he should not have thought

it likely that there should have been an abrupt junction between a closing membrane and the sides of the spaces below as Mr. Deby had drawn. He thought on *à priori* grounds there would have been a thickening at the angles.

Mr. Deby thought this argument was rather of a theoretical than a practical character, but he thought if they took a section of one of the joints of *Spirogyra* they would find that the closing membranes formed right angles with the sides of the filiform space.

Mr. Morland had found it to be invariably the case that there was a thickening at the angles as drawn by Prof. Stewart.

Mr. J. E. Ingpen said that at that late hour he would not trouble the meeting with more than a short communication upon the subject of mounting in media of high refractive index, the basis of which was sulphide of arsenic. It would no doubt be recollected that some time ago some very beautiful specimens of this kind of mounting were sent over to this country by Prof. Hamilton Smith. Mr. William Meates set himself at that time to find out what the medium was which Prof. Smith had employed, and after some amount of experimenting he came to the conclusion that it must be some preparation of sulphide of arsenic. Prof. Smith at first would not publish the formula, but when at length he was induced to do so, it turned out to be a mixture of sulphide of arsenic in bromide of arsenic. Mr. Meates then went on to experiment as to how far the effects could be varied, and he obtained a medium of very high index indeed, but he found that it had a very high melting point, and that this was greater in proportion to the quantity of arsenic. The results obtained were so good that Mr. Meates was encouraged to continue his experiments, especially as the medium was found to be very useful for mounting other things than diatoms. Blood globules were seen to advantage in it, but he had not yet been so successful as he hoped to be with podura scales. He had brought for exhibition a specimen of sulphide of arsenic; also a mount of the Cherryfield *Rhomboides* in phosphorus and bi-sulphide of carbon, the colour of which under the microscope appeared to be nearly a brick red, the colour in pure phosphorus being more green. Specimens mounted in sulphide of arsenic, styrax, &c., were also exhibited.

Mr. Deby said that he found that Prof. Hamilton Smith's medium was not be trusted for permanent mounting. He had a number of slides prepared with it, and about 90 per cent. of these had become spoilt. It was a most valuable preparation for purposes of examination, but it would not stand the test of time.

Votes of thanks to Mr. Morland, Mr. Deby, and Mr. Ingpen were then passed, and the meeting terminated with the usual Conversazione.

The following objects were exhibited:—

Living Barnacles, *Balanus balanoides*	Mr. F. W. Andrew.
Larva of *Tettigonia* (spring frog hopper) ...	Mr. C. Collins.
Head of *Colletes Daviesana* (Ground Bee) with explanatory drawing	Mr. F. Enock.

Diatoms mounted in sulphide of arsenic by Mr. W. C. Meates	Mr J. Ingpen.
Living Spider, *Epiera umbratica* ♀	Mr. G. E. Mainland.
Diatoms, *Surirella ovata* and *S. linearis* ...	Mr. H. Morland.
„ *Actinoptychus splendens*	Mr. E. M. Nelson.
Larva, pupa, and image of *Tanypus*	Mr. R. T. G. Nevins.
Phylloxera vastatrix	Mr. W. Watson.

Attendance—Members, 58; Visitors, 5.

June 11th, 1886.—Conversational Meeting.

The following objects were exhibited:—

Leptodora hyalina	Mr. F. W. Andrew.
Fairy fly, *Anagrus incarnatus*, with drawing	Mr. F. Enock.
Model of a diatom, *Surirella bifrons*	Mr J. D. Hardy.
Larva of newt, showing circulation	Mr. G. Hind.
Fish louse, *Argulus foliaceous*	Mr. C. K. Jaques.
Spider, *Salticus tardigradus* ♀	Mr. G. E. Mainland.
Type slide, diatoms from Richmond, Virginia	Mr. H. Morland.
Eggs and larvæ of water beetle, *Gyrinus natata*	Mr. R. T. G. Nevins.
Asplanchna Brightwelli	Mr. C. Rousselet.
Volvox globator, with resting spores	„
Section of chalk showing Foraminifera, &c., from New Zealand...	Mr. G. Smith.
Diatoms, *Aulacodiscus Grunowii*, n. s., from the Brünn Tegel	Mr. G. Sturt.
Pollen, 10 varieties on one slide	Mr. W. Watson.

Attendance—Members, 38; Visitors, 1.

June 25th, 1886.—Ordinary Meeting.

A. D. Michael, Esq., F.L.S., F.R.M.S., 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. Frank G. Bernan, Mr. Edward Briant, Dr. E. M. Crookshank, and Mr. Samuel Richardson.

The following additions to the Library were announced:—

"Journal of the Royal Microscopical Society" ...	In exchange.
"The American Monthly Microscopical Journal" ...	„ „
"Proceedings of the Royal Society"...	„ „
"The American Naturalist"	„ „

"Proceedings of the Geologists' Association" ...	In exchange.
"Proceedings of the New York Microscopical Society"	" "
"Report of the Proceedings of the Smithsonian Institution"	" "
"Grevillea"	Purchased.
"Quarterly Journal of Microscopical Science" ...	"
"Annals of Natural History"...	"
"British Petrography"—part 5	"

Mr. Morland exhibited and described a new form of cell slide for dry mounting, which he had obtained from Messrs. J. W. Queen and Co., of Philadelphia. The cells were made of stamped brass, soldered to a metallic slide; a cap fitted over the cell so as to be readily removed for the examination of the uncovered object when required. He had sent for an assortment of these slides, but as all those received were alike, he assumed that only one size was made. The cells could be obtained separately from the slides; the price was moderate, being equivalent to about 6s. per 100.

Mr. Karop thought it was rather inconvenient, in the case of objects to be dry mounted, to have the cells all of one depth. It also occurred to him that where metal slides were used the labels were very apt to come off.

Mr. E. M. Nelson's paper, "On Some Salt Water Monads and Bacteria," was read by the Secretary.

Mr. Karop thought that Mr. Nelson was rather rash in saying the things he had described were Bacteria. It appeared to him, from the description given, that what they had before them was a case of nuclear division, as pointed out by Dr. Dallinger.

The thanks of the meeting were voted to Mr. Morland and Mr. Nelson for their communications.

Mr. Buffham communicated to the Club the results of some of his recent observations "On Some New Forms of Fructification in the Marine Algæ," illustrating the subject by diagrams drawn upon the black board. Mr. Buffham concluded his remarks by saying that most microscopists of the ordinary type took up the pursuit as a sweetener of life, and after a general examination of the objects about them, such persons often found considerable difficulty in finding a subject which was suited to their tastes and their means. He thought that in the Algæ they would find a subject which would fulfil all requisite conditions, the objects were easily accessible, they were very beautiful in themselves, and they afforded a wide field for original observation, so that he could promise that if anyone would take up the subject he would be well repaid in many ways for the trouble taken in the course of its pursuit.

Mr. Karop was much obliged to Mr. Buffham for the interesting communication given to them at such short notice. The study would no doubt prove very interesting to those who would take it up, but he thought the difficulty with most people would be not so much how to get specimens as how to keep them. Many of these things looked very nice at first, but after a while they began to go bad, and the result was of course very disappoint-

ing. If, therefore, Mr. Buffham could give them a few hints as to preservation he was sure that all would be glad to hear them.

Mr. Buffham said the matter was simple enough, though he could quite believe what their Secretary had said with regard to the character of many of the slides which had been made from these objects. There was really no great difficulty about their preservation, and when one was at the shore it would soon be found out what was the best medium for the purpose. Most things would keep very well if well washed in sea water, and then put into the best glycerine, but too many should not be put into the same bottle, otherwise there would be perhaps too much water mixed with the glycerine. Other kinds which would not bear the glycerine should, after washing, be put into a saturated solution of common salt, and to prevent mycelium from forming, the cork should be well benzoled, so as to kill any spores which might be hanging about. Polysiphonia and allied species did best in a solution of salt. As regarded mounting, most kinds were preserved very well in Deane's gelatine, almost all his own specimens were mounted in this medium, and there was very little fault to find with it. He did not think the form of the specimens was quite so well preserved in this way as in fluid, but when a person mounted these things he did not want to have to look to them frequently afterwards, and to all who wished to avoid this trouble, he would say, "Don't put your specimens up in fluid, but mount them in the gelatine medium." He had some specimens mounted in it, which were four or five years old, and they seemed quite as good as when first prepared.

The President said that the latter portion of Mr. Buffham's remarks sounded as if he were relating the experience which he had himself acquired, for he had found that in collecting sea weeds the best thing was to wash them quite clean in salt water, unless they could do what was still better—obtain them from clear water where they grew naturally clean. Then the collector should carry with him a little bottle of glycerine into which to put such as he wished to preserve; except in cases of special genera, this would be found to answer very well. Some years ago he recommended this plan to Mr Gilburt, who found it to be very good. For mounting he had also found. Dean's glycerine medium to be the best; it did very well for the red sea weeds, and also for many other things. He had tried experiments in staining before mounting, and found that with a little care this could be done successfully and with advantage, and specimens stained the same colour as they were naturally were not so likely to fade afterwards as others which were mounted in their natural condition; they appeared to have a tendency to pick up the stain, and to retain it in those portions which were coloured in nature.

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

Notices of meetings, &c., for the ensuing month were then made, and the meeting terminated with the usual Conversazione.

The following objects were exhibited :—

Spores of Fungus, *Asterosporium Hoffmanni* ...	Mr. F. W. Andrew.
Parasite of Bee, *Stylops Spenceri* (nat. col.) ...	Mr. F. Enock.
Spider, *Drassus cupreus* ♀	Mr. G. E. Mainland.

Rotifera, *Rhinops, Brachionus, Triarthra* ...	Mr. C. Rousselet.
T. section, tooth of Icthyosaurus	Mr. G. Smith.
Diatoms, *Aulocodiscus Grunowii*	Mr. W. Watson.

Attendance—Members, 48; Visitors, 3.

July 9th, 1886.—Conversational Meeting.

The following objects were exhibited:—

Third leg of bee, *Macropis labiata* ♀ ...	Mr. F. Enock.
Hair tufts from larva of *Vanessa urtica* ...	Mr. H. E. Freeman.
Indian spider, *Salticus* sp. ♀	Mr. G. E. Mainland.
Diatoms, *Stephanopyxis corona*	Mr. H. Morland.
Lacinularia socialis, Plumatella rapens, and *Philodina erythophthalma*	Mr. R. T. G. Nevins.
Diatoms, *Triceratium Morlandii*, from New Zealand	Mr. G. Sturt.

Attendance—Members, 22; Visitors, 1.

July 23rd, 1886.—Ordinary Meeting.

E. T. Newton, Esq., F.G.S., in the Chair.

The Secretary called the attention of the members present to Rule 4, which provided that upon occasions like the present, when the President and Vice-Presidents were absent, the members should themselves proceed to appoint a Chairman.

It was thereupon proposed by Mr. Dadswell, and seconded by Mr. Parsons, that Mr. E. T. Newton be requested to take the chair on that occasion. The proposal having been put to the meeting by the Secretary, was unanimously carried.

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. A. Bickerton, Mr. R. Paul, and Mr. David G. Simpson.

The following additions to the Library were announced:—

"Report of the Manchester Microscopical Society"...	In exchange.
"The Botanical Gazette"...	,, ,,
"Proceedings of the New York Natural History Society"	,, ,,
"Proceedings of the Canadian Institute"	,, ,,
"Proceedings of the Belgian Microscopical Society"...	,, ,,

The Secretary announced that subscriptions to the Club were now due, and that any member desiring to do so might pay to the Treasurer 5s. as a subscription to the end of the present year, and then 10s. in January

for the twelvemonth ensuing; or they could, if desired, pay 15s. at once to carry them up to the end of 1887.

Mr. Gerald Sturt gave a brief *résumé* of his paper "On Some New Diatoms from Oamaru, New Zealand," the paper itself being of too technical a character to be interesting to the meeting if read *in extenso*. The material from which the diatoms had been obtained was some earth imported from New Zealand under the name of *kaolin*. This was, however, erroneously applied, kaolin being really disintegrated felspar. The earth in question came from Oamaru, its geological age had not yet been determined, but this question was under consideration, and further details were expected. The deposit bore a very remarkable similarity to the Cambridge Barbadoes earth, which produced so many famous forms, but the exact locality of which could not now be identified. It also resembled some earth from Simbirsk, in Russia, and another deposit at Brünn, the resemblance being so close that the forms found in one could not be distinguished from those taken from the others. It was also remarkable that several of the forms were still found living in the Indian Ocean. The deposit was an exceedingly rich one, and had already been found to contain 40 species entirely new to science.

The Chairman said they were very much obliged to Mr. Sturt for his very interesting paper, interesting not only to the members of the Club as microscopists, but also to geologists. He only regretted that so valuable a communication should have been made before so small an audience.

Mr. Karop said it was, of course, rather premature to discuss the paper without having the whole of it before them, but it was very interesting to find evidences of a sort of evolution of diatoms going on; if this could be traced in the case of *Naviculæ*, it would, undoubtedly, be most interesting.

A member inquired if he rightly understood Mr. Sturt to say that there were particular forms which had only been found in these deposits?

Mr. Sturt said this was so; they had been found by Greville in the original Cambridge Barbadoes earth, but had not been found since, except in the deposits mentioned.

Mr. Karop asked if the *Polycistinæ* were as remarkable in this earth as in that from Barbadoes?

Mr. Sturt said that the *Polycistinæ* were rather conspicuous by their absence, being very few comparatively. There was a large quantity of very curious sponge spicules, but Radiolaria were very scarce indeed.

The Chairman thought there were some points in connection with the subject which were of very considerable interest, especially the facts that the forms were in so many cases the same as those in the Barbadoes earth, and that other forms were the same as those now found living in the Indian Ocean. This was an observed fact, that forms which were found both in the living and fossil states were always such as were widely distributed, so that the circumstance that these were found in Barbadoes, Russia, and New Zealand, and also living in the Indian Ocean, was exactly what experience would lead them to expect. It would be extremely interesting to know, however, what was the geological age of the deposits

themselves. He was very glad to hear from Mr. Sturt that this was to be considered only as a first instalment, and that further communications upon the same subject would follow in due course. He had great pleasure in proposing a hearty vote of thanks to Mr. Sturt for this paper.

Mr. Sturt said that as the paper was the joint production of Mr. Grove, of Saltburn, and himself, any vote of thanks ought to include Mr. Grove.

A vote of thanks to Mr. Sturt and Mr. Grove was then unanimously passed.

Announcements of meetings for the ensuing month were then made, and the meeting terminated with the usual Conversazione.

The following objects were exhibited:—

Batrachospermum	Mr. F. W. Andrew.
Ichneumon fly, *Trichogramma evanescens* ...	Mr. F. Enock.
Micro-photograph of the late Dr. Carpenter ...	Mr. G. Hind.
Spider's nest	,, ,,
Larva of *Syrphus*	Mr. G. E. Mainland.
Various Diptera	Mr. R. T. G. Nevins.

Attendance—Members, 33; Visitor, 1.

INDEX.

OFFICERS AND COMMITTEE.

(Elected July, 1884.)

President.

W. B. Carpenter, C.B., F.R.S., &c., &c.

Vice-Presidents.

M. C. Cooke, M.A., LL.D., A.L.S.
J. Matthews, M.D., F.R.M.S.
A. D. Michael, F.L.S., F.R.M.S.
C. Stewart, M.R.C.S., F.L.S.

Committee.

J. W. Groves, F.R.M.S.
J. D. Hardy, F.R.M.S.
E. Jaques, B.A., F.R.M.S.
E. M. Nelson.
E. Dadswell.
Rev. H. J. Fase.
H. R. Gregory.
H. J Waddington.
T. C. White, M.R.C.S., L.D.S.
B. W. Priest.
J. G. Waller.
E. T. Newton, F.G.S.

Hon. Treasurer.

F. W. Gay, F.R.M.S., 113, High Holborn, W.C.

Hon. Secretary.

G. C. Karop, M.R.C.S., 198, Holland Road, Kensington, W.

Hon. Sec. for Foreign Correspondence and Editor of Journal.

H. F. Hailes, 5, Richmond Villas, Middle Lane, Crouch End, N.

Hon. Reporter.

R. T. Lewis, F.R.M.S.

Hon. Librarian.

Alpheus Smith,
39, Choumert Road, Rye Lane,
Peckham, S.E.

Hon. Curator.

Charles Emery,
9, New Road, Crouch End, N.

PAST PRESIDENTS.

		Elected.
EDWIN LANKESTER, M.D., F.R.S.	July,	1865.
ERNEST HART	,,	1866.
ARTHUR E. DURHAM, F.R.C.S., 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., F.Z.S.	,,	1876.
,, ,, ,, ,,	,,	1877.
THOS. H. HUXLEY, LL.D., F.R.S., &c.	,,	1878.
T. SPENCER COBBOLD, M.D., F.R.S., F.L.S., &c.		1879.
T. CHARTERS WHITE, M.R.C.S., F.L.S., &c.	,,	1880.
,, ,, ,, ,,	,,	1881.
M. C. COOKE, M.A., LL.D., A.L.S. ,,	,,	1882.
,, ,, ,, ,,	,,	1883.

HONORARY MEMBERS.

Date of Election.	
Jan. 24, 1868.	Arthur Mead Edwards, M.D., 120, Belleville avenue, Newark, New Jersey, U.S.A.
Mar. 19, 1869.	The Rev. E. C. Bolles, 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 23, 1875.	Lionel S. Beale, M.B., F.R.S., F.R.M.S., &c. (*Past President*), 61, Grosvenor street, W.
Sept. 22, 1876.	Frederick Kitton, Hon. F.R.M.S., &c., 3, Bedford street, Unthanks road, Norwich.
July 25, 1879.	W. B. CARPENTER, C.B., M.D., F.R.S., &c., &c., (*President*), 56, Regent's park road, N.W.
July 25, 1879.	Dr. E. Abbe, University, Jena, Saxe Weimer, Germany.
July 23, 1880.	F. H. Wenham, C.E., 3, Gothic Villas, Warbeck road, Shepherd's Bush, W.
Nov. 24, 1882.	Dr. Veit B. Wittrock, Professor at the Royal Academy of Sciences, and Director of the Museum of Natural History, Stockholm, Sweden.

LIST OF MEMBERS.

Date of Election.	
Sept. 24, 1869.	Ackland, William, L.S.A., F.R.M.S., 416, Strand, W.C.
Oct. 26. 1883.	Addiscott, C. J., Sydney Villa, St. Bildas road, Manor Park, Stoke Newington, N.
Nov. 27, 1868.	Adkins, William, 431, Oxford street, W.
June 24, 1881.	Alabone, E. W., M.D., 175, Highbury New park, N.
Mar. 23, 1866.	Allbon, William, F.R.M.S., 37, Gloucester place, Portman square, W.
July 26, 1872.	Alstone, John, 3, Great Tower street, E.C.
Dec. 17, 1869.	Ames, G. A. F.R.M.S., Union Club, Trafalgar square, W.C.
Dec. 22, 1865.	Andrew, F. W., 3, Neville terrace, Onslow gardens, S.W.
May 28, 1875.	Arrowsmith, Wastell, 99, Adelaide road, Haverstock hill, N.W.
June 22, 1883.	Ash, George C., 141, Maida Vale, W.
July 25, 1879.	Ashbridge, Arthur, 76, Leadenhall street, E.C.
Sept. 27, 1878.	Ashby, H. T., 8, Bartholomew road, Kentish town, N.W.
June 26, 1874.	Badcock, John, F.R.M.S., 270, Victoria park road, South Hackney, E.
Dec. 28, 1883.	Bailey, Rev. G., 1, South vale, Upper Norwood, S.E.
Dec. 27, 1867.	Bailey, J. W., 75, Broke road, Dalston, E.
April 24, 1868.	Baker, Charles, F.R.M.S., 244, High Holborn, W.C.
Feb. 25, 1876.	Ballard, Dr. W. R., jun., 26, Manchester square, W.

Date of Election.	
June 22, 1883.	Balleine, Arthur Edwin, 5, Heathcote street, Mecklenburg square, W.C.
Jan. 24, 1879.	Barham, G. T., Danehurst, Hampstead, N.W.
Dec. 27, 1872.	Barnard, Herbert, 33, Portland place, W.
April 22, 1870.	Barnes, C. B., 4, Egremont villas, White horse lane, South Norwood, S.E., and 27, Clement's lane, E.C.
July 27, 1883.	Barnes, Henry, Patschull house, Dartmouth Park avenue, N.
May 25, 1883.	Barratt, Thomas, Bell Moor House, Upper Heath, Hampstead, N.W.
Sept. 27, 1872.	Bartlett, Edward, L.D.S., M.R.C.S.E., 38, Connaught square, W.
Dec. 28, 1877.	Batchelor, J. A., Avenue road, Bexley, Kent.
June 27, 1883.	Bates, E., Assoc.I.C.E., 45, Fentiman's road, Clapham road, S.E.
Nov. 26, 1875.	Beaulah, John, Raventhorpe, Brigg.
July 25, 1884.	Beck, C., 31, Cornhill, E.C.
May 26, 1871.	Bedwell, F. A., M.A., Cantab., F.R.M.S., West parade, Hull, Yorkshire.
Mar. 28, 1884.	Beetham, A., 14, South square, Gray's Inn, W.C.
May 22, 1868.	Berney, John, F.R.M S., 61, North end, Croydon.
Oct. 23, 1868.	Bevington, W. A., F.R.M.S., "Avondale," Coloraine road, Blackheath, S.E.
Mar. 28, 1879.	Bird, F. E., 33, St. Saviour's road, Brixton hill, S.W.
July 28, 1871.	Bishop, William, 549, Caledonian road, N.
May 27, 1881.	Bishop, O. S., F.R.M.S., Oak villa, Muswell hill, N.
Feb. 23, 1866.	Blake, T., 58, Brook green, Hammersmith, W.
July 27, 1877.	Blenkinsop, B., Shord hill, Kenley, Surrey.
May 26, 1876.	Blundell, J., 38, Mount street, W.
Jan. 25, 1878.	Bogue, David, F.R.M.S., 3, St. Martin's place, Trafalgar square, W.C.
Dec. 27, 1881.	Bolton, J. G. E., M.R.C.S., Savanne, Mauritius.
Jan. 22, 1875.	Bolton, Thomas, F.R.M.S., 57, Newhall street, Birmingham.
Nov. 23, 1883.	Bostock, E., "The Radfords," Stone, Staffordshire.

Date of Election.	
Feb. 24, 1882.	Bound, H. J., 19, Torrington square, W.C.
Oct. 27, 1865.	Braithwaite, Robert, M.D., M.R.C.S.E., F.L.S., F.R.M.S. (*Past President*), The Ferns, 303, Clapham road, S.W.
June 28, 1878.	Brewster, W., 25, Myddelton square, E.C.
May 26, 1876.	Brigstock, J. W., 4, Comberton road, Upper Clapton, E.
Oct. 27, 1883.	Brown, Fredk. Wm., 35, Walterton road, St. Peter's park, Harrow road, W.
May 27, 1870.	Brown, G. D., M.R.C.S., Henley villa, Uxbridge road, Ealing, W.
Sept. 26, 1879.	Brown, William, B.Sc., 3, Elm cottages, Middle lane, Hornsey, N.
May 22, 1868.	Brown, W. J., 4, Heath villas, Maple road, Anerley, S.E.
May 26, 1871.	Browne, George, 45, Victoria road, Kentish town, N.W.
May 28, 1875.	Browne, J. W., Frascati, Masons hill, Bromley, Kent.
Feb. 27, 1872.	Browne, Rev. T. H., F.R.M.S., F.G.S., M.E.S., High Wycombe, Bucks.
Jan. 23, 1880.	Browne, W. R., 317, Essex road, Islington, N.
Dec. 22, 1882.	Bucknall, Edward, 16, Junction road, Highgate, N.
Jan. 26, 1877.	Buffham, T. H., 2, Connaught road, Walthamstow.
June 22, 1883.	Burbidge, William Henry, Stanley House, Alleyn park, Dulwich, S.E.
June 27, 1884.	Burrows, W. J., 16, Endymion road, Brixton hill, S.W.
Aug. 22, 1879.	Burton, William, 27, Wigmore street, W.
May 23, 1879.	Button, Arthur, Albert Cottages, Queen's road, Buckhurst hill.
June 14, 1865.	Bywater, W. M., F.R.M.S., 5, Hanover square, W.
Nov. 22, 1878.	Cafe, J. W., 46, Clifton hill, St. John's wood, N.W.
June 25, 1880.	Cambridge, John, Bury St. Edmunds, Suffolk.
Sept. 22, 1876.	Canton, Frederick, L.C.R.P., M.R.C.S., &c., 17, Great Marlborough street, Regent street, W.
May 23, 1879.	Carpenter, H. S., F.R.M.S., Beckington house, Weighton road, Anerley, S.E.

Date of Election.	
July 23, 1880.	Carr, Ebenezer, 26, Bromar road, Denmark park, S.E.
Nov. 24, 1882.	Carr, Thomas, M.R.C.S., Guy's Hospital, S.E.
May, 26, 1882.	Chapman, W. Ingram, 5, Hollywood villas, Melrose road, Southfields, S.W.
Dec. 27, 1878.	Chatto, Andrew, 214, Piccadilly, W.
Nov. 27, 1874.	Chippindale, George, Grape villa, Rothschild road, Chiswick High road, W.
Dec. 27, 1881.	Claremont, Claude Clarke, M.R.C.S., Millbrooke house, Hampstead road, N.W.
Feb. 23, 1883.	Clark, Joseph, Street, Somerset.
July 25, 1879.	Cobbold, T. S., M.D., F.R.S., F.L.S. (*Past President*), 74, Portsdown road, Maida vale, W.
May 22, 1868.	Cocks, W. G., 36, Gayhurst road, Dalston, E.
Nov. 25, 1881.	Coffin, Walter H., F.L.S., F.C.S., F.R.M.S., &c., 94, Cornwall gardens, South Kensington, S.W.
Sept. 22, 1876.	Cole, A. C., F.R.M.S., St. Domingo house, Oxford gardens, Notting hill, W.
Nov. 23, 1883.	Cole, M., St. Domingo house, Oxford gardens, Notting hill, W.
April 24, 1874.	Cole, William, M.E.S., *Hon. Secretary Essex Naturalists' Field Club,* Laurel cottage, King's place, Buckhurst hill, Essex.
Jan. 25, 1867.	Coles, Ferdinand, F.L.S., 53, Brooke road, Stoke Newington common, N.
Mar. 24, 1876.	Colsell, G. D., 1, Dermody road, East Down, Lewisham, S.E.
June 14, 1865.	Cooke, M.C., M.A., LL.D., A.L.S. (*Past President*), 146, Junction road, Upper Holloway, N.
Feb. 22, 1867.	Cooper, F. W., L.R.C.S.Edin., Leytonstone, E.
June 27, 1873.	Corbett, A. L., 103, Fentiman's road, Clapham road, S.W.
May 28, 1869.	Cottam, Arthur, F.R.A.S., H.M.Office of Woods, Whitehall place, S.W.
July 26, 1872.	Cowan, T. W., F.G.S., F.R.M.S., Comptons Lea, Horsham, Sussex.
Aug. 28, 1868.	Crisp, Frank, LL.B., B.A., *V.P. and Treas. Linnean Society; Hon. Sec. Royal Microscopical Society,* 5, Lansdowne road, Notting hill, W.

Date of Election.	
Dec. 23, 1870.	Crisp, J. S., F.R.M.S., Ashville, Lewin road, Streatham, S.W.
July 26, 1878.	Crockford, Wm., 2, St. Peter's road, Mile end, E.
Feb. 23, 1877.	Crofton, Edward, M.A. Oxon, F.R.M.S., 45, West Cromwell road, South Kensington, S.W.
Sept. 28, 1866.	Crouch, Henry, F.R.M.S., 66, Barbican, E.C.
June 22, 1877.	Cunliffe, P.G., F.R.M.S., The Elms, Handforth, Manchester.
June 25, 1880.	Curties, C. L., 244, High Holborn, W.C.
May 25, 1866.	Curties, Thomas, F.R.M.S., 244, High Holborn, W.C.
June 25, 1880.	Curties, W. I., 244, High Holborn, W.C.
Sept. 26, 1879.	Curtis, Charles, 29, Baker street, Portman sq., W.
Aug. 22, 1879.	Cuttell, F. G., 52, New Compton street, Soho, W.
April 22, 1881.	Cutting, W. M., 1, Curtain road, E.C.
Jan. 22, 1875.	Dadswell, Edward, 42, Barrington road, Stockwell, S.W.
Mar. 24, 1882.	Dale, Bernard, 14, Elm grove, Lee, Kent.
Nov. 23, 1877.	Dallas, W. S., F.L.S., &c., the Geological Society, Burlington house, Piccadilly, W.
Feb. 23, 1883.	Dallinger, Rev. W. H., F.R.S., F.R.M.S. (*President R.M.S.*), Wesley college, Sheffield.
May 23, 1879.	Dallmeyer, T. R., 19, Bloomsbury street, W.C.
Mar. 22, 1878.	Darby, the Ven. Archdeacon, St. Bridget's Rectory, Chester.
Mar. 22, 1878.	Drake, Edward, 16, Rochester terrace, Camden road, N.W.
Oct. 22, 1869.	Davis, Henry, 19, Warwick street, Leamington.
Aug. 23, 1883.	Davis, H., 108, Sandringham road, Dalston, E.
May 23, 1879.	Dawson, William, 24, Abbeygate street, Bury St. Edmunds, Suffolk.
May 28, 1875.	Dean, Arthur (*Hon. Sec. East Lond. Mic. Soc.*), 57, Southborough road, South Hackney, E.
Feb. 23, 1877.	Death, James, jun., 38, Gladstone street, St. George's road, Southwark, S.E.
Feb. 28, 1879.	Debenham, E. H., 9, Mincing lane, E.C.
Jan. 24, 1879.	Deby, Julien, C.E., F.R.M.S., 17, Boulevard du Regent, Brussels (care of Mr. Thos. Westwood).

Date of Election.	
Nov. 24, 1876.	Despointes, Francis, 16, St. George's square, Regent's park road, N.W.
Nov. 24, 1865.	Dobson, H. H., F.R.M.S., Holmesdale, Grange park, Ealing, W.
Nov. 27, 1868.	Douglas, Rev. R. C., Manaton rectory, Moretonhampstead, Exeter.
Oct. 25, 1878.	Dowler, Captain F. E., 28, Albermarle street, W.
Jan. 23, 1880.	Dowsett, G. H., 11, Gloucester place, Greenwich, S.E.
May 25, 1883.	Drake, C. A., The Distillery, Three Mill lane, Bromley-by-Bow.
July 25, 1879.	Driver, Alfred, 30, Leigham court road west, Streatham, S.W.
Aug. 26, 1872.	Dudgeon, R. E., M.D., 53, Montagu square, W.
Oct. 25, 1872.	Dunning, C. G., 55, Camden park road, N.W.
Sept. 22, 1865.	Durham, A. E., F.R.C.S., F.L.S., F.R.M.S., &c. (*Past President*), 82, Brook street, Grosvenor square, W.
July 27, 1883.	Durrand, Alexander, 5, Philbrick terrace, Nunhead lane, Peckham Rye, S.E.
Sept. 25, 1868.	Eddy, J. R., F.R.M.S., F.G.S., The Grange, Carleton, Skipton, Yorkshire.
June 28, 1867.	Edmonds, R., 178, Burrage road, Plumstead, S.E.
July 25, 1884.	Ellis, J. H., The Lindens, Geraldine road, Wandsworth, S.W.
May 26, 1876.	Emery, Charles (*Hon. Curator*), 9, New road, Crouch end, N.
May 26, 1871.	Enock, Frederick, Ferndale, Bath road, Woking Station.
Feb. 28, 1879.	Epps, Hahnemann, 95, Upper Tulse hill, Brixton, S.W.
Feb. 21, 1884.	Epps, J., jun., The Homestead, Ross Road, South Norwood Hill, S.E.
Dec. 27, 1878.	Erlebach, H. A., Mill hill school, Mill hill, N.W.
July 25, 1873.	Fase, Rev. H. J., 5, Bessborough gardens, S.W.
June 25, 1875.	Faulkner, Henry, jun., Fernwood, Roehampton park, S.W.
Jan. 28, 1876.	Faulkner, John, 20, Mornington crescent, N.W.
Aug. 25, 1882.	Field, W. H., 5, Palace road, Crouch end, N.

Date of Election.	
Feb. 27, 1880.	Fieldwick, Alfred, jun., 284, Dalston lane, Hackney, E.
July 22, 1881.	Firth, W. A., Whiterock, Belfast.
July 26, 1867.	Fitch, Frederick, F.R.G.S., F.R.M.S., Hadleigh house, Highbury New park, N.
Feb. 24, 1882.	Fitch, J. N., 17, Eversholt street, Camden Town, N.W.
Oct. 26, 1883.	Fleetwood, G., 388, Camden road, N.
Nov. 28, 1879.	Foster, William, jun., Cleveland road, Woodford, Essex
Mar. 24, 1871.	Foulerton, John, M.D., 44, Pembridge villas, Bayswater, 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, H. E., 60, Plimsoll road, Finsbury park, N.
May 22, 1868.	Fryer, G. H., 107, Belsize road, N.W.
July 23, 1880.	Funston, James, 93, Finsbury pavement, E.C.
June 23, 1882.	Garden, Alexander, M.D., Brigade Surgeon, Laharempore, India, care of R. S. Garden, 200, Piccadilly, W.
Mar. 25, 1870.	Garden, R. S., 42, Carlton hill, St. John's wood, N.W.
Feb. 26, 1875.	Gardner, Edmund, 454, Strand, W.C.
July 27, 1877.	Gardner, J. H., A.K.C., 44, Berners street, W.
April 23, 1880.	Gates, G. W. H., 21, Lombard street, E.C.
July 7, 1865.	Gay, F. W., F.R.M.S. (*Hon. Treasurer*), 113, High Holborn, W.C.
June 25, 1880.	George, C. F., M.R.C.S., Kirton-in-Lindsey, Lincolnshire.
July 26, 1867.	George, Edward, F.R.M.S., 12, Derby villas, Forest hill, S.E.
April 27, 1877.	Gilbertson, Henry, Mangrove house, Hertford.
June 24, 1881.	Gilburt, Henry, 63, Rectory road, Stoke Newington, N.
Oct. 27, 1876.	Gilburt, W. H., F.R.M.S., 48, Wetherell road, South Hackney, E.

Date of Election.	
June 27, 1873.	Glasspole, H. G., 15, Mall road, Hammersmith, W.
Nov. 28, 1879.	Goodinge, A. C., 119, High Holborn, W.C.
April 26, 1872.	Goodinge, J. W., F.R.G.S., F.R.M.S., 119, High Holborn, W.C.
Nov. 23, 1877.	Goodwin, William, 24, Miranda road, Upper Holloway, N.
July 27, 1883.	Goold, Ernest H., C.E., F.Z.S., M.R.I., 4, Dane's Inn, Strand, W.C.
Mar. 27, 1866.	Gray, S. O., Bank of England, E.C.
Feb. 24, 1882.	Greening, Linnæus, Birch house, Warrington.
Oct. 23, 1868.	Greenish, Thomas, F.R.M.S., 20, New street, Dorset square, N.W.
Oct. 23, 1868.	Gregory, H. R., 7, Quality court, Chancery lane.
April 27, 1883.	Gregory, William, 98, Brockley road, St. John's, S.E.
July 24. 1868.	Groves, J. W., F.R.M.S., 90, Holland road, Kensington, W., and Physiological Laboratory, King's College, W.C.
May 28, 1880.	Groves, William, 28, Manor park, Lee, S.E.
July 24, 1868.	Grubbe, E. W., C.E., 73, Redcliffe gardens, S.W.
Jan. 27, 1871.	Guimaraens, A. de Souza, F.R.M.S., 48, Heron road, Herne hill, S.E.
Sept. 28, 1877.	Hagger, John, Repton school, Burton-on-Trent.
Feb. 25, 1881.	Haigh, William, Tempsford villa, Uxbridge road, Ealing, W.
June 14, 1865.	Hailes, H. F. (*Hon. Secretary for Foreign Correspondence and Editor*), 5, Richmond villas, Middle lane, Crouch end, N.
Aug. 26, 1870.	Hailstone, R. H., 91, Adelaide road, N.W.
Feb. 23, 1867.	Hainworth, William, 3, Pembury road, Clapton, E.
July 28, 1876.	Halford, Edward, 18, Leinster square, Bayswater, W.
Dec. 28, 1866.	Hallett, R. J., 123, Seymour street, Euston square, N.W.
Feb. 22, 1869.	Hammond, A., F.L.S., 5, Swiss terrace, Elmers end road, Beckenham, S.E.
June 25, 1880.	Hancock, H. S. H., 50, Springdale road, Stoke Newington, N.

Date of Election.	
Jan. 24, 1879.	Harding, Burcham, 128, Adelaide road, N.W.
Feb. 24, 1882.	Harding, J. H., 4, Finsbury square, E.C.
July 23, 1880.	Hardingham, A. S., 59, St. George's square, S.W.
July 25, 1879.	Hardingham, G. G., F.R.M.S., 33, St. George's square, S.W.
Jan. 23, 1874.	Hardy, J. D., F.R.M.S., 73, Clarence road, Clapton, E., and 4, Lombard street, E.C.
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, Longton grove, Upper Sydenham, S.E.
April 23, 1875.	Harrison, James, 150, Akerman road, North Brixton, S.W.
May 23, 1884.	Havers, J. C., Wood Lea, Bedford hill, Balham, S.W.
Mar. 28, 1879.	Hawkins, C. E., H.M. Geological Survey, Jermyn street, S.W.
June 28, 1867.	Hawksley, T. P., 97, Adelaide road, N.W.
June 22, 1883.	Hazlewood, Jas. Edmund, F.R.M.S., 3, Lennox place, Brighton.
Aug. 23, 1872.	Hembry, F. W., F.R.M.S. (*Hon. Sec., S. Lond. Mic. and Nat. Hist. Soc.*), Home Lea, Hatherley road, Sidcup, Kent.
June 26, 1868.	Henry, A. H., 73, Redcliffe gardens, S.W.
Sept. 23, 1881.	Hensoldt, Heinrich, 7, Machell road, Nunhead, S.E.
April 25, 1884.	Higgins, J., London University, Burlington gardens, W.
Dec. 22, 1882.	Hilditch, James Bracebridge, Asgill house, Richmond, Surrey.
June 22, 1877.	Hill, R. W., 41, Lothbury, E.C.
Sept. 24, 1869.	Hilton, T. D., M.D., Upper 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.
Aug. 26, 1870.	Hirst, John, F.R.M.S., Ladcastle, Dobcross, Manchester.
Feb. 26, 1875.	Holford, Christopher, Bounty Office, Dean's yard, Westminster, S.W.

Date of Election.	
Jan. 23, 1880.	Holland, C. F., Brooke road, Upper Clapton, E.
July 25, 1884.	Holmes, W. M., 63, Lupus street, S.W.
April 26, 1867.	Hooton, Charles, Sunningdale house, Bickerton road, Upper Holloway, N.
Nov. 26, 1880.	Hopkins, Robert, Shearn villa, Walthamstow, Essex.
Oct. 26, 1866.	Horncastle, Henry, Cobham, near Woking station.
June 25, 1869.	Houghton, W., Hoe street, Walthamstow, E.
May 22, 1874.	Hovenden, C. W., F.R.M.S., 65, Rue de Faubourg Poissonière, Paris.
April 26, 1867.	Hovenden, Frederick, F.R.M.S., Glenlea, Thurlow park road, Dulwich, S.E.
Oct. 27, 1876.	Howard, D., 60, Belsize park, N.W.
Oct. 25, 1878.	Howling, W. E., Crowley's Brewery, Alton, Hants.
Jan. 23, 1880.	Hunt, Frederick, York lodge, Stamford hill, N.
Dec. 22, 1876.	Hunter, J. J., 20, Cranbourne street, W.C.
July 25, 1873.	Hurst, J. T., 1, Raymond villas, Geraldine road, Wandsworth, S.W.
June 28, 1878.	Huxley, Prof. T. H., F.R.S., &c. (*Past President*), Science Schools, South Kensington, S.W.
May 24, 1867.	Ingpen, J. E., F.R.M.S., 7, The Hill, Putney, S.W.
Dec. 17, 1875.	Jackson, C. L., F.L.S., F.Z.S., F.R.M.S., Hill Fold, Sharples, Bolton.
July 24, 1868.	Jackson, F. R., Culver cottage, Slindon, Arundel, Sussex.
June 25, 1880.	Jacques, Walter, 2, Fenchurch buildings, E.C.
Aug. 25, 1882.	Jakeman, Christopher, 72, South street, Greenwich.
June 14, 1865.	Jaques, Edward, B.A., H.M. Office of Woods, Whitehall place, S.W.
Feb. 28, 1873.	Jenkins, J. W., 3, Harcourt road, Wallington.
Feb. 21, 1884.	Jennings, A. V., 8, Broadhurst gardens, South Hampstead, N.W.
July 24, 1868.	Jennings, Rev. Nathaniel, M.A., F.R.A.S., 8, Broadhurst gardens, South Hampstead, N.W.

Date of Election.	
Feb. 24, 1871.	Johnson, M. Hawkins, F.R.M.S., F.G.S., 379, Euston road, N.W.
Mar. 24, 1871.	Johnstone, James, Stanhope lodge, Bideford.
Feb. 28, 1873.	Jones, G. J., Gainsborough house, Lymington.
June 25, 1875.	Jones, J. B., F.R.M.S., St. George's Chambers, 10, St. George's crescent, Liverpool.
Nov. 25, 1870.	Jones, Lieut.-Col. Lewis, Westgate-on-Sea, Isle of Thanet.
May 23, 1873.	Jones, Captain L. F., United Service Club, Pall Mall, S.W.
June 23, 1876.	Jones, T. E., 46, Park street, Stoke Newington, N.
Jan. 27, 1882.	Jones, Rev. T. R., M.A., Codicote Vicarage, Welwyn, Herts.
May 23, 1873.	Karop, G. C., M.R.C.S., &c. (*Hon. Secretary*), 198, Holland road, Kensington, W.
Feb. 21, 1884.	Kell, F. W., 20, Croftdown road, Highgate Rise, N.
July 25, 1884.	Kern, J. J., Fern Glen, Selhurst park, South Norwood, S.E.
Aug. 23, 1867.	Kiddle, Edward, 1, Cleveland villas, Rosemount road, Richmond hill, S.W.
Mar. 19, 1869.	Kilsby, T. W., 4, Brompton villas, Edmonton.
April 22, 1881.	King, H. W., The Cedars, Upper park road, New Southgate, N.
Dec. 23, 1870.	King, Robert, F.R.M.S., Fern house, Upper Clapton, E.
May 24, 1878.	King, W. T., M D., M.R.C.S., 74, Victoria park road, South Hackney, E.
Nov. 26, 1880.	Kingsett, C. T., F.C.S., F.I.C.
Feb. 28, 1873.	Kitsell, F. J., 24, St. Stephen's avenue, Goldhawk road, Shepherd's Bush, W.
Mar. 23, 1877.	Kluht, H. J., 44, Norfolk terrace, Bayswater, W.
Oct. 24, 1873.	Knight, J. M., 50, Bow road, E.
Nov. 25, 1870.	Ladd, William, F.R.A.S., F.R.M.S., Trewinian, Burnt Ash hill, Lee, Kent.
Jan. 24, 1879.	Lancaster, A. H., 7, Campden hill gardens, Kensington, W.
May 23, 1884.	Lancaster, E. Le Gonier, 16, Wharton road, West Kensington park, W.

Date of Election.

Mar. 22, 1867. Lancaster, Thomas, Bownham house, Stroud, Gloucestershire.

Jan. 28, 1881. Lankester, H. H., Ewendwr road, West Kensingington, W.

May 28, 1875. Larkin, John, 24, Charterhouse square, E.C.

Nov. 26, 1880. Larkin, R. J., 98, Clarence road, Lower Clapton, E.

June 25, 1869. Layton, C. E., 12, Upper Hornsey rise, N.

April 25, 1884. Lawrence, T. W. P., 47, Upper Bedford place, W.C.

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. (*Past President*), Ethelbert house, Margate.

Feb. 25, 1881. Leicester, Alfred, Lynwood, Harbord street, Waterloo, near Liverpool.

Oct. 25, 1867. Leifchild, J. R., M.A., 6, St. Lawrence road, Notting hill, W.

Sept. 22, 1865. Leighton, W. H., 2, Merton place, Chiswick, W.

April 27, 1866. Lewis, R. T., F.R.M.S. (*Hon. Reporter*), 1, Masbro' road, Brook green, W.

June 26, 1868. Lindley, W. H., jun., 29, Blittersdorffs platz, Frankfort-on-Maine.

May 26, 1871. Locke, John, 16, Georgiana street, Camden town, N.W.

April 23, 1869. Long, Henry, 90, High street, Croydon.

Nov. 24, 1866. Lovibond, J. W., F.R.M.S., St. Anne street, Salisbury.

Sept. 22, 1866. Lovick, T., 53, Queen's crescent, Haverstock hill, N.W.

April 27, 1866. Loy, W. T., F.R.M.S., Five Oaks, Billingshurst, Sussex.

Feb. 21, 1884. McCrie, G., 94, North Frederick street, Glasgow.

Nov. 23, 1866. McIntire, S. J., F.R.M.S., 14, Hetley road, Uxbridge road, Shepherd's bush, W.

Jan. 23, 1880. Mackenzie, James, Warden villa, Uxbridge road, Ealing, W.

Date of Election.	
April 27, 1883.	McManis, Thos. John, 28, Northcote street, Walthamstow, E.
Jan. 24, 1884.	Macrae, A. C., M.D., 119, Westbourne terrace, Hyde Park, W.
June 28, 1878.	Magor, J. B., L.D.S., 24, Chapel street, Penzance.
July 26, 1874.	Magor, Thomas, M.D., Eagle cottage, Hornsey, N.
May 25, 1883.	Mainland, G. E., 115, Forest road, Dalston, E.
May 25, 1883.	Mais, H. T., Coathorpe, M.I.C.E., Engineer in Chief, Adelaide, South Australia (care of T. Curties, 244, High Holborn, W.C.).
Sept. 27, 1872.	Manning, H. E. the Cardinal Archbishop, Archbishop's house, Westminster, S.W.
July 27, 1883.	Mansfield, Edward Joseph, 176, Evering road, Upper Clapton, E.
Jan. 23, 1880.	Martin, Francis, R.N., Shrub cottage, Fairfield road, Old Charlton, Kent.
April 26, 1867.	Matthews, G. K., St. John's lodge, Beckenham, Kent.
Oct. 26, 1866.	Matthews, John, M.D., F.R.M.S. (*V. P. and Past President*), 30, Colebrook row, Islington, N.
May 26, 1871.	May, J. W., F.R.M.S., Arundel house, Percy cross, Fulham, S.W.
Feb. 25, 1876.	May, W. R., 52, Malvern road, Dalston, E.
Mar. 22, 1867.	Meacher, J. W., 10, Hillmarten road, Camden road, N.
Feb. 28, 1879.	Menzies, James, 13, Leighton grove, N.W.
May 22, 1874.	Messenger, G. A., Lloyds, E.C.
July 27, 1877.	Michael, A. D., F.L.S., F.R.M.S. (*Vice-President*), Cadogan Mansions, Sloane square, Chelsea, S.W.
May 28, 1880.	Miles, Andrew, 23, Hanover park, Peckham, S.E.
July 7, 1865.	Millett, F. W., F.R.M.S., Marazion, Cornwall.
Oct. 22, 1880.	Milner, W. E., 47, Park road, Haverstock hill, N.W.
Sept. 22, 1882.	Moore, George, 7, Draper's gardens, Throgmorton street, E.C.
Jan. 23, 1874.	Moreland, Richard, jun., M.I.C.E., F.R.M.S., 4, The Quadrant, Highbury, N.

Date of Election.	
July 26, 1878.	Morland, Henry, Cranford, near Hounslow.
Oct. 27, 1866.	Morrieson, Colonel R., F.R.M.S., Oriental Club, Hanover square, W.
Dec. 27, 1876.	Morris, J. G., M.R.C.S., 135, St. Owen street, Hereford.
Jan. 24, 1879.	Murray, James, Osborne house, 50, Percy road, Shepherd's bush, W.
Feb. 22, 1878.	Needham, S. H., F.R.G.S., F.G.S., 33, Somerfield road, Finsbury park, N.
Mar. 24, 1876.	Nelson, E. M., Cleve house, West End lane, West Hampstead, N.W.
Mar. 24, 1871.	Nelson, James, 238, Kennington road, S.E.
Nov. 25, 1881.	Nevins, R. T. G., 80, Tufnell park road, N.
Jan. 26, 1872.	Newton, E. T., F.G.S., Geological Museum, Jermyn street, S.W.
Feb. 27, 1880.	Niven, George, Bank of Australia, 67, Cornhill, E.C.
May 22, 1874.	Nixon, P. C., Oporto, Portugal.
Aug. 26, 1881.	Northey, M. D., 4, Lower Brighton terrace, Surbiton.
Jan. 24, 1879.	Offord, J. M., 6, Boundary road, St. John's Wood, N.W.
Dec. 22, 1876.	Ogilvy, C. P., F.L.S., Sizewell house, Leiston, near Saxmundham, Suffolk.
May 24, 1878.	O'Hara, Lt.-Col. Richard, F.R.M.S. (late Royal Artillery), West Lodge, Galway.
Dec. 28, 1883.	Oliver, J., 123, Stamford street, S.E.
June 23, 1882.	Ollard, John Alex., F.R.M.S., Y^e Hermitage, Forty hill, Enfield.
July 28, 1882.	Ondaatje, Dr. W. C., F.R.M.S., Galle, Ceylon.
Dec. 27, 1867.	Oxley, Frederick, F.R.M.S., 8, Crosby square, Bishopsgate street, E.C.
July 25, 1879.	Palmer, G. H., 95, Cornwall gardens, S.W.
Oct. 27, 1871.	Parsons, F. A., 90, Leadenhall street, E.C.
Dec. 28, 1877.	Partridge, Thos., M.D., Stroud, Gloucestershire.
April 23, 1875.	Peal, C. N., F.R.M.S., Fernhurst, Mattock lane, Ealing, W.

Date of Election.	
Feb. 23, 1883.	Pearce, Fredk. Ernest, 14, Bloomsbury street, W.C.
May 24, 1867.	Pearson, John, 212, Edgeware road, W.
July 22, 1881.	Perigal, Henry, F.R.A.S., F.R.M.S., 9, North crescent, Bedford square, W.C.
Oct. 27, 1865.	Pickard, J. F., 195, Great Portland street, W.
May 23, 1879.	Pilcher, W. J., F.R.C.S., &c., Boston, Lincolnshire.
June 24, 1881.	Pilley, J. J., 8, Ellesmere road north, Bow, E., and the Old College, Dulwich.
Jan. 22, 1869.	Pillischer, Moritz, F.R.M.S., 88, New Bond street, W.
Sept. 27, 1878.	Plomer, G. D., F.R.M.S., 48, Springfield road, St. John's Wood, N.W.
Nov. 23, 1883.	Plowman, T., junr., St. Mellim, Bush Hill park, Enfield.
Sept. 28, 1877.	Pocklington, Henry, F.R.M.S., 20, Park road, Leeds.
Nov. 23, 1866.	Potter, George, F.R.M.S., 42, Grove road, Holloway, N.
Jan. 25, 1878.	Potts, R. A., 26, South Audley street, W.
June 24, 1881.	Potts, William, Hillside avenue, Beckenham, Kent.
June 22, 1866.	Powe, I., 71, George street, Richmond, Surrey.
Aug. 25, 1882.	Powell, George, 86, Avondale square, S.E.
April 25, 1879.	Powell, H. P., Mill Platt, Isleworth.
May 26, 1876.	Powell, J. T., 32, Dunlace road, Lower Clapton, E.
July 7, 1865.	Powell, Thomas, F.R.M.S., 18, Doughty street, Mecklenburg square, W.C.
June 27, 1873.	Priest, B. W., 22, Parliament street, S.W.
May 23, 1879.	Pritchard, J. D., Crymlyn Burrows, near Swansea.
July 26, 1867.	Pritchett, Francis, Clifford house, South Norwood park, S.E.
Feb. 25, 1881.	Probyn, Clifford, 55, Grosvenor street, W.
April 23, 1868.	Quekett, A. J. S., 51, Warwick road, Maida hill, W.
April 23, 1868.	Quekett, A. E., 51, Warwick road, Maida hill, W.

Date of Election.	
April 23, 1868.	Quckett, Rev. Wm., The Rectory, Warrington.
Feb. 23, 1866.	Quick, G. E., 74, Long lane, Bermondsey, S.E.
Oct. 26, 1866.	Rabbits, W. T., Irongates, Dacres road, Forest hill, S.E.
June 25, 1875.	Radford, W. S., M.D., F.R.M.S., Sidmouth.
Oct. 26, 1866.	Ramsden, Hildebrand, M.A. Cant., F.L.S. F.R.M.S., 26, Upper Bedford place, Russell square, W.C.
Aug. 28, 1868.	Rance, T. G., Elmside, Bickley, Kent.
June 24, 1881.	Ransom, F., Fairfield, Hitchin.
July 23, 1880.	Read, Rev. William, M.A., F.R.A.S., F.R.M.S., &c., Worthing, Sussex.
Dec. 27, 1878.	Reed, J. M., Sidmouth house, South park, Ilford, E.
June 22, 1877.	Reed, J. W., F.R.G.S., F.R.M.S., 17, Colebrooke row, Islington, N.
June 27, 1873.	Reeve, Frederick, 113, Clapham road, S.W.
July 7, 1865.	Reeves, W. W., F.R.M.S., 36, Ashburnham grove, Greenwich, S.E.
May 22, 1874.	Reid, W. W., Corra Lynn, Selhurst park, South Norwood, S.E.
Oct. 28, 1881.	Reynolds, W. P., 74, King William street, E.C.
May 23, 1879.	Rideout, William, F.R.M.S. (*Hon. Sec. Bolton Microscopical Club*), Hulliwell, Bolton.
May 22, 1868.	Rogers, John, F.R.M.S., 4, Tennyson street, Nottingham.
Oct. 26, 1866.	Rogers, Thomas, F.L.S., F.R.M.S., Selmeston house, Thurlow park road, West Dulwich.
May 22, 1868.	Roper, Freeman, C.S., F.L.S., F.G.S., F.R.M.S., Palgrave house, Eastbourne, Sussex.
June 23, 1876.	Roper, H. J., F.R.M.S., 7, Carlton grove, Peckham, S.E.
Oct. 27, 1876.	Roper, Robert, 29, Hampton road, Upton, Essex.
Jan. 24, 1884.	Rosseter, T. B., F.R.M.S., Fleur de Lis Hotel, Canterbury.
Jan. 26, 1883.	Rousselet, Charles, 42, Welbeck street, W.
July 24, 1868.	Rowe, James, jun., M.R.C.V.S., 65, High street, Marylebone, W.
Oct. 27, 1865.	Russell, James, 10, High street, Shoreditch, E.

Date of Election.	
May 22, 1868.	Russell, T. D., Coningsby villas, Rosendale road, West Dulwich, S.E.
Feb. 22, 1867.	Rutter, H. L., 24, Crownhurst road, Angel road, Brixton, S.W.
Nov. 22, 1878.	Sabel, E. E., 6, Grove road, Clapham park, S.W.
May 23, 1873.	Salkeld, Lt.-Col. J. C., F.R.M.S., 29, St. James's street, S.W.
Dec. 17, 1869.	Salmon, John, 24, Seymour street, Euston square, N.W.
Dec. 28, 1877.	Sands, Charles, 5, Woburn place, Russell square, W.C.
June 27, 1879.	Sawyer, G. D., F.R.M.S., 55, Buckingham place, Brighton.
Feb. 27, 1880.	Schulze, Adolf, 1, St. James's street, Hillhead, Glasgow, N.B.
Feb. 26, 1875.	Scofield, W. J., M.R.C.S., F.L.S., 19, Grosvenor, Bath.
Aug. 24, 1883.	Searle, A. H., 31, Hilldrop crescent, Camden road, N.W.
Mar. 24, 1882.	Selby, H., 100, Netherwood road, W.
July 27, 1868.	Sewell, Richard, Ashmare house, Keston, Kent.
May 25, 1883.	Sharer, W. R., 60, Thornhill square, Barnsbury, N.
July 23, 1880.	Shaw, H. V., Fir Croft, Keymer, Hurstpierpoint, Sussex.
Oct. 22, 1869.	Shaw, W. F. Mosshall grove, Finchley, N.
May 26, 1876.	Shepheard, Thomas, F.R.M.S., Kingsley lodge, Chester.
May 26, 1871.	Sigsworth, J. C., F.R.M.S., 43, South Eaton place, S.W.
June 27, 1873.	Simmonds, J. E., Royal Exotic Nursery, King's road, Chelsea, S.W.
Aug. 23, 1867.	Simmons, J. J., L.D.S., 18, Burton crescent, Euston road, N.W.
Oct. 28, 1881.	Simons, W. V., Nilgiri house, Baldwin crescent, Camberwell, S.E.
May 26, 1876.	Simpson, Edward, 24, Grummant road, Peckham road, S.E.

Date of Election.	
Feb. 23, 1883.	Simpson, Isaac, 1, Junction road, Upper Holloway, N.
Mar. 27, 1868.	Simson, Thomas, St. Peter's alley, Cornhill, E.C.
Dec. 28, 1866.	Slade, J., Albion road, Bexley heath, Kent.
Oct. 23, 1868.	Smart, William, 27, Aldgate, E.
May 25, 1866.	Smith Alpheus (*Hon. Librarian*), 39, Choumert road, Rye lane, Peckham, S.E.
April 23, 1880.	Smith, A. S., Silvermere, Cobham, Surrey.
July 25, 1879.	Smith, C. V., 5, Parade, Caermarthen.
Mar. 25, 1870.	Smith, F. L., 3, Grecian cottages, Crown hill, Norwood, S.E.
June 27, 1873.	Smith, G. J., F.R.M.S., 73, Farringdon street, E.C.
Dec. 23, 1870.	Smith, J. A., Eastwell, Westgate road, Beckenham, Kent.
Oct. 26, 1877.	Smith, Samuel, Maldon house, 17, Sydenham park, S.E.
Mar. 24, 1882.	Smith, W. Dalton, 2, Craigs court, Charing Cross, S.W.
Aug. 23, 1872.	Smith, W. S., 30, Loraine road, Holloway, N.
April 24, 1868.	Snellgrove, W., 58, Cranfield road, Wickham park, S.E.
Sep. 22, 1865.	Southwell, C., 44, Princes street, Soho, W.
May 26, 1876.	Southwell, C. W., 35, Douglas road, Cannonbury, N.
May 22, 1874.	Spencer, James, F.R.M.S., 50, South street, Greenwich, S.E.
June 26, 1868.	Spencer, John, Brooks' Bank, 81, Lombard street, E.C.
Dec. 28, 1883.	Spetch, R. J., 1, Mitre Court, Wood 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.
Feb. 21, 1884.	Steele, F., M.R.C.S., 22, Bloomsbury street, W.C.
Aug. 24, 1866.	Steward, J. H., F.R.M.S., 406, Strand, W.C.
June 22, 1877.	Stewart Charles, M.R.C.S., F.L.S. (*Sec. R.M.S.*), &c. (*Vice-President*), 42, Sinclair road, Kensington, W.
May 23, 1879.	Stocken, James, 21, Endsleigh gardens, N.W.

Date of Election.	
June 24, 1881.	Stokes, A. W., F.C.S., Laboratory, Vestry hall, Paddington, W.
July 25, 1879.	Stone, E. M., Cumnor, Lawrie park, Sydenham, S.E.
May 23, 1879.	Stubbins, John, F.G.S., F.R.M.S., Inglebank, Far Headingley, Leeds.
Sept. 23, 1881.	Sturt, Gerald, 27, Gordon square, W.C.
July 7, 1865.	Suffolk, W. T., F.R.M.S., Stettin lodge, St. Faith's road, Lower Norwood, S.E.
June 27, 1873.	Suter, E. D., Parkfield, St. Andrew's park, Hastings.
June 24, 1870.	Swain, Ernest, 17, Tadmor street, Shepherd's Bush, W.
Nov. 22, 1867.	Swainston, J. T., 3, St. Mark's square, Regent's park, N.W.
Nov. 24, 1866.	Swansborough, E., 20, John street, Bedford row, W.C.
Dec. 17, 1875.	Swift, M. J., 81, Tottenham court road, W.C.
Jan. 23, 1880.	Symons, W. H., F.C.S., F.R.M.S., 2, Queen's terrace, St. John's wood, N.W.
July 27, 1877.	Tanqueray, A. C., Reid's Brewery, Theobald's road, E.C.
Nov. 28, 1879.	Tasker, J. G., 18, Junction road, Upper Holloway, N.
Aug. 22, 1879.	Tate, J. W., 6, Clarendon terrace, Brentford road, Turnham green, W.
May 22, 1868.	Tatem, J. G., Russell street, Reading.
Feb. 25, 1881.	Taylor, Thomas, M.R.C.S., L.A.C., Bocking, near Braintree, Essex.
Aug. 23, 1878.	Teasdale, Washington, F.R.M.S., Rosehurst, Headingley, Leeds.
Dec. 22, 1865.	Terry, John, 4, Coventry park, Streatham, S.W.
Aug. 23, 1872.	Terry, Thomas, 5, Austin friars, E.C.
May 23, 1879.	Thompson, I. C., F.R.M.S., Woodstock, Waverley road, Liverpool.
May 28, 1875.	Thomson, J. R., 15, Highbury place, Islington, N.
Feb. 24, 1871.	Thornthwaite, W. H., 416, Strand, W.C.
Oct. 27, 1882.	Thurston, Edgar, L.R.C.P., L.S.A., A.K.C., 53, Henry street, Regent's park, N.W.

Date of Election.	
May 23, 1884.	Tipple, A. C., Alexander road, Upper Holloway, N.
June 23, 1871.	Topping, Amos, 28, Charlotte street, Caledonian road, N.
June 23, 1882.	Trinder, Stephen, 90, Morton road, Islington, N.
June 27, 1884.	Tress, S. C., West lodge, Clapham park, S.W.
July 24, 1868.	Tulk, John A., M.D., F.R.M.S., Cowley house, Chertsey.
July 26, 1867.	Turnbull, J., Laurel house, North hill, Highgate, N.
Aug. 24, 1877.	Turner, E. B., 1, Clifton villas, Amberley road, Lea bridge road, N.E.
June 25, 1869.	Turner, R. D., Roughway, near Tonbridge.
June 25, 1875.	Turner, Sydney, A.R.I.B.A.
Feb. 25, 1881.	Tyler, Charles, F.L.S., F.G.S., F.R.M.S., 317, Holloway road, N.
May 25, 1877.	Veasey, R. G., Ashchurch lodge, Ashchurch road, Shepherd's bush, W.
Feb. 28, 1879.	Venables, W., 95, Elgin road, St. Peter's park, Harrow road, W.
Feb. 27, 1880.	Vereker, The Hon. J. G. P., 1, Portman square, W.
May 23, 1879.	Vezey, J. J., F.R.M.S., 12, Sandbourne road, Brockley rise, S.E.
Mar. 24, 1882.	Vicars, John, 7, Hartington road, Liverpool.
June 25, 1880.	Waddington, H. J., 39, Gower street, W.C.
Feb. 27, 1874.	Walker, J. C., Highfield avenue road, Crouch end, N.
July 25, 1873.	Walker, J. S., Warwick road, Upper Clapton, E.
May 22, 1868.	Waller, J. G., 68, Bolsover street, Portland road, W.
Nov. 22, 1867.	Ward, F. H., M.R.C.S., F.R.M.S., Springfield house, near Tooting, S.W.
Feb. 25, 1881.	Ward, J. D., Northwood lodge, Cowes, Isle of Wight.
June 28, 1878.	Ward, R. J., Silver street, Lincoln.
Oct. 27, 1865.	Watkins, C. A., Rosemont, Greenhill road, Hampstead, N.W.
Sept. 28, 1877.	Watson, T. P., F.R.M.S., 313, High Holborn, W.C.

Date of Election.	
May 23, 1879.	Watts, The Rev. G. E., M.A., F.R.M.S., Kensworth vicarage, Dunstable, Herts.
Dec. 28, 1866.	Way, T. E., Argyll road, Ealing, W.
Oct. 26, 1877.	Weatherley, Capt. H. C. S., 64, Cheapside, E.C.
July 24, 1874.	Webb, C. E., Wildwood lodge, North end, Hampstead, N.W.
April 25, 1879.	Webster, H. W., M.D., St. George's Infirmary, Fulham road, S.W.
May 24, 1867.	Weeks, A. W. G., 36, Gunter grove, West Brompton, S.W.
July 25, 1884.	Wellington, R. H., 38, Fellow's road, South Hampstead, N.W.
May 23, 1884.	West, C., 9, Park row, Blackheath park.
May 26, 1882.	Western, George E., 27, Strawberry hill road, Twickenham.
Feb. 25, 1876.	Wheeler, George, 9, Cloudesley square, Barnsbury, N.
May 23, 1879.	Wheldon, John, F.R.M.S., 58, Great Queen street, Lincoln's Inn Fields, W.C.
Sept. 23, 1881.	Whelpton, E. S., B.A., Cantab., Boyland Oak, Streatham hill, S.W.
May 22, 1868.	White, T. Charters, M.R.C.S., L.D.S., F.L.S., F.R.M.S. (*Past President*), 32, Belgrave road, S.W.
Aug. 22, 1879.	Whittell, H. T., M.D., F.R.M.S., Board of Health, Adelaide, South Australia.
June 25, 1880.	Wickes, W. D., 32, Burlington gardens, Acton, W.
Mar. 25, 1881.	Wildy, Arthur, 48, Albion road, South Hampstead, N.W.
April 23, 1880.	Williams, Arthur, 48, Osnaburg street, Regent's park, N.W.
July 28, 1882.	Williams, Benjamin, 3, Comberton road, Upper Clapton, E.
Mar. 24, 1871.	Williams, George, F.R.M.S., 135, Coningham road, Shepherd's bush, W.
Nov. 23, 1877.	Williams, G. S., 20, Oxford road, Kilburn, N.W.
June 27, 1879.	Willson, James, 2, Oval road, Regent's park, N.W.
Feb. 22, 1867.	Wilson, Frank, 110, Long acre, W.C.

Date of Election.	
April 23, 1880.	Winney, H. J., 1, Shorters court, Throgmorton street, E.C.
Aug. 27, 1869.	Woods, W. Fell, 1, Park hill, Forest hill, S.E.
Jan. 28, 1876.	Woollett, John, 58, Cloudesley road, Islington, N.
Oct. 25, 1867.	Worthington, Richard, Champion park, Denmark hill, S.E.
June 27, 1873.	Wrey, G. E. B., Addington house, Addington road, Reading.
Aug. 22, 1879.	Wright, B. M., 54, Guilford street, Russell square, W.C.
May 25, 1877.	Yates, Francis, Rockwood, Surbiton hill.
Jan. 25, 1878.	Yates, Robert, 64, Park street, Southwark, S.E.
June, 22, 1883.	Young, William Martin, 16, Maclise road, West Kensington park, W.

NOTICE.

Members are requested to give early information to one of the Hon. Secretaries of any change of residence, so as to prevent miscarriage of Journals and Circulars.

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 a President, four Vice-Presidents, an Honorary Treasurer, one or more Honorary Secretaries, an Honorary Secretary for Foreign Correspondence, an Honorary Reporter, an Honorary Librarian, an Honorary Curator, and twelve other Members,—six to form a quorum. That the Presidents, Vice-Presidents, Treasurer, Secretaries, Reporter, Librarian, Curator, 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, Secretaries, Reporter, Librarian, Curator, and vacancies on the Committee. That the President, Vice-Presidents, Treasurer, Secretaries, Reporter, Librarian, and Curator be nominated by the Committee. That the nominations for Members of Committee be made by the Members on resolutions duly moved and seconded, no Member being entitled to propose more than one Candidate. That a list of all nominations made as above be printed upon the ballot paper; the nominations for vacancies upon the Committee being arranged in such order as shall be determined by lot, as drawn by the President and Secretary. 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, Secretaries, Reporter, Librarian, and Curator.

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 Club 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, Reporter, Librarian, Curator, 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 Rules, 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 18

The Ballot will take place 18

MEETINGS.

OF THE

QUEKETT MICROSCOPICAL CLUB, 1884-5.

AT

UNIVERSITY COLLEGE, GOWER STREET,

ON THE

Second and Fourth Fridays of every Month.

1884.—Friday,	August	...	...	8 ... 22
	September	...	...	12 ... 26
	October	...	...	10 ... 24
	November	...	...	14 ... 28
	December	...	...	12 ... 26
1885.—Friday,	January	...	...	9 ... 23
	February	...	...	13 ... 27
	March	...	...	13 ... 27
	April	...	...	10 ... 24
	May	...	...	8 ... 22
	June	...	...	12 ... 26
	July	...	...	10 ... 24

The Ordinary Meetings are held on the *fourth* Friday in each month. Proceedings begin at Eight 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 24th, 1885, at Eight o'clock, for Election of Officers and other business.

EXCURSIONS, 1884.

April	5.	BROMLEY, for KESTON. To meet at Holborn Viaduct Station.
April	19.	ROYAL BOTANIC GARDENS. To meet at Entrance, on South side of the Gardens, *not later* than 3 p.m.
May	3.	CHINGFORD, for EPPING FOREST. To meet at Liverpool Street Station.
May	17.	WOODSIDE PARK, for TOTTERIDGE, returning by Mill Hill. To meet at Moorgate Street Station.
June	7.	WOKING. To meet at Waterloo, Main Line Station.
June	21.	EXCURSIONISTS' ANNUAL DINNER. Arrangements will be duly announced.
June	28.	HAMPTON COURT. To meet at Waterloo, Suburban Station.
July	5.	DAY EXCURSION, WHITSTABLE. To meet at Holborn Viaduct Station, 10 a.m., or next later Train. (*Notice should be given to the Secretary of the Excursions Sub-Committee, to obtain reduction of fares.*)
July	19.	CATERHAM, for Godstone. To meet at Cannon Street Station.
Aug.	23.	SHEPPERTON, for WALTON. To meet at Waterloo, Loop Line Station.
Sept.	6.	ESHER. To meet at Waterloo, Suburban Station.
Sept.	20.	HALE END. To meet at Liverpool Street Station.
Oct.	4.	RICHMOND. To meet at Waterloo, Loop Line Station.
Oct.	18.	HOMERTON, for HACKNEY MARSHES. To meet at Homerton Station.

The time for departure from Town, unless otherwise specified, will be the First Train after TWO o'clock.

John Badcock, C. G. Dunning,
W. G. Cocks, J. D. Hardy,
Edw. Dadswell, J. T. Powell,
} Excursions Sub-Committee.

Fred. A. Parsons, Hon. Sec. Excursions Sub-Committee,
90, Leadenhall Street, E.C.

OFFICERS AND COMMITTEE.

(Elected July, 1885.)

President.

A. D. Michael, F.L.S., F.R.M.S.

Vice-Presidents.

W. B. Carpenter, C.B., F.R.S., &c., &c.
M. C. Cooke, M.A., LL.D., A.L.S.
J. Matthews, M.D., F.R.M.S.
C. Stewart, M.R.C.S., F.L.S.

Committee.

E. Dadswell.
Rev. H. J. Fase.
H. R. Gregory.
H. J. Waddington.
T. C. White, M.R.C.S., L.D.S.
B. W. Priest.
J. G. Waller.
E. T. Newton, F.G.S.
J. W. Groves, F.R.M.S.
F. W. Hembry, F.R.M.S.
E. M. Nelson.
W. W. Reeves, F.R.M.S.

Hon. Treasurer.

F. W. Gay, F.R.M.S., 113, High Holborn, W.C.

Hon. Secretary.

G. C. Karop, M.R.C.S., 198, Holland Road, Kensington, W.

Hon. Sec. for Foreign Correspondence and Editor of Journal.

Henry F. Hailes, 15, Westfield Road, Hornsey, N.

Hon. Reporter.

R. T. Lewis, F.R.M.S.

Hon. Librarian.

Alpheus Smith,
39, Choumert Road, Rye Lane,
Peckham, S.E.

Hon. Curator.

Charles Emery,
9, New Road, Crouch End, N.

PAST PRESIDENTS.

		Elected.
EDWIN LANKESTER, M.D., F.R.S. - -	July,	1865.
ERNEST HART - - - - - - -	,,	1866.
ARTHUR E. DURHAM, F.R.C.S., 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., F.Z.S.	,,	1876.
,, ,, ,, ,, - -	,,	1877.
THOS. H. HUXLEY, LL.D., F.R.S., &c. - -	,,	1878.
T. SPENCER COBBOLD, M.D., F.R.S., F.L.S., &c.		1879.
T. CHARTERS WHITE, M.R.C.S., F.L.S., &c.	,,	1880.
,, ,, ,, ,, - -	,,	1881.
M. C. COOKE, M.A., LL.D., A.L.S. ,, - -	,,	1882.
,, ,, ,, ,, - -	,,	1883.
W. B. CARPENTER, C.B., F.R.S., &c., &c. -	,,	1884.

HONORARY MEMBERS.

Date of Election.	
Jan. 24, 1868.	Arthur Mead Edwards, M.D., 120, Belleville avenue, Newark, New Jersey, U.S.A.
Mar. 19, 1869.	The Rev. E. C. Bolles, 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 23, 1875.	Lionel S. Beale, M.B., F.R.S., F.R.M.S., &c. (*Past President*), 61, Grosvenor street, W.
Sept. 22, 1876.	Frederick Kitton, Hon. F.R.M.S., &c., 3, Bedford street, Unthanks road, Norwich.
July 25, 1879.	W. B. Carpenter, C.B., M.D., F.R.S., &c., &c., (*Past President*), 56, Regent's park road, N.W.
July 25, 1879.	Dr. E. Abbe, University, Jena, Saxe Weimar, Germany.
July 23, 1880.	F. H. Wenham, C.E., 3, Gothic Villas, Warbeck road, Shepherd's Bush, W.
Nov. 24, 1882.	Dr. Veit B. Wittrock, Professor at the Royal Academy of Sciences, and Director of the Museum of Natural History, Stockholm, Sweden.

LIST OF MEMBERS.

Date of Election.	
Sept. 24, 1869.	Ackland, William, L.S.A., F.R.M.S., 416, Strand, W.C.
Oct. 26, 1883.	Addiscott, C. J., Sydney Villa, St. Bildas road, Manor park, Stoke Newington, N.
Nov. 27, 1868.	Adkins, William, 431, Oxford street, W.
Mar. 23, 1866.	Allbon, William, F.R.M.S., 37, Gloucester place, Portman square, W.
Oct. 24, 1884.	Allen, W. A., 156, Choumert road, Rye lane, Peckham, S.E.
July 26, 1872.	Alstone, John, 3, Great Tower street, E.C.
Dec. 17, 1869.	Ames, G. A., F.R.M.S., Union Club, Trafalgar square, W.C.
Dec. 22, 1865.	Andrew, F. W., 3, Neville terrace, Onslow gardens, S.W.
May 28, 1875.	Arrowsmith, Wastell, 99, Adelaide road, Haverstock hill, N.W.
June 22, 1883.	Ash, George C., 141, Maida vale, W.
July 25, 1879.	Ashbridge, Arthur, 76, Leadenhall street, E.C.
Sept. 27, 1878.	Ashby, H. T., 8, Bartholomew road, Kentish town, N.W.
June 26, 1874.	Badcock, John, F.R.M.S., 270, Victoria park road, South Hackney, E.
Dec. 28, 1883.	Bailey, Rev, G., 1, South vale, Upper Norwood, S.E.
Dec. 27, 1867.	Bailey, J. W., 75, Broke road, Dalston, E.
April 24, 1868.	Baker, Charles, F.R.M.S., 244, High Holborn, W.C.
Feb. 25, 1876.	Ballard, Dr. W. R., jun., 26, Manchester square, W.

Date of Election.	
June 22, 1883.	Balleine, Arthur Edwin, 5, Heathcote street, Mecklenburg square, W.C.
Jan. 24, 1879.	Barham, G. T., Danehurst, Hampstead, N.W.
Dec. 27, 1872.	Barnard, Herbert, 33, Portland place, W.
April 22, 1870.	Barnes, C. B., 4, Egremont villas, White horse lane, South Norwood, S.E., and 27, Clement's lane, E.C.
July 27, 1883.	Barnes, Henry, Patschull house, Dartmouth Park avenue, N.
May 25, 1883.	Barratt, Thomas, Bell Moor House, Upper Heath, Hampstead, N.W.
Sept. 27, 1872.	Bartlett, Edward, L.D.S., M.R.C.S.E., 38, Connaught square, W.
Dec. 28, 1877.	Batchelor, J. A., Avenue road, Bexley, Kent.
June 27, 1883.	Bates, E., Assoc.I.C.E., 45, Fentiman's road, Clapham road, S.E.
Nov. 28, 1884.	Bates, F., 22, West street, Leicester.
Nov. 26, 1875.	Beaulah, John, Raventhorpe, Brigg.
July 25, 1884.	Beck, C., 31, Cornhill, E.C.
May 26, 1871.	Bedwell, F. A., M.A. Cantab, F.R.M.S., West parade, Hull, Yorkshire.
Mar. 28, 1884.	Beetham, A., 14, South square, Gray's Inn, W.C.
May 22, 1868.	Berney, John, F.R.M.S., 61, North end, Croydon.
Oct. 23, 1868.	Bevington, W. A., F.R.M.S., "Avondale," Coloraine road, Blackheath, S.E.
Mar. 28, 1879.	Bird, F. E., 33, St. Saviour's road, Brixton hill, S.W.
July 28, 1871.	Bishop, William, 549, Caledonian road, N.
Feb. 23, 1866.	Blake, T., 58, Brook green, Hammersmith, W.
July 27, 1877.	Blenkinsop, B. Shord hill, Kenley, Surrey.
May 26, 1876.	Blundell, J., 38, Mount street, W.
Dec. 27, 1881.	Bolton, J. G. E., M.R.C.S., Savanne, Mauritius.
Jan. 22, 1875.	Bolton, Thomas, F.R.M.S., 57, Newhall street, Birmingham.
Nov. 23, 1883.	Bostock, E., "The Radfords," Stone, Staffordshire.
Feb. 24, 1882.	Bound, H. J., 19, Torrington square, W.C.
Jan. 23, 1885.	Bousfield, E. C., L.R.C.P.Lond., M.R.C.S., 363, Old Kent road, S.E.

Date of Election.

Oct. 27, 1865. Braithwaite, Robert, M.D., M.R.C.S.E., F.L.S., F.R.M.S. (*Past President*), The Ferns, 303, Clapham road, S.W.

June 28, 1878. Brewster, W., 25, Myddelton square, E.C.

May 26, 1876. Brigstock, J. W., "Ferntower," Manor road, Stoke Newington, N.

Oct. 27, 1883. Brown, Fredk. Wm., 35, Walterton road, St. Peter's park, Harrow road, W.

Sept. 26, 1879. Brown, William, B.Sc., 3, Elm cottages, Middle lane, Crouch end, N.

May 22, 1868. Brown, W. J., 4, Heath villas, Maple road, Anerley, S.E.

May 26, 1871. Browne, George, 45, Victoria road, Kentish town, N.W.

May 28, 1875. Browne, J. W., Frascati, Masons hill, Bromley, Kent.

Feb. 27, 1872. Browne, Rev. T. H., F.R.M.S., F.G.S., M.E.S., High Wycombe, Bucks.

Jan. 23, 1880. Browne, W. R., 317, Essex road, Islington, N.

May 22, 1885. Buckland, H., Ivy Holt, Station road, Sidcup, Kent.

Dec. 22, 1882. Bucknall, Edward, 16, Junction road, Highgate, N.

Jan. 26, 1877. Buffham, T. H., 2, Connaught road, Walthamstow.

June 22, 1883. Burbidge, William Henry, Stanley House, Alleyn park, Dulwich, S.E.

June 27, 1884. Burrows, W. J., 16, Endymion road, Brixton hill, S.W.

Aug. 22, 1879. Burton, William, 27, Wigmore street, W.

June 14, 1865. Bywater, W.M., F.R.M.S., 5, Hanover square, W.

Nov. 22, 1878. Cafe, J. W., 46, Clifton hill, St. John's wood, N.W.

June 25, 1880. Cambridge, John, Bury St. Edmunds, Suffolk.

May 23, 1879. Carpenter, H. S., F.R.M.S., Beckington house, Weighton road, Anerley, S.E.

July 23, 1880. Carr, Ebenezer, 26, Bromar road, Denmark park, S.E.

Nov. 24, 1882. Carr, Thomas, M.R.C.S., Guy's Hospital, S.E.

Date of Election.	
May 26, 1882.	Chapman, W. Ingram, 5, Hollywood villas, Melrose road, Southfields, S.W.
Dec. 27, 1878.	Chatto, Andrew, 214, Piccadilly, W.
Nov. 27, 1874.	Chippindale, George, Grape villa, Rothschild road, Chiswick High road, W.
Dec. 27, 1881.	Claremont, Claude Clarke, M.R.C.S., Millbrooke house, Hampstead road, N.W.
Feb. 23, 1883.	Clark, Joseph, Street, Somerset.
May 22, 1885.	Clinch, J. W., Lake Brewery, Douglas, Isle of Man.
July 25, 1879.	Cobbold, T. S., M.D., F.R.S., F.L.S., (*Past President*), 74, Portsdown road, Maida vale, W.
May 22, 1868.	Cocks, W. G., 36, Gayhurst road, Dalston, E.
Nov. 25, 1881.	Coffin, Walter H., F.L.S., F.C.S., F.R.M.S., &c., 94, Cornwall gardens, South Kensington, S.W.
Sept. 22, 1876.	Cole, A. C., F.R.M.S., St. Domingo house, Oxford gardens, Notting hill, W.
Nov. 23, 1883.	Cole, M., St. Domingo house, Oxford gardens, Notting hill, W.
April 24, 1874.	Cole, William, M.E.S., *Hon. Secretary Essex Naturalists' Field Club*, Laurel cottage, King's place, Buckhurst hill, Essex.
Jan, 25, 1867.	Coles, Ferdinand, F.L.S., 53, Brooke road, Stoke Newington common, N.
Mar. 24, 1876.	Colsell, G. D., 1, Dermody road, East Down, Lewisham, S.E.
June 14, 1865.	Cooke, M.C., M.A., LL.D., A.L.S. (*Past President*), 146, Junction road, Upper Holloway, N.
Feb. 22, 1867.	Cooper, F. W., L.R.C.S. Edin., Leytonstone, E,
June 27, 1873.	Corbett, A. L., 103, Fentiman's road, Clapham road, S.W.
May 28, 1869.	Cottam, Arthur, F.R.A.S., H.M. Office of Woods, Whitehall place, S.W.
July 26, 1872.	Cowan, T. W., F.G.S., F.R.M.S., Comptons Lea, Horsham, Sussex.
Nov. 28, 1884.	Crisp, C., 81, Fifth avenue, Kensal green, W.
Aug. 28, 1868.	Crisp, Frank, LL.B., B.A., *V.P. and Treas. Linnean Society; Hon. Sec. Royal Microscopical Society*, 5, Lansdowne road, Notting hill, W.

Date of Election.	
Dec. 23, 1870.	Crisp, J. S., F.R.M.S., Ashville, Lewin road, Streatham, S.W.
July 26, 1878.	Crockford, Wm., 2, St. Peter's road, Mile end, E.
Feb. 23, 1877.	Crofton, Edward, M.A. Oxon., F.R.M.S., 45, West Cromwell road, South Kensington, S.W.
Sept. 28, 1866.	Crouch, Henry, F.R.M.S., 66, Barbican, E.C.
Sept. 26, 1884.	Crowhurst, H. A., 313, High Holborn, W.C.
June 22, 1877.	Cunliffe, P.G., F.R.M.S., The Elms, Handforth, Manchester.
June 25, 1880.	Curties, C. L., 244, High Holborn, W.C.
May 25, 1866.	Curties, Thomas, F.R.M.S., 244, High Holborn, W.C.
June 25, 1880.	Curties, W. I., 244, High Holborn, W.C.
Sept. 26, 1879.	Curtis, Charles, 29, Baker street, Portman sq., W.
Aug. 22, 1879.	Cuttell, F. G., 52, New Compton street, Soho, W.
April 22, 1881.	Cutting, W. M., 1, Curtain road, E.C.
Jan. 22, 1875.	Dadswell, Edward, 42, Barrington road, Stockwell, S.W.
Mar. 24, 1882.	Dale, Bernard, 14, Elm grove, Lee, Kent.
Nov. 23, 1877.	Dallas, W. S., F.L.S., &c., the Geological Society, Burlington house, Piccadilly, W.
Feb. 23, 1883.	Dallinger, Rev. W. H., F.R.S., F.R.M.S., (*President R.M.S.*), Wesley College, Sheffield.
May 23, 1879.	Dallmeyer, T. R., 19, Bloomsbury street, W.C.
Mar. 22, 1878.	Darby, the Ven. Archdeacon, St. Bridget's Rectory, Chester.
Mar. 22, 1878.	Darke, Edward, 16, Rochester terrace, Camden road, N.W.
Oct. 22, 1869.	Davis, Henry, 19, Warwick street, Leamington.
Aug. 23, 1883.	Davis, H., 108, Sandringham road, Dalston, E.
May 23, 1879.	Dawson, William, 24, Abbeygate street, Bury St. Edmunds, Suffolk.
May 28, 1875.	Dean, Arthur, (*Hon. Sec. East Lond. Mic. Soc.*), 57, Southborough road, South Hackney, E.
Feb. 23, 1877.	Death, James, jun., 38, Gladstone street, St. George's road, Southwark, S.E.
Feb. 28, 1879.	Debenham, E. H., 9, Mincing lane, E.C.

Date of Election.	
Jan. 24, 1879.	Deby, Julien, C.E., F.R.M.S., 17, Boulevard du Regent, Brussels (care of Mr. Thos. Westwood).
Nov. 24, 1876.	Despointes, Francis, 16, St. George's square, Regent's park road, N.W.
Nov. 24, 1865.	Dobson, H. H., F.R.M.S., Holmesdale, Grange park, Ealing, W.
Nov. 27, 1868.	Douglas, Rev. R. C., Manaton Rectory, Moreton-hampstead, Exeter.
Oct. 25, 1878.	Dowler, Captain F. E., 28, Albermarle street, W.
Jan. 23, 1880.	Dowsett, G. H., 11, Gloucester place, Greenwich, S.E.
May 25, 1883.	Drake, C. A., The Distillery, Three Mill lane, Bromley-by-Bow.
July 25, 1879.	Driver, Alfred, 30, Leigham court road west, Streatham, S.W.
Aug. 26, 1872.	Dudgeon, R.E., M.D., 53, Montagu square, W.
Oct. 25, 1872.	Dunning, C. G., 55, Camden park road, N.W.
Sept. 22, 1865.	Durham, A. E., F.R.C.S., F.L.S., F.R.M.S., &c., (*Past President*), 82, Brook street, Grosvenor square, W.
July 27, 1883.	Durrand, Alexander, 5, Philbrick terrace, Nunhead lane, Peckham Rye, S.E.
Sept. 25, 1868.	Eddy, J. R., F.R.M.S., F.G.S., The Grange, Carleton, Skipton, Yorkshire.
June 28, 1867.	Edmonds, R., Royal Arsenal, Woolwich, S.E.
July 25, 1884.	Ellis, J. H., The Lindens, Geraldine road, Wandsworth, S.W.
May 26, 1876.	Emery, Charles (*Hon. Curator*), 9, New road, Crouch end, N.
May 26, 1881.	Enock, Frederick, Ferndale, Bath road, Woking Station.
Feb. 28, 1879.	Epps, Hahnemann, 95, Upper Tulse hill, Brixton, S.W.
Feb. 21, 1884.	Epps, J., jun., "The Homestead," Ross road, South Norwood hill, S.E.
Dec. 27, 1878.	Erlebach, H. A., Mill hill school, Mill hill, N.W.
July 25, 1873.	Fase, Rev. H. J., 8, Dents road, Wandsworth common, S.W.

Date of Election.	
June 25, 1875.	Faulkner, Henry, jun., Fernwood, Roehampton park, S.W.
Jan. 28, 1876.	Faulkner, John, 20, Mornington crescent, N.W.
Aug. 25, 1882.	Field, W. H., 5, Palace road, Crouch end, N.
Feb. 27, 1880.	Fieldwick, Alfred, jun., 284, Dalston lane, Hackney, E.
July 22, 1881.	Firth, W. A., Whiterock, Belfast.
July 26, 1867.	Fitch, Frederick, F.R.G.S., F.R.M.S., Hadleigh house, Highbury New park, N.
Feb. 24, 1882.	Fitch, J. N., 17, Eversholt street, Camden Town, N.W.
Oct. 26, 1883.	Fleetwood, G., 388, Camden road, N.
Nov. 28, 1879.	Forster, William, jun., Cleveland road, Woodford, Essex.
Mar. 24, 1871.	Foulerton, John, M.D., 44, Pembridge villas, Bayswater, W.
Oct. 24, 1884.	Fowler, C., Ebenezer House, Thirlock road, Gospel Oak.
Feb. 27, 1885.	Fowler, Rev. W. W., M.A., F.L.S., The School House, Lincoln.
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, H. E., 60, Plimsoll road, Finsbury park, N.
May 22, 1868.	Fryer, G. H., 107, Belsize road, N.W.
July 23, 1880.	Funston, James, 93, Finsbury pavement, E.C.
June 23, 1882.	Garden, Alexander, M.D., Brigade Surgeon, Laharempore, India, care of R. S. Garden, 200, Piccadilly, W.
Mar. 25, 1870.	Garden, R. S., 42, Carlton hill, St. John's wood, N.W.
Feb. 26, 1875.	Gardner, Edmund, 454, Strand, W.C.
Jan. 23, 1885.	Garner, J. H., 75, Sparkenhoe street, Leicester.
April 23, 1880.	Gates, G. W. H., 21, Lombard street, E.C.
July 7, 1865.	Gay, F. W., F.R.M.S. (*Hon. Treasurer*), 113, High Holborn, W.C.
June 25, 1880.	George, C. F., M.R.C.S., Kirton-in-Lindsey, Lincolnshire.

Date of Election.	
July 26, 1867.	George, Edward, F.R.M.S., 12, Derby villas, Forest hill, S.E.
April 27, 1877.	Gilberston, Henry, Mangrove house, Hertford.
June 24, 1881.	Gilburt, Henry, 63, Rectory road, Stoke Newington, N.
Oct. 27, 1876.	Gilburt, W. H., F.R.M.S., 48, Wetherell road, South Hackney, E.
June 27, 1873.	Glasspoole, H. G., 15, Mall road, Hammersmith, W.
Nov. 28, 1879.	Goodinge, A. C., 119, High Holborn, W.C.
April 26, 1872.	Goodinge, J. W., F.R.G.S., F.R.M.S., 119, High Holborn, W.C.
Nov. 23, 1877.	Goodwin, William, 24, Miranda road, Upper Holloway, N.
July 27, 1883.	Goold, Ernest H., C.E., F.Z.S., M.R.I., 4, Dane's Inn, Strand, W.C.
Mar. 27, 1866.	Gray, S. O., Bank of England, E.C.
Feb. 24, 1882.	Greening, Linnæus, Birch house, Warrington.
Oct. 23, 1868.	Greenish, Thomas, F.R.M.S., 20, New street, Dorset square, N.W.
Oct. 23, 1868.	Gregory, H. R., 7, Quality court, Chancery lane.
April 27, 1883.	Gregory, William, 98, Brockley road, St. John's, S.E.
July 24, 1868.	Groves, J. W., F.R.M.S., 90, Holland road, Kensington, W., and Physiological Laboratory, King's College, W.C.
July 24, 1868.	Grubbe, E. W., C.E., 73, Redcliffe gardens, S.W.
Jan. 27, 1871.	Guimaraens, A. de Souza, F.R.M.S., 48, Heron road, Herne hill, S.E.
Sept. 28, 1877.	Hagger, John, Repton school, Burton-on-Trent.
Feb. 25, 1881.	Haigh, William, Tempsford villa, Uxbridge, road, Ealing, W.
June 14, 1865.	Hailes, H. F. (*Hon. Secretary for Foreign Correspondence and Editor*), 15, Westfield road, Hornsey, N.
Aug. 26, 1870.	Hailstone, R. H., 91, Adelaide road, N.W.
Feb. 23, 1867.	Hainworth, William, 15, Darenth road, Stamford hill, N.
July 28, 1876.	Halford, Edward, 18, Leinster square, Bayswater, W.

Date of Election.	
Dec. 28, 1866.	Hallett, R. J., 123, Seymour street, Euston square, N.W.
Feb. 22, 1869.	Hammond, A., F.L.S., 5, Swiss terrace, Elmers end road, Beckenham, S.E.
June 25, 1880.	Hancock, H. S. H., 50, Springdale road, Stoke Newington, N.
Jan. 24, 1879.	Harding, Burcham, 128, Adelaide road, N.W.
Feb. 24, 1882.	Harding, J. H., 4, Finsbury square, E.C.
July 23, 1880.	Hardingham, A. S., 59, St. George's square, S.W.
July 25, 1879.	Hardingham, G. G., F.R.M.S., 33, St. George's square, S.W.
Jan. 23, 1874.	Hardy, J. D., F.R.M.S., 73, Clarence road, Clapton, E., and 4, Lombard street, E.C.
Sept. 28, 1866.	Harkness, W., F.R.M.S., Laboratory, Somerset house, W.C.
April 23, 1875.	Harrison, James, 150, Akerman road, North Brixton, S.W.
May 23, 1884.	Havers, J. C., Wood Lea, Bedford hill, Balham, S.W.
Mar. 28, 1879.	Hawkins, C. E., H.M. Geological Survey, Jermyn street, S.W.
June 28, 1867.	Hawksley, T. P., 97, Adelaide road, N.W.
June 22, 1883.	Hazlewood, Jas. Edmund, F.R.M.S., 3, Lennox place, Brighton.
Aug. 23, 1872.	Hembry, F. W., F.R.M.S., (*Hon. Sec., S. Lond. Mic. and Nat. Hist. Soc.*), Home Lea, Hatherley road, Sidcup, Kent.
June 26, 1868.	Henry, A. H., 73, Redcliffe gardens, S.W.
April 25, 1884.	Higgins, J., London University, Burlington gardens, W.
June 22, 1877.	Hill, R. W., 41, Lothbury, E.C.
Sept. 24, 1869.	Hilton, T. D., M.D., Upper Deal, Kent.
Sept. 28, 1866.	Hind, F. H. P., 11, Copthall court, Throgmorton street, E.C.
May 22, 1874.	Hind, George, 244, High Holborn, W.C.
Aug. 26, 1870.	Hirst, John, F.R.M.S., Ladcastle, Dobcross, Manchester.
Mar. 27, 1885.	Hodges, W., M.R.C.S., L.R.C.P., Northfield, Kirkburton, Huddersfield, Yorks.

Date of Election.	
Feb. 26, 1875.	Holford, Christopher, Bounty Office, Dean's yard, Westminster, S.W.
Jan. 23, 1880.	Holland, C. F., 184, Brooke road, Upper Clapton, E.
July 25, 1884.	Holmes, W. M., 63, Lupus street, S.W.
April 26, 1867.	Hooton, Charles, Sunningdale house, Bickerton road, Upper Holloway, N.
Nov. 26, 1880.	Hopkins, Robert, Shearn villa, Walthamstow, Essex.
Oct. 26, 1866.	Horncastle, Henry, Cobham, near Woking station.
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, Frederick, F.R.M.S., Glenlea, Thurlow park road, Dulwich, S.E.
Oct. 27, 1876.	Howard, D., 60, Belsize park, N.W.
Oct. 25, 1878.	Howling, W. E., Crowley's Brewery, Alton, Hants.
Jan. 23, 1880.	Hunt, Frederick, York lodge, Stamford hill, N.
Dec. 22, 1876.	Hunter, J. J., 20, Cranbourne street, W.C.
July 25, 1873.	Hurst, J. T., 1, Raymond villas, Geraldine road, Wandsworth, S.W.
June 28, 1878.	Huxley, Prof. T. H., F.R.S., &c. (*Past President*), Science Schools, South Kensington, S.W.
May 24, 1867.	Ingpen, J. E., F.R.M.S., 7, The Hill, Putney. S.W.
Dec. 17, 1875.	Jackson, C. L., F.L.S., F.Z.S., F.R.M.S., Hill Fold, Sharples, Bolton.
July 24, 1868.	Jackson, F. R., Culver cottage, Slindon, Arundel, Sussex.
June 25, 1880.	Jacques, Walter, 2, Fenchurch buildings, E.C.
Aug. 25, 1882.	Jakeman, Christopher, 72, South street, Greenwich.
Feb. 27, 1885.	Jaques, E. R., 36, Old Gravel lane, St. George's, E.
June 14, 1865.	Jaques, Edward, B.A., H.M. Office of Woods, Whitehall place, S.W.
Feb. 28, 1873.	Jenkins, J. W., 3, Harcourt road, Wallington.

Date of Election.	
Feb. 21, 1884.	Jennings, A. V., 8, Broadhurst gardens, South Hampstead, N.W.
July 24, 1868.	Jennings, Rev. Nathaniel, M.A., F.R.A.S., 8, Broadhurst gardens, South Hampstead, N.W.
Feb. 24, 1871.	Johnson, M. Hawkins, F.R.M.S., F.G.S., 379, Euston road, N.W.
Mar. 24, 1871.	Johnstone, James, Stanhope lodge, Bideford.
Feb. 28, 1873.	Jones, G. J., Duke street, Settle, Yorks.
June 25, 1875.	Jones, J. B., F.R.M.S., St. George's Chambers, 10, St. George's crescent, Liverpool.
Nov. 25, 1870.	Jones, Lieut.-Col. Lewis, Westgate-on-Sea, Isle of Thanet.
June 23, 1876.	Jones, T. E., 46, Park street, Stoke Newington, N.
Jan. 27, 1882.	Jones, Rev. T. R., M.A., Codicote Vicarage, Welwyn, Herts.
May 23, 1873.	Karop, G. C., M.R.C.S., &c. (*Hon. Secretary*), 198, Holland road, Kensington, W.
Feb. 21, 1884.	Kell, F. W., 20, Croftdown road, Highgate Rise, N.
July 25, 1884.	Kern, J. J., Fern Glen, Selhurst park, South Norwood, S.E.
Aug. 23, 1867.	Kiddle, Edward, 1, Cleveland Villas, Rosemount road, Richmond hill, S.W.
Mar. 19, 1869.	Kilsby, T. W., 4, Brompton villas, Edmonton.
April 22, 1881.	King, H. W., The Cedars, Upper Park road, New Southgate, N.
Dec. 23, 1870.	King, Robert, F.R.M.S., Fern House, Upper Clapton, E.
May 24, 1878.	King, W. T., M.D., M.R.C.S., 74, Victoria park road, South Hackney, E.
Nov. 26, 1880.	Kingsett, C. T., F.C.S., F.I.C.
Feb. 28, 1873.	Kitsell, F. J., 24, St. Stephen's avenue, Goldhawk road, Shepherd's Bush, W.
Mar. 23, 1877.	Kluht, H. J., 44, Norfolk terrace, Bayswater, W.
Oct. 24, 1873.	Knight, J. M., 50, Bow road, E.
Jan. 24, 1879.	Lancaster, A. H., 7, Campden hill gardens, Kensington, W.
May 23, 1884.	Lancaster, E. Le Gonier, 16, Wharton road, West Kensington park, W.

Date of Election.	
Mar. 22, 1867.	Lancaster, Thomas, Bownham house, Stroud, Gloucestershire.
May 28, 1875.	Larkin, John, 24, Charterhouse square, E.C.
Nov. 26, 1880.	Larkin, R. J., 98, Clarence road, Lower Clapton, E.
June 25, 1869.	Layton, C. E., 12, Upper Hornsey rise, N.
April 25, 1884.	Lawrence, T. W. P., 47, Upper Bedford place, W.C.
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. (*Past President*), Renton House, 343, Brixton road, S.W.
Feb. 25, 1881.	Leicester, Alfred, Lynwood, Harbord street, Waterloo, near Liverpool.
Oct. 25, 1867.	Leifchild, J. R., M.A., 6, St. Lawrence road, Notting hill, W.
Sept. 22, 1865.	Leighton, W. H., 2, Merton place, Chiswick, W.
April 27, 1866.	Lewis, R. T., F.R.M.S. (*Hon. Reporter*), 1, Masbro' road, Brook green, W.
June 26, 1868.	Lindley, W. H., jun., 29, Blittersdorffs platz, Frankfort-on-Maine.
Oct. 24, 1884.	Litchfield, F., 25, Addison gardens, W.
May 26, 1871.	Locke, John, 16, Georgiana street, Camden town, N.W.
April 23, 1869.	Long, Henry, 90, High street, Croydon.
Nov. 24, 1866.	Lovibond, J. W., F.R.M.S., St. Anne street, Salisbury.
Sept. 22, 1866.	Lovick, T., 53, Queen's crescent, Haverstock hill, N.W.
April 27, 1866.	Loy, W. T., F.R.M.S., Five Oaks, Billingshurst, Sussex.
Feb. 21, 1884.	McCrie, G., 94, North Frederick street, Glasgow.
Nov. 23, 1866.	McIntire, S. J., F.R.M.S., 14, Hetley road, Uxbridge road, Shepherd's Bush, W.
Jan. 23, 1880.	Mackenzie, James, Warden villa, Uxbridge road, Ealing, W.

Date of Election.	
April 27, 1883.	McManis, Thos. John, 95, Almack road, Clapton E.
Jan. 24, 1884.	Macrae, A. C., M.D., 119, Westbourne terrace, Hyde Park, W.
June 28, 1878.	Magor, J. B., L.D.S., 24, Chapel street, Penzance.
July 26, 1874.	Magor, Thomas, M.D., Eagle Cottage, Hornsey, N.
May 25, 1883.	Mainland, G. E., Glenthorp, Woodside lane, North Finchley, N.
May 25, 1883.	Mais, H. T., Coathorpe, M.I.C.E., Engineer in Chief, Adelaide, South Australia (care of T. Curties, 244, High Holborn, W.C.)
Sept. 27, 1872.	Manning, H. E., the Cardinal Archbishop, Archbishop's house, Westminster, S.W.
July 27, 1883.	Mansfield, Edward Joseph, 176, Evering road, Upper Clapton, E.
Jan. 23, 1880.	Martin, Francis, R.N., Shrub cottage, Fairfield road, Old Charlton, Kent.
April 26, 1867.	Matthews, G. K., St. John's lodge, Beckenham Kent.
Oct. 26, 1866.	Matthews, John, M.D., F.R.M.S., (*V.P. & Past President*), 30, Colebrook row, Islington, N.
May 26, 1871.	May, J. W., F.R.M.S., Arundel House, Percy cross, Fulham, S.W.
Feb. 25, 1876.	May, W. R., 52, Malvern road, Dalston, E.
Mar. 22, 1867.	Meacher, J. W., 10, Hillmarten road, Camden road, N.
Feb. 28, 1879.	Menzies, James, 13, Leighton grove, N.W.
May 22, 1874.	Messenger, G. A., Lloyds, E.C.
July 27, 1877.	Michael, A. D., F.L.S., F.R.M.S. (*President*), Cadogan Mansions, Sloane square, Chelsea, S.W.
May 28, 1880.	Miles, Andrew, 19, Commercial road, Camberwell, S.E.
July 7, 1865.	Millett, F. W., F.R.M.S., Marazion, Cornwall.
Oct. 22, 1880.	Milner, W. E., 47, Park road, Haverstock hill, N.W.
Sept. 22, 1882.	Moore, George, 7, Draper's gardens, Throgmorton street, E.C.
Jan. 23, 1874.	Moreland, Richard, jun., M.I.C.E., F.R.M.S., 4, The Quadrant, Highbury, N.

Date of Election.	
July 26, 1878.	Morland, Henry, Cranford, near Hounslow.
Oct. 27, 1866.	Morrieson, Colonel R., F.R.M.S., Oriental Club, Hanover square, W.
Jan. 24, 1879.	Murray, James, Osborne house, 50, Percy road, Shepherd's bush, W.
Feb. 22, 1878.	Needham, S. H., F.R.G.S., F.G.S., 33, Somerfield road, Finsbury Park, N.
Mar. 24, 1876.	Nelson, E. M., Cleve house, West End lane, West Hampstead, N.W.
Mar. 24, 1871.	Nelson James, 328, Kennington road, S.E.
Nov. 25, 1881.	Nevins, R. T. G., 80, Tufnell park road, N.
Jan. 26, 1872.	Newton, E. T., F.G.S., Geological Museum, Jermyn street, S.W.
Feb. 27, 1880.	Niven, George, Bank of Australia, 1, Bishopsgate street within, E.C.
May 22, 1874.	Nixon, P. C., Oporto, Portugal.
Aug. 26, 1881.	Northey, M. D., 4, Lower Brighton terrace, Surbiton.
Jan. 24, 1879.	Offord, J. M., 6, Boundary road, St. John's Wood, N.W.
Dec. 22, 1876.	Ogilvy, C. P., F.L.S., Sizewell house, Leiston, near Saxmundham, Suffolk.
May 24, 1878.	O'Hara, Lt.-Col. Richard, F.R.M.S., (late Royal Artillery), West Lodge, Galway.
Dec. 28, 1883.	Oliver, J., 123, Stamford street, S.E.
June 23, 1882.	Ollard, John Alex., F.R.M.S., Barnesfield, Stone, Greenhithe, Kent.
July 28, 1882.	Ondaajte, Dr. W. C., F.R.M.S., Galle, Ceylon.
Dec. 27, 1867.	Oxley, Frederick, F.R.M.S., 8, Crosby square, Bishopsgate street, E.C.
July 25, 1879.	Palmer, G. H., 95, Cornwall Gardens, S.W.
July 24, 1885.	Parker, J. A. D., Sunny hill, Camden park, Chislehurst.
Mar. 27, 1885.	Parritt, H. W., 97, Camden street, N.W.
Oct. 27, 1871.	Parsons, F. A., 90, Leadenhall street, E.C.
Dec. 28, 1877.	Partridge, Thos., M.D., Stroud, Gloucestershire.
April 23, 1875.	Peal, C. N., F.R.M.S., Fernhurst, Mattock lane, Ealing, W.

Date of Election.	
Feb. 23, 1883.	Pearce, Fredk. Ernest, 14, Bloomsbury street, W.C.
May 24, 1867.	Pearson John, 3. Westbourne Grove, W.
July 22, 1881.	Perigal, Henry, F.R.A.S., F.R.M.S., 9, North crescent, Bedford square, W.C.
Oct. 24, 1884.	Petty, T., Deddington, Oxon.
Oct. 27, 1865.	Pickard, J. F., 195, Great Portland street, W.
May 23, 1879.	Pilcher, W. J., F.R.C.S., &c., Boston, Lincolnshire.
June 24, 1881.	Pilley, J. J., 8, Ellesmere road, north, Bow, E., and the Old College, Dulwich.
Jan. 22, 1869.	Pillischer, Moritz, F.R.M.S., 88, New Bond street, W.
Sept. 27, 1878.	Plomer, G. D., F.R.M.S., 48, Springfield road, St. John's Wood, N.W.
Nov. 23, 1883.	Plowman, T., junr., St. Mellim, Bush Hill park, Enfield.
Sept. 28, 1877.	Pocklington, Henry, F.R.M.S., 20, Park road, Leeds.
May 22, 1885.	Pocock, P. W., Remington villa, Egham, Surrey.
July 24, 1885.	Porter, J. L. M., 8, Wood vale, Forest hill, S.E.
Nov. 23, 1866.	Potter George, F.R.M.S., 42, Grove road, Holloway, N.
Jan. 25, 1878.	Potts, R. A., 26, South Audley street, W.
June 24, 1881.	Potts, William, Hillside avenue, Beckenham, Kent.
June 22, 1866.	Powe, I., 76, St. George's street, Richmond, Surrey.
Aug. 25, 1882.	Powell, George, 86, Avondale square, S.E.
April 25, 1879.	Powell, H. P., Mill Platt, Isleworth.
May 26, 1876.	Powell, J. T., 32, Dunlace road, Lower Clapton, E.
July 7, 1865.	Powell, Thomas, F.R.M.S., 18, Doughty street, Mecklenburg square, W.C.
June 27, 1873.	Priest, B. W., 22, Parliament street, S.W.
May 23, 1879.	Pritchard, J. D., Crymlyn Burrows, near Swansea.
July 26, 1867.	Pritchett, Francis, Clifford House, South Norwood Park, S.E.
Feb. 25, 1881.	Probyn, Clifford, 55, Grosvenor street, W.
April 23, 1868.	Quekett, A. J. S., 51, Warwick road, Maida hill, W.
April 23, 1868.	Quekett, A. E., 51, Warwick road, Maida hill, W.

Date of Election.	
April 23, 1868.	Quekett, Rev. Wm., The Rectory, Warrington.
Feb. 23, 1866.	Quick, G. E., 74, Long lane, Bermondsey, S.E.
Oct. 26, 1866.	Rabbits, W. T., Irongates, Dacres road, Forest hill, S.E.
June 25, 1875.	Radford, W. S., M.D., F.R.M.S., Sidmouth.
Oct. 26, 1866.	Ramsden, Hildebrand, M.A. Cant., F.L.S., F.R.M.S., 26, Upper Bedford place, Russell square, W.C.
Aug. 28, 1868.	Rance, T. G., Elmside, Bickley, Kent.
June 24, 1881.	Ransom, F., Fairfield, Hitchin.
Dec. 27, 1878.	Reed, J. M., Sidmouth house, South park, Ilford, E.
June 22, 1877.	Reed, J. W., F.R.G.S., F.R.M.S., 17, Colebrooke row, Islington, N.
June 27, 1873.	Reeve, Frederick, 113, Clapham road, S.W.
July 7, 1865.	Reeves, W. W., F.R.M.S., 32, Geneva road, Brixton, S.W.
Oct. 28, 1881.	Reynolds, W. P., 74, King William street, E.C.
May 22, 1885.	Rhein, W., 22, Milman street, Bedford Row, W.C.
May 23, 1879.	Rideout, William, F.R.M.S., (*Hon. Sec. Bolton Microscopical Club*), Seymour road, Astley road, Bolton.
May 22, 1868.	Rogers, John, F.R.M.S., 4, Tennyson street, Nottingham.
Oct. 26, 1866.	Rogers, Thomas, F.L.S., F.R.M.S., Selmeston house, Thurlow park road, West Dulwich.
May 22, 1868.	Roper, Freeman, C.S., F.L.S., F.G.S., F.R.M.S., Palgrave house, Eastbourne, Sussex.
June 23, 1876.	Roper, H. J., F.R.M.S., 7, Carlton grove, Peckham, S.E.
Oct. 27, 1876.	Roper, Robert, 29, Hampton road, Upton, Essex.
Jan. 24, 1884.	Rosseter, T. B., F.R.M.S., Fleur de Lis Hotel, Canterbury.
Jan. 26, 1883.	Rousselet, Charles, 42, Welbeck street, W.
July 24, 1868.	Rowe, James, jun., M.R.C.V.S., 65, High street, Marylebone, W.
Oct. 27, 1865.	Russell, James, 10, High street, Shoreditch, E.
May 22, 1868.	Russell, T. D., Coningsby villas, Rosendale road, West Dulwich, S.E.

Date of Election.	
Feb. 22, 1867.	Rutter, H. L., 24, Crownhurst road, Angel road, Brixton, S.W.
Nov. 22, 1878.	Sabel, E. E., 6, Grove road, Clapham park, S.W.
July 24, 1885.	Sadgrove, A. G., Tower Chambers, Moorgate street, E.C.
May 23, 1873.	Salkeld, Lt.-Col. J. C., F.R.M.S., 29, St. James's street, S.W.
Dec. 17, 1869.	Salmon, John, 24, Seymour street, Euston square, N.W.
Dec. 28, 1877.	Sands, Charles, 5, Woburn place, Russell square, W.C.
Nov. 28, 1884.	Sanford, P. G., Laboratory, London Hospital, E.
June 27, 1879.	Sawyer, G. D., F.R.M.S., 55, Buckingham place, Brighton.
Feb. 27, 1880.	Schulze, Adolf, 1, St. James's street, Hillhead, Glasgow, N.B.
Feb. 26, 1875.	Scofield, W. J., M.R.C.S., F.L.S., 19, Grosvenor, Bath.
Mar. 24, 1882.	Selby, H., 100, Netherwood road, W.
July 27, 1868.	Sewell, Richard, Ashmare house, Keston, Kent.
May 25, 1883.	Sharer, W. R., 60, Thornhill square, Barnsbury, N.
July 23, 1880.	Shaw, H. V., Fir Croft, Keymer, Hurstpierpoint, Sussex.
Oct. 22, 1869.	Shaw, W. F., Mosshall grove, Finchley, N.
May 26, 1876.	Shepheard, Thomas, F.R.M.S., Kingsley lodge, Chester.
May 26, 1871.	Sigsworth, J. C., F.R.M.S., 43, South Eaton place, S.W.
June 27, 1873.	Simmonds, J. E., Royal Exotic Nursery, King's road, Chelsea, S.W.
Aug. 23, 1867.	Simmons, J. J., L.D.S., 18, Burton crescent, Euston road, N.W.
Oct. 28, 1881.	Simons, W. V., Nilgiri house, Baldwin crescent, Camberwell, S.E.
May 26, 1876.	Simpson, Edward, 24, Grummant road, Peckham road, S.E.
Feb. 23, 1883.	Simpson, Isaac, 1, Junction road, Upper Holloway, N.

Date of Election.	
Nov. 23, 1877.	Simpson, T., Fernymere, Castlebar, Ealing, W.
Mar. 27, 1868.	Simson, Thomas, St. Peter's alley, Cornhill, E.C.
Dec. 28, 1866.	Slade, J., Albion road, Bexley heath, Kent.
Oct. 23, 1868.	Smart, William, 27, Aldgate, E.
May 25, 1866.	Smith, Alpheus (*Hon. Librarian*), 39, Choumert road, Rye lane, Peckham, S.E.
April 23, 1880.	Smith, A. S., Silvermere, Cobham, Surrey.
Mar. 25, 1870.	Smith, F. L., 3, Grecian cottages, Crown hill, Norwood, S.E.
June 27, 1873.	Smith, G. J., F.R.M.S., 73, Farringdon street, E.C.
Oct. 26, 1877.	Smith, Samuel, Maldon House, 17, Sydenham park, S.E.
Mar. 24, 1882.	Smith, W. Dalton, 2, Craigs court, Charing Cross, S.W.
Aug. 23, 1872.	Smith, W. S., 30, Loraine road, Holloway, N.
Aug. 22, 1884.	Smithson, T. S., Facit, Rochdale.
Nov. 28, 1884.	Snell, F. A., The Chestnuts, Chislehurst.
April 24, 1868.	Snellgrove, W., 58, Cranfield road, Wickham park, S.E.
Sept. 22, 1865.	Southwell, C., 44, Princes street, Soho, W.
May 26, 1876.	Southwell, C. W., 35, Douglas road, Canonbury, N.
May 22, 1874.	Spencer, James, F.R.M.S., 121, Lewisham road, Lewisham.
June 26, 1868.	Spencer, John, Brooks' Bank, 81, Lombard, street, E.C.
Dec. 28, 1883.	Spetch, R. J., 1, Mitre Court, Wood street, E.C.
Mar. 27, 1885.	Squire, P. W., F.L.S., F.C.S., 40, Avenue road, Regent's Park, N.W.
Feb. 21, 1884.	Steele, F., M.R.C.S., 22, Bloomsbury street, W.C.
Feb. 27, 1885.	Stephenson, J. W., F.R A.S., F.R.M.S., 186, Clapham road, S.W.
Aug. 24, 1866.	Steward, J. H., F.R.M.S., 406, Strand, W.C.
June 22, 1877.	Stewart, Charles, M.R.C.S., F.L.S., *(Sec. R.M.S.)*, &c. *(Vice-President,)*, 42, Sinclair road, Kensington, W.
May 23, 1879.	Stocken, James, 21, Endsleigh gardens, N.W.

Date of Election.	
June 24, 1881.	Stokes, A. W., F.C.S., Laboratory, Vestry hall, Paddington, W.
July 25, 1879.	Stone, E. M., Cumnor, Lawrie park, Sydenham, S.E.
May 23, 1879.	Stubbins, John, F.G.S., F.R.M.S., Inglebank, Far Headingley, Leeds.
Sept. 23, 1881.	Sturt, Gerald, 27, Gordon square, W.C.
July 7, 1865.	Suffolk, W. T., F.R.M.S., Stettin lodge, St. Faith's road, Lower Norwood, S.E.
June 27, 1873.	Suter, E. D., Parkfield, Alexandra park, Hastings.
June 24, 1870.	Swain, Ernest, 17, Tadmor street, Shepherd's Bush, W.
Nov. 22, 1867.	Swainston, J. T., 3, St. Mark's square, Regent's park, N.W.
Nov. 24, 1866.	Swansborough, E., 20, John street, Bedford row, W.C.
Dec. 17, 1875.	Swift, M. J., 81, Tottenham court road, W.C.
Jan. 23, 1880.	Symons, W. H., F.C.S., F.R.M.S., 130, Fellowes road, South Hampstead, N.W.
July 27, 1877.	Tanqueray, A. C., Reid's Brewery, Theobald's road, E.C.
Nov. 28, 1879.	Tasker, J. G., 18, Junction road, Upper Holloway, N.
May 22, 1868.	Tatem, J. G., Russell street, Reading.
Feb. 25, 1881.	Taylor, Thomas, M.R.C.S., L.A.C., Bocking, near Braintree, Essex.
Aug. 23, 1878.	Teasdale, Washington, F.R.M.S., Rosehurst, Headingley, Leeds.
Dec. 22, 1865.	Terry, John, 4, Coventry park, Streatham, S.W.
Aug. 23, 1872.	Terry, Thomas, 5, Austin friars, E.C.
Mar. 27, 1885.	Thomas, J. T. N., "Rossie," Crosbie road south, Waterloo, Liverpool.
May 23, 1879.	Thompson, I. C., F.R.M.S., Woodstock, Waverley road, Liverpool.
May 28, 1875.	Thomson, J. R., 15, Highbury place, Islington, N.
Feb. 24, 1871.	Thornthwaite, W. H., Willow Bridge road, Canonbury, N.

Date of Election.	
Oct. 27, 1882.	Thurston, Edgar, L.R.C.P., L.S.A., A.K.C., King's College, Stroud.
May 23, 1884.	Tipple, A. C., 35, Alexander road, Upper Holloway, N.
June 23, 1871.	Topping, Amos, 28, Charlotte street, Caledonian road, N.
June 23, 1882.	Trinder, Stephen, 90, Morton road, Islington, N.
June 27, 1884.	Tress, S. C., West lodge, Clapham park, S.W.
July 24, 1868.	Tulk, John A., M.D., F.R.M.S., Cowley house, Chertsey.
July 26, 1867.	Turnbull, J., Laurel house, North hill, Highgate, N.
Aug. 24, 1877.	Turner, E. B., Francis road, Leyton, Essex.
June 25, 1875.	Turner, Sydney, A.R.I.B.A.
Feb. 25, 1881.	Tyler, Charles, F.L.S., F.G.S., F.R.M.S., 317, Holloway road, N.
Feb. 27, 1885.	Upton, C., 25, Mayola road, Clapton, E.
May 25, 1877.	Veasey, R. G., Ashchurch lodge, Ashchurch road, Shepherd's bush, W.
Feb. 28, 1879.	Venables, W., 95, Elgin road, St. Peter's park, Harrow road, W.
Feb. 27, 1880.	Vereker, The Hon. J. G. P., 1, Portman square, W.
May 23, 1879.	Vezey, J. J., F.R.M.S., 12, Sandbourne road, Brockley rise, S.E.
Mar. 24, 1882.	Vicars, John, 7, Hartington road, Liverpool.
June 25, 1880.	Waddington, H. J., 39, Gower street, W.C.
Mar. 27, 1885.	Wainwright, C. J., Elmhurst, East Finchley, N.
Feb. 27, 1874.	Walker, J. C., Highfield avenue road, Crouch end, N.
July 25, 1873.	Walker, J. S., Warwick road, Upper Clapton, E.
Feb. 27, 1885.	Wall, P. W., M.I.C.E., F.G.S., 9, Duke street, Portland place, W.
May 22, 1868.	Waller, J. G., 68, Bolsover street, Portland road, W.
Feb. 27, 1885.	Ward, A. H., 3, Mansfield street, Portland place, W.

Date of Election.	
Nov. 22, 1867.	Ward, F. H., M.R.C.S., F.R.M.S., Springfield house, near Tooting, S.W.
Feb. 25, 1881.	Ward, J. D., Northwood lodge, Cowes, Isle of Wight.
June 28, 1878.	Ward, R. J., Silver street, Lincoln.
Oct. 27, 1865.	Watkins, C. A., Rosemont, Greenhill road, Hampstead, N.W.
Sept. 28, 1877.	Watson, T. P., F.R.M.S., 313, High Holborn, W.C.
Sept. 26, 1884.	Watson, W., 313, High Holborn, W.C.
May 23, 1879.	Watts, The Rev. G. E., M.A., F.R.M.S., Kensworth vicarage, Dunstable, Herts.
Dec. 28, 1866.	Way, T. E., Argyll road, Ealing, W.
Oct. 26, 1877.	Weatherley, Capt. H. C. S., 64, Cheapside, E.C.
July 24, 1874.	Webb, C. E., Wildwood lodge, North end, Hampstead, N.W.
April 25, 1879.	Webster, H. W., M.D., St. George's Infirmary, Fulham road, S.W.
May 24, 1867.	Weeks, A. W. G., 36, Gunter grove, West Brompton, S.W.
July 25, 1884.	Wellington, R. H., 38, Fellow's road, South Hampstead, N.W.
May 23, 1884.	West, C., 7, Park row, Blackheath, S.E.
May 26, 1882.	Western, George E., 27, Strawberry hill road, Twickenham.
Feb. 25, 1876.	Wheeler, George, 9, Cloudesley square, Barnsbury, N.
May 23, 1879.	Wheldon, John, F.R.M.S., 58, Great Queen street, Lincoln's Inn Fields, W.C.
Sept. 23, 1881.	Whelpton, E. S., B.A. Cantab., Boyland Oak, Streatham hill, S.W.
May 22, 1868.	White, T. Charters, M.R.C.S., L.D.S., F.L.S., F.R.M.S. (*Past President*), 32, Belgrave road, S.W.
Aug. 22, 1879.	Whittell, H. T., M.D., F.R.M.S., Board of Health, Adelaide, South Australia.
June 25, 1880.	Wickes, W. D., 32, Burlington gardens, Acton, W.
Mar. 25, 1881.	Wildy, Arthur, 48, Albion road, South Hampstead, N.W.

Date of Election.	
April 23, 1880.	Williams, Arthur, 48, Osnaburg street, Regent's park, N.W.
July 28, 1882.	Williams, Benjamin, 3, Comberton road, Upper Clapton, E.
Mar. 24, 1871.	Williams, George, F.R.M.S., 135, Coningham road, Shepherd's bush, W.
Nov. 23, 1877.	Williams, G. S., 20, Oxford road, Kilburn, N.W.
May 22, 1885.	Williams, T., 31, High street, Kensington, W.
June 27, 1879.	Willson, James, 2, Oval road, Regent's park, N.W.
Feb. 22, 1867.	Wilson Frank, 110, Long acre, W.C.
Oct. 24, 1884.	Wilson, W., 8, Mildmay Park, N.
April 23, 1880.	Winney, H. J., 1, Shorter's court, Throgmorton street, E.C.
Aug. 27, 1869.	Woods, W. Fell, 1, Park hill, Forest hill, S.E.
Feb. 27, 1885.	Woodward, B. H., F.R.M.S., 80, Petherton road, Highbury New Park, N.
Jan. 28, 1876.	Woollett, John, 58, Cloudesley road, Islington, N.
Oct. 25, 1867.	Worthington, Richard, Champion park, Denmark hill, S.E.
June 27, 1873.	Wrey, G. E. B., Addington house, Addington road, Reading.
Aug. 22, 1879.	Wright, B. M., 54, Guilford street, Russell square, W.C.
May 25, 1877.	Yates, Francis, Rockwood, Surbiton hill.
Jan. 25, 1878.	Yates, Robert, 64, Park street, Southwark, S.E.
June 22, 1883.	Young, William Martin, 16, Maclise road, West Kensington park, W.

NOTICE.

Members are requested to give early information to one of the Hon. Secretaries of any change of residence, so as to prevent miscarriage of Journals and Circulars.

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 a President, four Vice-Presidents, an Honorary Treasurer, one or more Honorary Secretaries, an Honorary Secretary for Foreign Correspondence, an Honorary Reporter, an Honorary Librarian, an Honorary Curator, and twelve other Members,—six to form a quorum. That the Presidents, Vice-Presidents, Treasurer, Secretaries, Reporter, Librarian, Curator, 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, Secretaries, Reporter, Librarian, Curator, and vacancies on the Committee. That the President, Vice-Presidents, Treasurer, Secretaries, Reporter, Librarian, and Curator be nominated by the Committee. That the nominations for Members of Committee be made by the Members on resolutions duly moved and seconded, no Member being entitled to propose more than one Candidate. That a list of all nominations made as above be printed upon the ballot paper; the nominations for vacancies upon the Committee being arranged in such order as shall be determined by lot, as drawn by the President and Secretary. 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, Secretaries, Reporter, Librarian, and Curator.

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 Club 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, Reporter, Librarian, Curator, 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 Rules, 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 18
The Ballot will take place 18

MEETINGS

OF THE

QUEKETT MICROSCOPICAL CLUB, 1885-6.

AT

UNIVERSITY COLLEGE, GOWER STREET,

ON THE

Second and Fourth Fridays of every Month.

1885.—Friday,	August	...	...	14 ...	28
	September	...	...	11 ...	25
	October	...	...	9 ...	23
	November	...	...	13 ...	27
	December	...	...	11 ...	*
1886.—Friday,	January	...	...	8 ...	22
	February	...	...	12 ...	26
	March	...	...	12 ...	26
	April	...	...	9 ...	23
	May	...	...	14 ...	28
	June	...	...	11 ...	25
	July	...	...	9 ...	23

* Christmas day—no meeting.

The Ordinary Meetings are held on the *fourth* Friday in each month. Proceedings begin at Eight 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 23rd, 1886, at Eight o'clock, for Election of Officers and other business.

EXCURSIONS, 1885.

April	18.	ROYAL BOTANIC GARDENS. To meet at the entrance at 3 p.m.
April	25.	WOODSIDE PARK, for TOTTERIDGE, returning by Mill Hill. To meet at Broad Street Station.
May	9.	BROMLEY, for KESTON. To meet at Holborn Viaduct Station.
May	23.	DAY EXCURSION, WHITSTABLE. To meet at Holborn Viaduct Station, 10 a.m., or next later Train. (*Notice should be given to the Secretary of the Excursions Sub-Committee to obtain reduction of Fares.*)
June	13.	STAINES. To meet at Waterloo, Loop Line Station.
June	27.	EXCURSIONISTS' ANNUAL DINNER. Arrangements will be duly announced.
July	11.	WATFORD, for RICKMANSWORTH. To join the Hertfordshire Natural History Society. To meet at Broad Street Station.
July	25.	SHEPPERTON, for WALTON. To join the Richmond Athenæum Field Club. To meet at Waterloo, Loop Line Station.
Aug.	29.	CATERHAM, for GODSTONE. To join the Croydon Club. To meet at Cannon Street Station.
Sept.	12.	RICHMOND. To meet at Waterloo, Loop Line Station.
Sept.	26.	HALE END. To meet at Liverpool Street Station.
Oct.	10.	MITCHAM JUNCTION, for MITCHAM COMMON. To join the Croydon Club. To meet at London Bridge Station. South London Line.

The time for departure from Town, unless otherwise specified, will be THE FIRST TRAIN AFTER TWO o'CLOCK.

W. G. Cocks, F. W. Hembry,
Edw. Dadswell, J. T. Powell,
C. J. Dunning, Chas. Rousselet,
J. D. Hardy,
} Excursions Sub-Committee.

Fredk. A. Parsons, Hon. Sec. Excursions Sub-Committee,
25, Great Percy Street, W.C.