John. W. Burton

2 vols

THE BRITISH DIATOMACEÆ.

Frontispiece. Part 1.

Tuffen West, chromo lith. ad nat.

$\frac{1}{1000}$ ths, Inch.

Ford & West, Imp. 54, Hatton Garden.

A SYNOPSIS

OF THE

BRITISH DIATOMACEÆ;

WITH REMARKS

ON THEIR

STRUCTURE, FUNCTIONS AND DISTRIBUTION;

AND INSTRUCTIONS FOR

COLLECTING AND PRESERVING SPECIMENS.

BY

THE REV. WILLIAM SMITH, F.L.S.

THE PLATES

BY

TUFFEN WEST,

MEMBER OF THE MICROSCOPICAL SOCIETY OF LONDON.

"Naturam maximè admiraberis, si omnia ejus opera *perlustraris.*"—GALEN.

IN TWO VOLUMES.

VOL. I.

LONDON:

PRINTED FOR SMITH AND BECK, 6 COLEMAN STREET, CITY;

PUBLISHED BY JOHN VAN VOORST, PATERNOSTER ROW.

1853.

PRINTED BY TAYLOR AND FRANCIS,
RED LION COURT, FLEET STREET.

TO

G. H. K. THWAITES, ESQ.,

OF

PERADENIA, CEYLON,

BY WHOSE ENCOURAGEMENT I WAS INCITED TO ENTER UPON

THE FOLLOWING INVESTIGATIONS,

AND BY WHOSE AID I WAS ENABLED TO OVERCOME

THE EARLIER DIFFICULTIES OF THE STUDY,

I INSCRIBE THESE PAGES,

DESIRING THUS TO EXPRESS MY THANKS,

AND

TESTIFY MY ESTEEM,

WILLIAM SMITH.

Lewes, March 1853.

PREFACE.

THE siliceous epiderms of the Diatomaceæ have, of late years, furnished the microscopist with a series of objects, not merely attractive to the general observer, from the elegance of their forms, but interesting to the more scientific student from the minute complexity of their structure, whose detection and delineation call into requisition the exercise of the most patient observation and the skilful management of the highest powers of his instrument. Much attention has in consequence been drawn to these minute organisms, and the want of some English manual, containing a classified arrangement and description of species, has been extensively felt. The present work has been undertaken to supply this want, and owes its appearance to the enterprise and liberality of the eminent opticians whose names appear on the title-page. While securing me from loss, these gentlemen have placed me under no inconvenient restrictions, and have left me at liberty to render the work, as far as possible, a record of the facts at present known with regard to the Diatomaceæ. So little, however, has been published upon the subject by English naturalists, and my views of structure and classification differ so widely from those of continental writers, with whose works I am acquainted, that I have found it necessary to make the following pages little else than a record of individual observation. To state at length the views of foreign authors, merely to show in what respects I differ from their conclusions, or to detail their systems only to illustrate my own departures from their methods of arrangement, appeared to me less likely to serve the cause of a branch of knowledge yet in comparative infancy, than to place before the inquirer a series of observations for which I could personally vouch, and thus to accumulate facts, at present so scantily supplied, upon which the future student might rest a more complete structure of theory and classification.

How far the present work contains materials new to the English reader will be understood when I state, that of the 224 species included in the first sub-tribe, not more than twenty have hitherto been recorded by our native observers; and of the others, a very large proportion are either for the first time described, or can only be doubtfully referred to the outline figures given by Ehrenberg and Kützing, and rendered accessible to the English reader in the pages of Pritchard's History of Animalcules.

But the task I had assigned to myself would have been much less productive of results had I not been aided by the frank and cordial co-operation of fellow-inquirers, who, by the liberal communication of specimens from other localities, have enabled me to enrich my record with some of its most beautiful and interesting forms. It is my pleasing duty to acknowledge the obligations I thus owe to Mrs. Griffiths of Torquay, Dr. Dickie of Belfast, Dr. Greville of Edinburgh, Professor Williamson of Manchester, Mr. Edward Jenner of Lewes, and M. De Brébisson of Falaise, whose entire herbaria in some cases, or in others ample selections therefrom, as far as relates to the Diatomaceæ, have been placed at my command. I have, however, to regret that these collections, with one exception, contain but few species in the genera embraced in my first volume, and that in this exception, which refers to the species from Falaise, the specimens reached me at so late a period that I have been unable to use them in the nomenclature of my plates, and could only employ them in correcting and enlarging the synonyms given in the text.

For other specimens, and many of them in a living state, I am indebted to gentlemen, whose favours I have recorded under the species they have respectively contributed. Among these fellow-labourers I must not omit a special acknowledgment to my zealous and indefatigable correspondent Chr. Johnson, Esq. of Lancaster, who, by frequent communication of specimens collected by himself and Mr. George Smith of Wray, and by the liberal aid of books and translations, has contributed important assistance.

Nor do I wish to leave unnoted the labours of my predecessors, more especially those of Mr. Ralfs and Mr. Thwaites, to whom is due nearly all that has been known of our British species of Diatomaceæ. How much is owing to the accurate and laborious researches of Mr. Ralfs, will be better seen in my second volume, which will embrace the greater number of the genera to which he has directed his attention.

I have, lastly, to acknowledge the efficient assistance received from my able coadjutor Mr. Tuffen West, whose accurate representations, in every case faithfully drawn from nature, have so materially enhanced the value of my work to the scientific student, and conferred upon it much of whatever value it may possess, in the estimation of the general observer.

As I have not admitted anything into my pages which I have not verified by actual observation, I have abstained from recording localities unless specimens have been seen and examined by myself. In the uncertainty which attended the nomenclature of species, and the imperfect means of identification open to the English observer, this course was imperative.

I have departed from the rule in one case only, *Arachnoidiscus*

Ehrenbergii, Supp. Plate XXXI. fig. 256, and on that occasion an admirable photograph of the object left me no room for hesitation as to the species intended. To avoid confusion and uncertainty in the synonyms, I have also abstained from recording written descriptions, and the references in every case, not otherwise stated, are to the numbers of the plate and figure in the work quoted; and, to preserve uniformity, I have invariably used letters for the plate, and numerals for the figure.

It will be seen that I have omitted all mention of the genus *Dictyocha,* whose forms, familiar to the English collector, have hitherto been classed with the objects described in the present work. This organism has, however, little in common with the true Diatomaceæ, and the position and structure of its siliceous skeleton altogether exclude it from the class.

I have been obliged to defer, until the completion of the plates, all explanation respecting the important function of Reproduction in the Diatomaceæ, and a detailed examination of the controversy respecting the animal or vegetable nature of these organisms; neither of these subjects could have been fully discussed without a reference to many of the figures to be given in my second volume, and I have thought it better to postpone these topics, however immediately interesting, than to enter upon explanations that must necessarily have been imperfect or unintelligible.

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INTRODUCTION.

Section I.

Habitats and General Appearance of the Diatomaceæ.

The Diatomaceæ are readily distinguished from the Desmidieæ, the Palmellaceæ, and other unicellular Algæ, by the possession of an epidermal covering of silex, which renders their forms indestructible by the ordinary agents of decomposition. They are all exceedingly minute, and require the human eye to be aided by the various appliances of the optician's art, that their beautiful forms may become objects of admiration and study. They inhabit the sea or fresh water, but the species peculiar to the one are never found in a living state in the other locality, though there are some which prefer a medium of a mixed nature, and are only to be met with in water more or less brackish. The latter are often found in great abundance and variety in districts occasionally subject to marine influences, such as marshes in the neighbourhood of the sea, or the deltas of rivers, where, on the occurrence of high tides, the freshness of the water is affected by percolation from the adjoining stream, or more directly by the occasional overflow of its banks. Other favourite habitats of the Diatomaceæ are stones of mountain streams or waterfalls, and the shallow pools left by the retiring tide at the mouths of our larger rivers. They are not however confined to the localities I have mentioned,—they are in fact almost ubiquitous, and there is hardly a roadside ditch, water-trough or cistern which will not reward a search, and furnish specimens of the tribe.

The indestructible nature of their epiderm has also served to perpetuate the presence of these forms in numerous localities, from which their living representatives have long since disappeared. Districts recovered from the sea, in the present or other periods of the earth's history, frequently contain myriads of such exuviæ forming strata of considerable thickness. Such deposits have been found in Bohemia, in the neighbourhood of Berlin, in various districts in Italy, and in several of the American States. The city of Richmond in Virginia is said to be built upon a stratum of Diatomaceous remains 18 feet in thickness, and extensive tracts in the Arctic Regions have been found covered with similar relics of a former vegetation.

Nor are we without examples, though on a less extensive scale, in our own country. The ancient site of a mountain lake in the neighbourhood of Dolgelly, localities of a somewhat similar kind near Lough Island-Reavey, in Down, and Lough Mourne, in Antrim, have furnished large supplies of some of the forms described in the present work. Several deposits of a like kind have been met with in Scotland, and have also contributed to enrich the present volumes. The extreme minuteness of the organisms which have furnished such remains, and the hardness of their material, have rendered the substance formed by their aggregation, a useful agent in the mechanical arts, in which it has been employed to confer a polish upon hard surfaces. It is from this circumstance that the material known as Tripoli derives its value as a polisher of metals; and the Dolgelly deposit has to some extent been employed for a similar purpose.

One of the most singular instances of the preservation of Diatomaceous forms occurs in regard to Guano, so largely imported as a manure from Peru and Africa. This material is found to contain a large number of the siliceous coverings of these minute organisms, which have been swallowed by the marine birds frequenting the spots from which the Guano is procured, have survived the process of digestion to which they were at first submitted, and the ages during which they have been imbedded in decomposed or decomposing matter, and now serve by the beauty of their forms to delight the microscopist, and by the property which their presence imparts to the Guano, to contribute to the fertility of our pastures and the growth of our cereals. It is well known that the latter plants contain a large amount of silica in the structures of their stem and leaves; it is therefore probable that the value of this manure may in some degree depend upon the presence of these minute organic remains, which may thus confer upon the Guano a quality rendering it eminently conducive to the healthy growth of such crops.

When occurring in strata of a fossil or subfossil character, as the deposits of Dolgelly, Richmond, and Lough Mourne, the epiderms of the Diatomaceæ appear as a white or cream-coloured powder; but their living masses present themselves as coloured fringes attached to larger plants—or forming a covering to stones or rocks in cushion-like tufts—or spread over their surface as delicate velvet—or depositing themselves as a filmy stratum on the mud—or intermixed with the scum of living or decayed vegetation floating on the surface of the water. Their colour is usually a yellowish brown of a greater or less intensity, varying from a light chestnut in individual specimens, to a shade almost approaching black in the aggregated masses. Their presence may often be detected without the aid of a microscope, by the absence, in many species, of the fibrous tenacity which distinguishes other plants: when removed from their natural position, they become distributed through the water, and are held in suspension by it, only subsiding after some little time has elapsed.

The frustules of the Diatomaceæ, as the individual organisms have not inaptly been denominated, are either free, adherent, or variously aggregated: in *Nitzschia*, *Navicula* and others, we have the frustules absolutely free; in *Epithemia*, *Cocconeis*, &c., they are usually adherent. One mode of aggregation is that of a ribbon-like filament of indefinite length, as in *Fragillaria*, &c.; another, that of a zigzag chain, in which the frustules cohere only by their angles, as in *Grammatophora*, *Diatoma* and others. In some species the Diatom is provided with a gelatinous pedicel or stipes by which it is united with other frustules, and maintains a connection with a foreign body; we have this form in *Synedra* and *Gomphonema*, &c. In others, again, it is enclosed, with multitudes of its confrères, in a gelatinous or membranaceous thallus, as in *Schizonema*, *Encyonema* and their allies, and the aggregation of the frustules in such cases sometimes rivals in form and size the branching filaments of the larger Algæ.

Upon submitting living Diatomaceæ to a microscopic examination, their forms are found to be exceedingly diversified, though the mineral nature of their epiderm confers upon them a general character which reminds the observer of inorganic rather than of vegetable or animal productions. Thus prismatic and quadrilateral forms are among the most general; linear, crescent, or boat-shaped outlines are not unfrequent; while indidivuals gracefully curved in a sigmoid manner, and others resembling miniature shields or circular discs, occasionally present themselves.

Section II.

Structure of the Siliceous Epiderm of the Diatomaceous Frustule.

To ascertain the true form and structure of the Diatomaceous frustule requires a careful microscopic examination, not only of living, but of desiccated or prepared specimens. Indeed it is only after an examination of the latter, that the true character of the living frustule can be understood. I shall therefore commence my description of the structure of these organisms by a reference to frustules which have been deprived of their softer parts, either by submitting them to the action of fire, or to the corrosive influence of an acid.

The epiderm of the Diatom consists of two siliceous plates or valves, usually of the most perfect symmetry. When first produced, these valves are closely applied to each other, and the line of junction forms a suture along which the valves readily separate during the process of self-division which speedily follows the perfect formation of the cell. It seems to be a law with these organisms, that no portion of the internal cell-membrane can be exposed to the free action of the surrounding water, without secreting a siliceous epiderm; the moment the valves become separated in the process of self-division, we consequently find that the secretion of a third plate of silex commences. This plate forms a band between the valves, and will for convenience sake be afterwards spoken of as the Connecting Membrane. As self-division is continually going on while the frustules are in a healthy or growing state, it is rare to find a specimen in which the valves are not in some degree separated, and consequently in which there is not more or less of a connecting membrane.

But that no such membrane exists on the first production of the frustule is obvious, upon the examination of a specimen in which self-division is just completed, as in Pl. VIII. fig. 59 *d*; Pl. XVIII. fig. 167 *d*; and Pl. XXVII. fig. 235 *d*, compared with Pl. VIII. fig. 59 *b*; Pl. XVIII. fig. 169 *b*; and Pl. XXVII. fig. 235 *b*, in which the process has made some advance. The process of self-division will be described hereafter; the present remarks are intended to show that the Epiderm of the Diatom, strictly speaking, consists of only two parts, the connecting membrane being an addition consequent upon the development which attends the growth of the frustule.

Along the line of suture in disciform or circular frustules, but more generally at the extremities of the valves only, when the Diatom is of an oblong, linear, or elongated form, there exist perforations in the silex, which permit the surrounding water to have access to the surface of the internal cell-membrane. The formation of silex seems occasionally to be arrested in the neighbourhood of these spots, and the connecting membrane is in consequence either wholly or partially interrupted at such places. Thus, after the internal cell-membrane is removed by acid, when it often happens that the valves fall away from the connecting membrane, the latter separates into two parts, and the frustule has in consequence been described as consisting of four plates.

The interruptions in the siliceous epiderm, to which reference has just been made, are usually apparent as slight depressions at the extremities of the frustule; and the appearances they present have been denominated "puncta" by Mr. Ralfs. In some species these interruptions are more numerous, being found along the entire line of suture, and are often connected with minute canals, hollowed out between the siliceous epiderm and internal cell-membrane, and apparently formed by waved flexures of the epidermal envelope. These are noticed under the genus *Epithemia*, p. 11. They are very conspicuous in *Epithemia longicornis*, Supp. Plate XXX. fig. 247, and form distinctive characters in the genera *Surirella* and *Campylodiscus*. I have employed the term "Foramina," in reference to these perforations in the siliceous epiderm, and the epithet "Canaliculi," to designate the grooves into which they occasionally open.

The connecting membrane, being of later formation, is usually less firmly siliceous than the epidermal valves, and rarely presents much complexity of structure. Not so with the valves themselves; we have here the greatest variety of form and diversity of structural arrangement.

These variations in form and structure will be best understood by an inspection of the figures, and will be noticed more particularly under each genus. I shall confine my remarks at present to a few general characters.

In all, we find the valves presenting a surface of a greater or less degree of convexity. This follows as a necessary consequence, from their enclosing, when applied to each other, the space occupied by the internal cell. This convexity is often that of a regularly curved surface, forming a segment of a circle of a greater or less radius. The segment is occasionally that of a perfect hemisphere, and the valves, when applied to each other, form a miniature globe; but more frequently the curvature is slight, and extends over a part of the valve only, which then appears as a portion of a hollow tube, closed at one end, and which may be either cylindrical or compressed, triangular or quadrilateral.

The intimate structure of the valve presents an amazing variety, in every genus, and almost in every species, offering distinct features, which serve as the best and most facile means of distinction and identification. Striæ or lines frequently moniliform, dots arranged in a radiate or concentric manner, and minute divisions presenting perfectly hexagonal outlines, are among the most frequent appearances. Great diversity of opinion has prevailed respecting the nature of these markings, and various functions have been assigned to them, as they have been regarded as apertures, protuberances, or depressions. I am, however, disposed to regard them all as modifications in the arrangement of the silex of the valve, arising from the mode of development peculiar in each case to the membrane with which the silex is combined. It is a well-established fact, that all increase in vegetable and animal tissues takes place by the production and addition of cells; and the law seems to prevail even in the formation of the envelopes of the minute organisms with which we are now concerned. Certainly no one can look at the structure exhibited by the siliceous valves of *Triceratium Favus*, Pl. V. fig. 44, and those of *Isthmia enervis* or *I. nervosa*, to be given in the second volume of the present work, without feeling assured that he has before him the representation of a cellular membrane, precisely homologous with the epidermal tissues of many vegetable organs. An object-glass of sufficient power and definition shows the same structure in the valves of many species of *Pleurosigma*; and the generalization is at once forced upon the observer, that the valvular markings in every case arise from modifications of cellular tissue,—a conclusion which a further and closer examination does much to confirm. In no case have I been able to satisfy myself of the existence of perforations in the general surface of the valves; and the existence of depressions or elevations (except in a few cases, when such appearances arise from the wavy outline of the surface,) seems to me to be equally problematical; but no difficulty presents itself to the supposition, that the moniliform striæ of *Epithemia*, *Navicula*, and others, the circular markings of *Coscinodiscus eccentricus*, Plate III. fig. 38, and the irregular star-like structure of *Eupodiscus Argus*, Plate IV. fig. 39, are all modifications of cellular tissue; and even in the costæ of *Pinnularia* and the unresolvable striæ of *Eupodiscus sculptus*, Plate IV. fig. 42, and others, it is not difficult to conceive that we have confluent cells whose union gives rise to the appearance of lines or bands.

With the appearances thus arising from the cellular structure of the tissue with which the silex is combined, we must not confound those which are caused by the presence of Canaliculi, to which reference has already been made; nor must we overlook others, which, although connected with the structure of the valve, arise from the absence of cells. Thus in many genera the valve is notably distinguished by the presence of a longitudinal band of silex, free from markings, and widened into small expansions at the centre and extremities, or at the extremities only. This band is simply a portion of the tissue in which the silex is deposited in a solid mass, and is probably designed to give firmness to the valve. At the expansions of this band the silex is still further accumulated, and forms Nodules, which also strengthen the epidermal envelope.

That these expansions are not perforations in the valve, as alleged by Ehrenberg, and acquiesced in by Kützing, might be shown in various ways. The internal contents of the frustule never escape at such points when the frustule is subjected to pressure, but invariably at the suture or the extremities, where the Foramina, already described, exist. Nor does the valve, when fractured, show any disposition to break at the expansions of the central line, as would necessarily be the case were such points perforations, and not nodules. Moreover, the central band of silex is itself frequently traversed by a narrow line, which arises from the confluence of a series of cells, which thus form a minute tube; but this tube invariably ends in a rounded extremity at the central and terminal nodules, and does not pass into an opening or aperture in the valve. A reference to Plate XIX. fig. 166. will illustrate these remarks. The bending down of this tube, and the thickening downwards of the silex at the nodules, give the semblance of depression to the surface of the valve at such places. But I am disposed to think that this is merely an optical appearance; and am at all events assured that no perforation exists at such points, and that the terms applied to these nodules by different authors, implying that they are openings or ostiola, are altogether inadmissible.

SECTION III.

INTERNAL STRUCTURE AND CELL-CONTENTS OF THE DIATOMACEOUS FRUSTULE.

I now proceed to describe the living frustule, some of the appearances presented by which can only be understood by a previous acquaintance with the structural character derived from an examination of the siliceous envelope.

A careful study of these organisms in a fresh state is necessary to enable the observer to arrive at a correct idea of their true character. The species are liable to material alterations when removed for any length of time from their natural localities; the lapse of a few days, and sometimes of a few hours, being sufficient to modify or altogether change the colour and arrangement of the cell-contents, and to suspend the peculiar movements which in many species accompany their living condition. They must, therefore, be examined under favourable circumstances, or our conclusions may be of the most erroneous kind; and a neglect of these precautions has undoubtedly led in some cases to grave errors respecting the structure, and even the nature, of the Diatomaceous frustule. As I look upon these organisms as unicellular plants, I consequently regard the siliceous valves as investing a closed membranous sac or cell. Nor is this a matter of conjecture and analogy only. In some cases I have seen unmistakeable indications of the existence of this membrane, which I have noticed to contract around the cell-contents upon the death of the cell; and in one species, *Stauroneis pulchella*, Plate XIX. fig. 194, in which the membrane in question appears to possess an unusual degree of firmness, the siliceous valves, after a slight maceration in acid, may be seen to fall away from the internal membrane, and to leave the latter unaltered in form. Moreover, the experiments and authority of Professor Bailey place the existence of an internal membrane beyond all doubt. This acute observer states that, "If hydrofluoric acid is applied to recent Diatomaceæ, the shell soon dissolves, leaving distinct internal, flexible cell-membranes, retaining the general form of the shells." (From Silliman's Journal for May 1851, quoted in Ann. Nat. Hist. 2nd Ser. vol. viii. p. 157.)

The usual colour of the living frustule I have stated to be a yellow, with a brown or greenish shade of a greater or less intensity; this colour is found to arise from the contents of the cell, which consist of a mucilaginous fluid, in which float numerous minute granules, generally accumulated in thin layers towards the internal cell-walls. When the frustule is so turned that this layer of endochrome is presented edgeways to the eye, the granules appear to be chiefly aggregated into two plates, applied to the opposite sides of the frustule; and when self-division is in progress, and the cell-contents are divided into two portions, such a separation or temporary aggregation of the endochrome must necessarily ensue; but in the simplest condition of the frustule the contents are diffused over the entire surface of the cell-walls, precisely as may be seen in the cells of many of the larger Algæ, or of some water plants of a higher order, as in the leaves of *Hydrocharis Morsus-ranæ* and others.

The endochrome of the Diatomaceous frustule is not, however, spread with uninterrupted regularity over the entire wall of the cell; at a spot exactly in the centre of the frustule it is usually absent, being aggregated in a narrow line or ring around a circular space occupied by a transparent vesicle, the nucleus or cytoblast of the cell, which frequently encloses an evident nucleolus. Nor are we to regard the endochrome as being always confined to the surface of the cell-wall. It is often diffused throughout the entire cavity, in lines radiating from the nucleus. Such a disposition frequently occurs in *Pleurosigma* and others, and is invariably found in *Navicula elliptica*. (See Frontispiece, fig. CLII.)

In most species several smaller globules, in addition to the central vesicle, are found occupying certain fixed positions within the cell; these are probably special secretions from the cell-contents, of an oily nature; and I am disposed to attribute to them the origin of the peculiar odour exhaled from the frustules in the process of burning. The number of these globules is frequently four, often placed near the extremities, or, more rarely, clustered around the central vesicle. Professor Kützing has examined these globules with the greatest care, and has convinced himself of their oily nature. He regards them as representing the amylaceous secretions of the Desmidieæ and Confervæ, and the starch-granules of the cotyledons of the higher vegetables. (Bacillarien, p. 23.)

A distinct movement of the granular particles of the endochrome, closely resembling the circulation of the cell-contents in *Closterium Lunula*, noticed by Mr. Ralfs (British Desmidieæ, Preface, p. xxi.), and which I have frequently detected in the same species, has occasionally fallen under my notice in some of the larger species of Diatomaceæ.

In *Surirella biseriata*, Plate VIII. fig. 57, this motion has been more especially apparent; but I have also observed it take place in *Nitzschia scalaris*, Plate XIV. fig. 115, and *Campylodiscus spiralis*, Plate VII. fig. 54.

This circulation has not, however, the regularity of movement so conspicuous in the Desmidieæ, and is of too ambiguous a character to furnish data for any very certain conclusions, save one, viz. that the Diatom must be a single cell, and cannot contain a number of separate organs, such as have been alleged to occupy its interior; since the endochrome moves freely from one portion of the frustule to another, approaching and receding from the central nucleus unimpeded by any intervening obstacle.

Of the chemical composition of the endochrome, I am at present unable to offer a satisfactory analysis. Professor Frankland, of Manchester, who kindly consented to direct his attention to the chemical constituents of these organisms, but whose engagements have hitherto prevented him from completing the necessary investigations, informs me that a large amount of iron exists in the state of a silicate or protoxide in the siliceous epiderm; and he attributes to its presence the brown colour which is assumed upon exposing the Diatoms to the influence of a moderate heat, the protoxide of iron, by the gradual absorption of oxygen, being converted into brown peroxide of iron, which assumes a redder tinge upon being more strongly heated.

Of the behaviour of the endochrome under the influence of certain reagents, I may merely remark at present, that dilute tincture of iodine causes the internal membrane to contract upon the cell-contents, and converts these, from the golden yellow which they exhibit in some species, into a bright green; and that a weak solution of sulphuric acid, while it effects the same contraction in the cell-wall, gives to the contents, which have been previously treated with iodine, a dark brown hue.

Alcohol, on the other hand, as in the case of vegetable cells in general, dissolves the utricle and its contained endochrome, or, at all events, entirely removes their colour, and leaves their siliceous epiderm in a state of perfect transparency. It does not, however, dissolve the envelope in which the frustules of the frondose forms are imbedded, nor the filamentous stipes or gelatinous cushions to which other species are attached.

Section IV.

Movements of the Diatomaceæ.

One of the most striking circumstances connected with the living frustule, is the singular motion which most of the free species exhibit.

This motion is of a peculiar kind, being generally a series of jerks, producing a rectilinear movement in one direction, and a return, upon nearly the same path, after a few moments' pause, by another series of isochronal impulsions.

The movement is evidently of a mechanical nature, produced by the operation of a force not depending upon the volition of the living organisms. An obstacle in the path is not avoided, but pushed aside; or, if it be sufficient to avert the onward course of the frustule, the latter is detained for a time equal to that which it would have occupied in its forward progression, and then retires from the impediment, as if it had accomplished its full course.

There is certainly no character of animality in the movement; and the observer familiar with the phænomena of life in the earlier stages of vegetable existence, is constrained to seek a counterpart in the involuntary motions of the filaments of the *Oscillatorieæ*, or of the gemmiparous spores of the *Fuci* and *Confervæ*.

The movements of the Diatomaceæ appear rapid and vivacious under the microscope; but it must be remembered that the high powers usually employed in the observation of these minute organisms magnify their motions as well as their bulk. I have noted the movements of several species with the aid of an eye-piece micrometer and a seconds watch, and found that one of the most rapid, viz. *Bacillaria paradoxa*, moved over $\frac{1}{200}$th of an inch in a second; *Pinnularia radiosa*, one of the slowest, over $\frac{1}{3400}$th of an inch in the same time; and that the same period was occupied by *Pinnularia oblonga* in traversing $\frac{1}{2000}$th of an inch, *Nitzschia linearis* $\frac{1}{2500}$th of an inch, and *Pleurosigma strigosum* $\frac{1}{2400}$th of an inch. Or, expressing the spaces and times by other units, we find that the most active required somewhat more than three minutes to accomplish movements whose sum would make one inch, and the slowest nearly an hour to perform the same feat.

These movements are usually noticed only in the free species of the class, as in those belonging to the genera *Navicula*, *Nitzschia*, and others, and especially in the more minute or younger individuals. Motion is not, however, confined to these, but may at times be detected in other forms, and even the frustules of attached species, as those of *Gomphonema*, when forcibly separated from their stipes, occasionally exhibit an evident tendency to change their position. The movements in the latter are, however, exceedingly languid, and have nothing of the isochronism so notable in the others.

Of the cause of these movements I fear I can give but a very imperfect account. It appears certain that they do not arise from any external organs of motion. The more accurate instruments now in the hands of the observer have enabled him confidently to affirm, that all statements resting upon the revelations of more imperfect object-glasses, which have assigned motile cilia, or feet, to the Diatomaceous frustule, have been founded upon illusion and mistake. Among the hundreds of species which I have examined in every stage of growth and phase of movement, aided by glasses which have never been surpassed for clearness and definition, I have never been able to detect any semblance of a motile organ; nor have I, by colouring the fluid with carmine or indigo, been able to detect in the coloured particles surrounding the Diatom, those rotatory movements which indicate, in the various species of true infusorial animalcules, the presence of cilia. I am constrained to believe that the movements of the Diatomaceæ are owing to forces operating within the frustule, and are probably connected with the endosmotic and exosmotic action of the cell. The fluids which are concerned in these actions must enter and be emitted through the minute foramina at the extremities of the siliceous valves; and it may easily be conceived, that an exceedingly small quantity of water expelled through these minute apertures would be sufficient to produce movements in bodies of so little specific gravity.

If the motion be produced by the exosmose taking place alternately at one and the other extremity, while endosmose is proceeding at the other, an alternating movement would be the result in frustules of a linear form; while in others of an elliptical or orbicular outline, in which foramina exist along the entire line of suture, the movements, if any, must be irregular, or slowly lateral.

Such is precisely the case. The backward and forward movements of the *Naviculeæ* have been already described; in *Surirella* and *Campylodiscus* the motion never proceeds farther than a languid roll from one side to the other; and in *Gomphonema*, in which a foramen, fulfilling the nutritive office, is found at the larger extremity only, the movement is a hardly perceptible advance in intermitted jerks in the direction of the narrow end. The subject is, however, one involved in much obscurity, and is probably destined to remain, for some time to come, among the mysteries of nature, which baffle while they excite inquiry.

Section V.

Self-division in the Diatomaceæ.

This process, by which a single cell is converted into two perfect cells, is by no means peculiar to the Diatomaceæ, but prevails extensively in the vegetable kingdom, if indeed it be not the ordinary mode of increase in all such tissues. Certain it is, that in the great class of unicellular Algæ, it is the universal mode of growth and multiplication. It, however, presents several peculiarities in the organisms with which we are now concerned, and is also so readily noted and followed in all its stages in the Diatomaceæ, that a close observance and clear comprehension of the process in their case may illustrate and guide inquiry in other tribes.

The first step in the process of self-division in the Diatomaceous frustule, is the fission of the internal cell, probably by the doubling-in of its membranous wall, and consequently the separation of the endochrome or cell-contents; the central vesicle or cytoblast also dividing into two parts, which remove to a little distance from each other; these movements being simultaneous with a retrocession of the epidermal valves and the formation of the siliceous connecting-membrane already described. In the centre of the enlarged frustule, in exact apposition to the original valves, and closely applied to them, there are now formed two new valves, covering the surface of the cell-membranes along the line of fission. The divided portions of the endochrome spread themselves along the membrane which is embraced by the new valves, and there result two half-new frustules, bound together by the connecting-membrane, generated during the process we have described. The figures of self-division given throughout the plates will serve to illustrate this description; and more especially those in Pl. VIII. fig. 59*d*, Pl. XV. fig. 126 *d*, Pl. XXII. fig. 216 *d*.

During the healthy life of the Diatom, the process of self-division is being continually repeated; the two half-new frustules at once proceed to divide again, each into two frustules, and thus the process continues. I have been unable to ascertain the time occupied in a single act of self-division; but supposing it to be completed in twenty-four hours, we should have, as the progeny of a single frustule, the amazing number of one thousand millions in a single month: a circumstance which will in some degree explain the sudden, or at least rapid, appearance of vast numbers of these organisms, in localities where they were, but a short time previously, either unrecognized, or only sparingly diffused.

The new valves formed during the process of self-division ordinarily appear exact counterparts in form and size of the valves of the original frustule; but a careful examination of the process in the filamentous species has led me to conclude that a slight enlargement occasionally takes place in the new valves, thus causing a widening of the filament.

This increase is however so small, that in a filament of many hundred frustules, the enlargement is scarcely appreciable. The rapid attenuation represented by some authors in the filaments of the *Fragilariæ* must therefore be attributed to the deceptive appearance presented by a compressed band when slightly twisted, the semblance of attenuation being thus given to the portions which are presented in an oblique direction to the eye of the observer.

The increase in the new valves, although slight, will however sufficiently account for the varying breadth of the bands in the filamentous species, and the diversity of size in the frustules of the free forms, without obliging us to suppose that a growth or aggregation takes place in the siliceous valve when once formed. Starting from a single frustule, it will be at once apparent, that if its valves remain unaltered in size, while the cell-membrane experiences repeated self-division, we shall have two frustules constantly retaining their original dimensions, four slightly increased, eight somewhat larger, and so on, in a geometrical ratio, which will soon present us with an innumerable multitude containing individuals in every stage, but in which the larger sizes preponderate over the smaller; and such are the circumstances ordinarily found to attend the presence of large numbers of these organisms.

It is hardly necessary to remind the student acquainted with the general laws of the vegetable kingdom, that this multiplication of the Diatomaceous frustule is not a true reproduction of the species, but merely a growth or extension of the original frustule with which we may suppose self-division to originate; and as the myriads of cells which constitute the entirety of the largest sea-weed, are regarded in their aggregation as forming but one plant, so may we consider the thousand millions into which a single month's growth has multiplied the original frustule, as belonging to the individuality of the first organism in the Diatomaceous chain of being.

With the free species of the Diatomaceæ the analogy may seem a forced one; but its correctness is at once apparent, if we ascend to more complex combinations in the filamentous and frondose genera, no very obvious difference existing between the union of cells in *Fragilaria* and those of many species of the *Confervæ*; or their aggregation in *Schizonema*, and various forms of the larger Algæ. The most important distinction between the combination of cells in the two cases, is the greater readiness with which the connection is dissolved in the Diatomaceæ and the retention of independent life in each separated cell; but as we descend in the scale to the lower Algæ, and approach the *Ulvaceæ* or *Palmellaceæ*, even this difference disappears, and the smallest portion of the frond, even a simple cell, in these forms enjoys the same independent vitality and power of increase as the Diatomaceous frustule.

The increase by self-division in the Diatomaceæ is therefore not a renewal, but a mere extension of individual life; and the process has been justly defined by Mr. Thwaites, in the analogous case of the *Palmellaceæ*, as an act of *Gemmation* rather than *Reproduction*.

"If we duly consider this fact," remarks this acute and zealous student of nature, "how much does it exalt the lower tribes of plants in our estimation! since we may contemplate an individual plant of them not as the single phyton—not as the single frond—not as the single cell—but as the aggregate, it may be, of thousands of these;—view it occupying as much space, and exercising as great an influence in the œconomy of nature, as the largest forest tree." (Annals of Natural History, 2nd Series, vol. ii. p. 315.)

Section VI.

Terminology and Classification.

The circumstances attendant upon the self-division of the Diatom furnish means for fixing the terminology applied to the different aspects of the frustule. It would have been desirable to have here adopted the terms employed by former writers, especially by those distinguished authors who have led the way in the study of these organisms; but this course is precluded by the circumstance that these writers have employed terms which imply views of the structure and nature of the Diatomaceous frustule that are now altogether inadmissible, or at all events at variance with the conclusions of the present writer.

Thus, the terms *ventral* and *dorsal*, employed by Ehrenberg, would be clearly inconsistent, if not unmeaning, when applied to the different aspects, or parts of *a plant*. The terms *primary* and *secondary sides*, adopted by Kützing and others, are not open to the same difficulty; but they labour under this objection, that they have not been employed by Mr. Ralfs, the highest English authority upon the subject. I shall therefore adopt the nomenclature of the last-named writer, as the most convenient for the English student, and use the term "front view," to denote the aspect of the frustule when the valvular suture, or the line along which self-division takes place, is turned towards the observer; and the term "side view," when the centre of one valve is directed to the eye.

Even these terms will require modification when applied to some of the more complex and irregular forms; but in general their meaning will be sufficiently obvious, and special cases will be noticed as they present themselves.

Self-division also supplies circumstances and distinctions, which appear to me most suitable in the present state of our knowledge, on which to found a generic arrangement of the Diatomaceæ. The circumstances which accompany the Reproduction of these organisms are so imperfectly ascertained, and that in so few species, that it is impossible to employ them with advantage in a generic arrangement. Self-division seems to me to come next in order, as a most important function connected with increase and growth, and to supply the necessary variety of phænomena on which to ground our sectional divisions.

I have therefore separated those forms where self-division is accompanied by the secretion of a permanent gelatinous or membranaceous envelope, in which the frustules are subsequently imbedded, from those in which such secretion is altogether absent, or is represented merely by a cushion or stipes, to which the frustules are attached by a small portion of their surface; and I have placed the latter, as of simpler organization, in my first tribe, arranging the genera belonging to it into sub-tribes, depending upon the permanency or otherwise of the connecting-membrane, another product of the self-dividing process. This enables me to place apart those genera whose species present us with frustules in which the union of the cells is dissolved almost immediately upon the completion of self-division, as well as those where a cushion or stipes still maintains a kind of indirect individuality in the divided frustules, from the genera in which the cells cohere after gemmiparous increase, and by such coherence form filaments of various lengths and forms, allotting the latter to sub-tribes which respectively present a compressed filament, a zigzag chain, or a cylindrical thread. In the second tribe, including those genera which have frondose forms, I find characters for my sub-tribes in the nature of the frond and the arrangement of the frustules.

I do not propose this arrangement as free from exceptions or even serious defects, but I have adopted it in preference to those hitherto given, as bringing more frequently together forms allied in structure and mode of growth, and as being at the same time more strictly in accordance with the external physiognomies of these organisms, and therefore more likely to be apprehended by the inquirer entering upon the study of this department of nature. A wider study of Diatomaceous forms will doubtless lead to more accurate and more natural generalizations.

Section VII.

On Collecting and Preserving Specimens of the Diatomaceæ.

I have already described the various localities in which the Diatomaceæ ordinarily abound. Supposing the observer to be acquainted with their general appearance, it remains for me to point out the method to be observed in their collection, and to furnish the student with a few directions as to their subsequent preservation.

Let him provide himself in the first place with the necessary apparatus. For the field, this includes a good stock of small wide-mouthed bottles, that each gathering may be kept perfectly distinct; a long rod or stick, to which can be attached a small muslin net; a cutting hook, of about three inches in length; and a broad flat spoon: the first, to collect such specimens as float upon the surface, or are held in suspension by the water; the second, to remove the larger Algæ which may be covered with parasitic Diatoms; and the third, to skim the surface of the mud for those which lie at the bottom of the pool.

He will probably find, notwithstanding every care, that his specimens are mixed with much foreign matter, in the form of minute particles of mud or sand, which impair their value, and interfere with observation, especially with the higher powers of his instrument. These substances the student may remove in various ways; by repeated washings in pure water, and at the same time, profiting by the various specific gravities of the Diatoms and the intermixed substances, to secure their separation; but more particularly, by availing himself of the tendency which the Diatomaceæ, in common with all growing plants, possess, of making their way towards the light. The free forms may be thus procured in a tolerably clean state; all that is necessary being, to place the gathering which contains them in a shallow vessel, and leave them undisturbed for a sufficient length of time in the sunlight, and then carefully to remove them from the surface of the mud or water.

Having performed these operations, which a little practice will render comparatively easy and generally successful, the next proceeding is to preserve the specimens in such a manner as to render them suitable for examination by the microscope at any future time. This may be done in various ways, according to the nature of the species and the precise object desired.

The simplest method, and the one most generally useful to the scientific observer, is simply to dry the specimens upon small portions of talc, which can at any time be placed under the microscope, and examined without further preparation; and this mode possesses one great advantage, that the specimens can be submitted without further preparation to a heat sufficient to remove all the cell-contents and softer parts, leaving the siliceous epiderm in a transparent state. But this method will not preserve the natural appearance of the filamentous, stipitate, or frondose forms; nor will it satisfy the amateur who desires a specimen for his cabinet, and demands a mounting of a permanent kind and neat appearance.

To meet these requirements, it is necessary that the specimen should be preserved in fluid or balsam. The modes of mounting objects in both these ways are best learnt by the examination of specimens thus prepared; and the manipulation required can only be successfully acquired by practice.

I have never found written or verbal directions of much real value, and shall confine myself to a few hints, which may supplement the discernment and patience of the operator, but cannot supersede their presence nor supply their absence.

The walls of the artificial cell for the filamentous and stipitate forms, I invariably form of litharge (protoxide of lead) and japanners' gold-size; and I attach the thin glass covers with a cement of gold-size, mixing with it a little lamp-black, to give a darker colour to the last coating applied.

The fluid I employ is distilled water, without any mixture whatever, having found all compound fluids not merely unnecessary, but injurious.

If the filamentous and stipitate forms are not, however, mounted in a fresh state, the frustules separate from each other, part from their stipes, and lose their characteristic appearance. To remedy these inconveniences, I immerse such specimens as cannot be placed in cells when freshly gathered, in spirits of wine and water—one part of the former to six of the latter, and their attachment to their stipes remains afterwards undisturbed, unless violence be employed to separate them.

In preserving the Diatomaceæ in balsam, the siliceous valves are the portions alone required. Indeed, it would be impracticable satisfactorily to mount specimens in their natural state in such a medium, as the presence of the cell-contents would prevent the access of the balsam to the interior of the frustule. To procure the valves in a separated state, it is necessary to boil the frustules for a few minutes in muriatic or nitric acid; thus removing the softer parts, and dissolving the connexion between the various portions of the frustule. The acid must afterwards be removed by repeated washings, allowing the siliceous materials to settle to the bottom of the vessel after each addition of water: we thus procure the specimens in a proper state. Having poured off the superfluous water, a drop of the fluid containing the Diatomaceæ is to be placed on the slide, evaporated to dryness, and the balsam and cover applied as in the ordinary mode. To avoid the presence of air-bubbles, it is only necessary to use the balsam in a sufficiently fluid state; and this may be secured by mixing it with ether or rectified spirits of turpentine, taking care entirely to expel the latter by the application of a gentle, but long-continued heat, before applying the glass cover.

With some valves, more especially in those specimens the resolution of whose cellular structure requires the application of the highest powers of the instrument, a different mode of mounting is necessary, as the application of balsam obliterates the more delicate markings. Such objects must be preserved in a dry state, without being immersed in any medium, and must not only be covered with glass sufficiently thin to allow the approach of a lens of high power, but also placed upon a glass slide, whose thickness will not impede the use of condensing lenses of short focal lengths. These objects are accomplished by perforating a wooden or metallic slide, and placing upon the perforations, which ought to be as large as practicable, a portion of thin glass, to receive the object, cementing this to the slide, and placing over it a cover of glass not exceeding $\frac{1}{150}$th of an inch in thickness, and thinner if possible. To prevent the admission of moisture, which would ultimately make its way to the object and destroy its value, it is indispensable that the cover should be cemented to the thin glass below. A neglect of this precaution will, sooner or later, be followed by the loss, to all valuable purpose, of the contained specimens.

In noticing the usual habitats of the Diatomaceæ, I have omitted to mention a locality not ordinarily accessible—the deeper parts of the ocean—which can only be reached by the dredge of the more enthusiastic and laborious collector. Many interesting species will reward a search conducted with this implement. The magnificent *Campylodiscus Horologium*, Pl. VI. fig. 51, was thus obtained. But these more hidden "treasures of the deep" may be reached in an indirect mode, by employing those fishes or molluscs which frequent deep water, as our substitutes for the dredge. Thus, in the stomachs of the crab or lobster, sole or turbot, the scallop or whelk, such organisms are often found; and several species, rarely or never occurring in my usual haunts, have been supplied in abundance by a careful dissection of the above microphagists.

I have also failed to indicate any season as more suitable than another for the researches of the student. I have, however, designedly omitted to do so, as every season is productive of interesting forms. The notes appended to the descriptions of each species, in which I have, when possible, recorded the months in which the species were collected, will show how perennial is the supply. Weather permitting, the collector may always reckon upon well-filled bottles, provided his rambles are by the sea-coast, or through a district supplied with ponds and streams. I take my leave of him for the present, by recommending to his pursuit a study pregnant with interest and with beauty; which fills the mind with wonder in the contemplation of forms at once so minute and perfect, so humble in their individual capacity, and yet by their numbers and wide diffusion occupying an important position in the organic world, and fulfilling the purposes of Power, Wisdom, and Benignity.

ADDENDA ET CORRIGENDA.

Page 5, line 11, *for* studied, *read* stated.

7, line 9, *for* the genus *Diadesmis* substitute the genus *Achnanthidium.*

11, add to the instances of Conjugation in *Epithemia, E. Zebra*; noticed by Mr. Thwaites in Ann. Nat. Hist., Nov. 1847.

21, to the description of *Cocconeis Placentula,* add, Striæ 45 in ·001″; and to habitat, In Conjugation, Lewes, Feb. 1853.

23, line 5, for *Orthosira sulcata,* Kütz., read *Melosira sulcata,* Kütz.

24, to the locality of *Eupodiscus crassus,* add, Stomach of scallop, Feb. 1853.

25, to the habitat of *Eupodiscus sculptus,* add, Isle of Dogs, Mr. Roper.

27, *Triceratium striolatum*? Ehr. Specimens from Mr. Brightwell have satisfied me that this is not *T. striolatum* of Ehrenberg; I therefore propose for it the name of *T. undulatum.*

29, to the localities of *Campylodiscus spiralis,* add, Newhaven, Sussex, Dec. 1852, *W. Sm.*

33, *Surirella panduriformis* is probably a var. of *S. pinnata.*

35, for n. sp. annexed to *Tryblionella Scutellum,* read *W. Sm.*

40, add to the habitat of *Nitzschia angularis,* Poole Bay, Sept. 1849, *W. Sm.*

51, last line but one, insert a full stop after 42, and read in continuation, Var. β. Ehr. Inf. xiii. 7, *et seq.*

SYNOPSIS

OF

THE BRITISH DIATOMACEÆ.

PRELIMINARY NOTICES.

The following List includes the principal works on the Diatomaceæ which the writer has had the opportunity of consulting. The prefixed abbreviations indicate the contractions employed when reference is made to such works or their authors.

Ag. Syst. Systema Algarum. C. A. Agardh, 1824.

Ag. Consp. Conspectus Criticus Diatomacearum. C. A. Agardh, 1830.

Bail. Sound. Microscopic Examination of Soundings off Atlantic Coast of the U.S. By Professor J. W. Bailey (in Smithsonian Contributions to Knowledge), 1850.

Bail. Obs. Microscopical Observations in S. Carolina, Georgia and Florida. By Prof. J. W. Bailey (in Smithsonian Contributions to Knowledge), 1850.

Bréb. Alg. Algues des Environs de Falaise, par MM. De Brébisson et Godey (Mémoires de la Société Académique de Falaise), 1835.

Bréb. Consid. Considérations sur les Diatomées, par A. De Brébisson. Falaise, 1838.

Bright. Inf. Sketch of a Fauna Infusoria for East Norfolk. By T. Brightwell, F.L.S., 1848.

Dick. Ann. Papers in the Annals of Natural History. By Professor Dickie, v. d.

Dillw. Conf. British Confervæ. By L. W. Dillwyn, F.R.S. & F.L.S., 1809.

Dujar. Inf. Infusoires, par F. Dujardin, 1841.

Ehr. Inf. Die Infusionsthierchen, von D. C. G. Ehrenberg, 1838.

Grev. S. C. F. Scottish Cryptogamic Flora. By R. K. Greville, LL.D. 6 vols., v. d.

Grev. B. F. The Diatomaceæ in Hooker's British Flora, vol. ii. P. 1. p. 401 *et seq.* By Dr. Greville, 1833.

Harv. Man. Manual of the British Algæ. By W. H. Harvey, M.D., 1841.

Hass. Alg. History of the British Freshwater Algæ. By A. H. Hassall, F.L.S. 2 vols., 1845.

Jenn. F. Tun. Flora of Tunbridge Wells. By E. Jenner, A.L.S. (no date).

Kütz. Bacill. Die Kieselschaligen Bacillarien, von F. T. Kützing, 1844.

Kütz. Phy. Ger. Phycologia Germanica, von F. T. Kützing, 1845.

Kütz. Sp. Alg. Species Algarum, von F. T. Kützing, 1849.

Lyng. Tent. Tentamen Hydrophytologiæ Danicæ. H. C. Lyngbye. 2 vols., 1819.

Prit. Anim. A History of Infusorial Animalcules. By A. Pritchard, M.R.I., 1852.

Quek. H. C. Histological Catalogue of the College of Surgeons. By J. Quekett.

Ralfs, Ann. Papers in the Annals of Natural History. By J. Ralfs, M.R.C.S., v. d.

W. Sm. Ann. Papers in ditto. By Rev. W. Smith, F.L.S., v. d.

Thw. Ann. Papers in ditto. By G. H. K. Thwaites, v. d.

The letters n. sp. denote that the species to which they are appended is believed to be now for the first time described: W. Sm. that the species has been previously described, or the generic or specific name been altered, by the present writer; in the latter case the original appellation is given in the list of synonyms. In other cases the writers by whom generic and specific names have been first employed are indicated by contractions, the signification of which may generally be ascertained by a reference to the list of authors given above.

The following abbreviations are adopted in the text:—

F. = Frustule.
F. V. = Front view of frustule.
S. V. = Side view of frustule.
V. = Valve.
1″ = English inch.

The letters S. V. and V. may usually be employed indifferently, as in most cases the outline of one valve, when its general surface is turned towards the observer, is identical with that of the side view of the entire frustule.

The letters v.v. following the specific description imply that I have examined a living specimen, and v.s. that I have seen the species only in a dry or fossil state.

The letters which accompany the numbers in the Plates indicate that the figures to which they are attached represent,—*a*, a side view; *b*, a front view; *c*, a front view of single valve; and *d*, self-division: when a numeral alone is employed, the figure is that of a side view of a single valve.

The unit of measurement employed is that of an English inch, the magnitudes being expressed in decimals, thus enabling those who may desire to reduce the dimensions given to the various continental standards (when the values of these are known), to do so by a simple process. The scale in each plate affords a ready means of ascertaining the size of the specimen from which each figure has been drawn ; but where much diversity has been found to exist in the dimensions of the individuals examined, the extremes observed have been noted in the text.

The figures, unless when otherwise indicated on the Plates themselves, are to be regarded as representations of the objects as seen under an amplifying power of 400 diameters, and the details given may be taken as tests of the defining capability of an instrument provided with a magnifying power of that amount. In a few cases a lens of somewhat higher power has been employed, to resolve and estimate the number of the striæ, this designation being applied in every case, not otherwise studied, to the *transverse* lines or markings of the siliceous valves.

The following British Diatomaceous deposits, recent or subfossil, are those most frequently referred to :—

PETERHEAD DEPOSIT. Described in the Annals of Natural History, Aug. 1848, by Professor Dickie.

PREMNAY PEAT. Described in the Annals of Natural History, Aug. 1848, by Professor Dickie.

DOLGELLY EARTH. Supplied by Chr. Johnson, Esq., Lancaster, 1850. Noticed by him in the Annals of Natural History, June 1847.

MARL, CO. DOWN. Supplied by J. McAdam, Esq., Belfast, 1849.

LOUGH ISLAND-REAVEY DEPOSIT. Supplied by the late William Thompson, Esq., Belfast. Described in Magazine of Natural History for July 1839, by Dr. Drummond; and noticed in the Annals of Natural History, Feb. 1850, by the present writer.

LOUGH MOURNE DEPOSIT. Described in Annals of Natural History, Feb. 1850, by the present writer.

CANTYRE PEAT. Supplied by Prof. Balfour, and noticed in the Annals of Natural History, April 1851 and June 1851.

RAASAY EARTH. Fossil Earth from the Island of Raasay, supplied by Prof. Dickie.

A few species are referred to Foreign localities; these references have been determined by specimens distributed by the London Opticians or known to microscopical observers, and for the genuineness of which the present writer is unable to assign his personal authority ;—such notices may serve in some degree to indicate the wide range of many of our native forms.

SYNOPTICAL ARRANGEMENT

OF THE

BRITISH DIATOMACEÆ.

Class CRYPTOGAMIA.

Sub-class ALGÆ. Natural Order DIATOMACEÆ.

Plant a Frustule; consisting of a unilocular or imperfectly septate cell invested with a bivalve siliceous epidermis. Gemmiparous increase, by Self-Division; during which process the cell secretes a more or less siliceous Connecting Membrane. Reproduction, by Conjugation and the formation of Sporangia.

Tribe I. *Frustules naked; not imbedded in gelatine nor enclosed in membranaceous tubes.*

Sub-tribe 1. *Connecting membrane deciduous; frustules solitary or during self-division in pairs, rarely in greater numbers, adherent or free, dispersed, or aggregated into a mucous stratum.*

22 Genera. Epithemia, Eunotia, Cymbella, Amphora, Cocconeis, Coscinodiscus, Eupodiscus, Actinocyclus, Arachnoidiscus, Triceratium, Cyclotella, Campylodiscus, Surirella, Tryblionella, Cymatopleura, Nitzschia, Amphiprora, Amphipleura, Navicula, Pinnularia, Stauroneis, Pleurosigma.

SUB-TRIBE 2. *Connecting membrane subpersistent; frustules after self-division attached by a gelatinous cushion, or dichotomous stipes.*

7 GENERA. Synedra, Doryphora, Cocconema, Gomphonema, Podosphenia, Rhipidophora, Licmophora.

SUB-TRIBE 3. *Connecting membrane evanescent, or obsolete; frustules after self-division united into a compressed filament.*

12 GENERA. Meridion, Bacillaria, Himantidium, Odontidium, Denticula, Fragilaria, Eucampia, Achnanthes, Diadesmis, Rhabdonema, Striatella, Tetracyclus.

SUB-TRIBE 4. *Connecting membrane subpersistent; frustules after self-division united into a zigzag chain.*

6 GENERA. Diatoma, Grammatophora, Tabellaria, Amphitetras, Biddulphia, Isthmia.

SUB-TRIBE 5. *Connecting membrane subpersistent as a siliceous annulus; frustules after self-division united into a cylindrical filament.*

3 GENERA. Podosira, Melosira, Orthosira.

TRIBE II. *Frustules invested with a gelatinous or membranaceous envelope.*

SUB-TRIBE 6. *Frond indefinite, mammillate; frustules scattered.*

1 GENUS. Mastogloia.

SUB-TRIBE 7. *Frond definite, compressed or globular; frustules scattered.*

2 GENERA. Dickieia, Berkeleyia.

SUB-TRIBE 8. *Frond definite, filamentous; frustules in rows.*

3 GENERA. Encyonema, Colletonema, Schizonema.

SUB-TRIBE 9. *Frond definite, filamentous; frustules fasciculated.*

1 GENUS. Homœocladia.

ANALYSIS OF THE GENERA.

1.	Frustules nude	2
	,, enveloped in gelatine or enclosed in membranaceous tubes	46
2.	Frustules not forming a filament	3
	,, forming a filament or chain	28
3.	Frustules free or adherent	4
	,, attached by a cushion or stipes	23
4.	Frustules furnished with canaliculi	5
	,, not so furnished	7
5.	Valves arcuate or inflated	EPITHEMIA.
	,, saddleshaped	CAMPYLODISCUS.
	,, elliptical, ovate or linear	6
6.	Valves concave, alæ marginal	SURIRELLA.
	,, plane, alæ submarginal	TRYBLIONELLA.
7.	Valves triangular	TRICERATIUM.
	,, orbicular	8
	,, not triangular nor orbicular	12
8.	Valves striated	CYCLOTELLA.
	,, cellular	9
9.	Valves plane	10
	,, undulated	ACTINOCYCLUS.
10.	Discs of Valves furnished with processes	EUPODISCUS.
	,, ,, not so furnished	11
11.	Valves with a central pseudo-nodule	ARACHNOIDISCUS.
	,, without a central nodule	COSCINODISCUS.
12.	Valves arcuate	EUNOTIA.
	,, not arcuate	13
13.	Valves cymbiform	14
	,, elliptical, oval or linear	15
14.	Nodule subcentral	CYMBELLA.
	,, marginal	AMPHORA.

15. Frustules adherent .... COCCONEIS.
   ,, free 16

16. Valves transversely undulated .... CYMATOPLEURA.
   ,, without undulations 17

17. Valves with longitudinal ridges 18
   ,, plane or convex 20

18. Valves with a central ridge or keel 19
   ,, with two or more ridges .... AMPHIPLEURA.

19. Valves elliptical, deeply constricted .... AMPHIPRORA.
   ,, much elongated ; constriction, if any, slight ...... NITZSCHIA.

20. Valves sigmoid .... PLEUROSIGMA.
   ,, straight 21

21. Valves with central nodule 22
   ,, with central nodule dilated into a Stauros ...... STAURONEIS.

22. Valves striated .... NAVICULA.
   ,, costate .... PINNULARIA.

23. Frustule linear or much elongated .... SYNEDRA.
   ,, elliptical or cymbiform 24
   ,, cuneate 25

24. Valves having terminal and subcentral nodules .... COCCONEMA.
   ,, without nodules.................................. DORYPHORA.

25. Valves with a nodule in the centre and at each end.... GOMPHONEMA.
   ,, without nodules.................................. 26

26. Stipes obsolete or very short .... PODOSPHENIA.
   ,, elongated 27

27. Stipes filiform .... RHIPIDOPHORA.
   ,, incrassate .... LICMOPHORA.

28. Filament compressed, continuous.................................. 29
   ,, a zigzag chain 39
   ,, cylindrical 44

29. Filament spiral .... MERIDION.
   ,, coiled .... BACILLARIA.
   ,, straight 30

30. Frustule with internal septa 37
   ,, without septa 31

31. Valves with central and terminal nodules .... DIADESMIS.
   ,, without nodules 32

32. Frustule curved on Front View .... ACHNANTHES.
   ,, oblong on Front View 33

33. Valves arcuate .... HIMANTIDIUM.
   „ straight 34

34. Valves with a central sinus .... EUCAMPIA.
   „ without a sinus 35

35. Valves delicately striated .... FRAGILARIA.
   „ distinctly costate 36

36. Frustules united into a lengthened filament .... ODONTIDIUM.
   „ few, scarcely forming a filament .... DENTICULA.

37. Frustules compressed 38
   „ inflated .... TETRACYCLUS.

38. Filament tenacious........ RHABDONEMA.
   „ not tenacious .... STRIATELLA.

39. Frustules with internal septa 40
   „ without septa 41

40. Septa waved .... GRAMMATOPHORA.
   „ straight .... TABELLARIA.

41. Frustules square or rhomboidal........ AMPHITETRAS.
   „ compressed 42

42. Frustules prismatic .... DIATOMA.
   „ subcylindrical 43

43. Angles of frustules rounded, slightly produced .... ISTHMIA.
   „ much produced .... BIDDULPHIA.

44. Filament of few frustules .... PODOSIRA.
   „ numerous frustules 45

45. Frustules with rounded extremities .... MELOSIRA.
   „ truncated .... ORTHOSIRA.

46. Frond indefinite .... MASTOGLOIA.
   „ definite 47

47. Frond compressed .... DICKIEIA.
   „ globular .... BERKELEYIA.
   „ filamentous........ 48

48. Frustules in rows 49
   „ fasciculated .... HOMŒOCLADIA.

49. Frustules those of a Cymbella .... ENCYONEMA.
   „ „ Navicula 50

50. Filaments simple .... COLLETONEMA.
   „ branched .... SCHIZONEMA.

THE BRITISH DIATOMACEÆ.

Genus 1. EPITHEMIA, *Kütz.*

Frustules adherent, quadrilateral; valves arcuate, furnished with transverse canaliculi.

A section of the frustule in the present genus would present an outline of varied form, either elliptical or quadrilateral, or that of two nearly perfect circles united by an oblong isthmus; the shape of the frustule in the latter case may be compared, as it has been done by Meneghini, to that of a coffee berry, or more correctly to a grain of wheat, but in no case would the section present a trapezoidal outline, the valves being always parallel or equidistant. This genus, as the name implies, is characterized by the adherence of its frustules to Algæ of a larger growth. This character is true of most of the species, and even where not strictly applicable, as in *E. gibba* and others, we detect a disposition to rely on a foreign body for support, their frustules being usually imbedded in the mucus of some member of the family of the Palmellaceæ.

The transverse costæ, so conspicuous in some species, I regard as minute canals, which convey the nutrimental fluid to the surface of the internal membrane. They are not modifications of the cellular structure of the siliceous epiderm, otherwise, the striæ would not pass, as they do, uninterruptedly over the entire surface of the valve.

Conjugation, and the formation of Sporangia in this genus, have been noticed by Mr. Thwaites in *E. turgida* and *E. gibba*, by myself in these species and in *E. Sorex*.

1. **Epithemia Hyndmanii,** *W. Sm.* F. V. inflated; V. much and regularly arched, extremities rounded, not recurved; striæ moniliform, 16 in ·001″; canaliculi inconspicuous, 9 in ·001″. Length of F. ·0025″ to ·0076″. v.s.

W. Sm. Ann. 2nd Ser. vol. v. p. 124.

Fresh water. Lough Mourne Deposit, Cantyre Peat.

Plate I. 1.

2. **Epithemia turgida,** *W. Sm.* F. V. somewhat inflated; V. slightly arched, extremities suddenly attenuate, obtuse; striæ moniliform, 21 in ·001″; canaliculi distinct, 12 in ·001″. Length ·0026″ to ·0062″. v.v.

Epithemia Vertagus, Kütz. Bacill. xxx. 5. sic. cl. De Brébisson in litt. cum specim.
Eunotia turgida, Ehr. Inf. tab. xiv. 5. xxi. 20 *a*. Quek. H. C. xii. 5. In Conjugation, Thw. Ann. vol. xx. pl. iv. Prit. Anim. xiv. 1–8.
Cymbella turgida, Hass. Alg. pl. c. 7.

Fresh water. Near Aberdeen, *Dr. Dickie.* Wareham, Lewes, May 1850, &c., *W. Sm.* Lough Mourne Deposit, Dolgelly Earth, Cantyre Peat and Peterhead Deposit.

Plate I. 2. Frustule with endochrome, Frontispiece, vol. i. fig. II.

3. **Epithemia granulata,** *Kütz.* F. V. linear; V. slightly arched, linear, otherwise like the last. Length ·0033″ to ·0081″. v.s.

Kütz. Bacill. v. 20. *Eunotia granulata,* Ehr. Inf. xxi. 20 *β*.

Fresh water. Lough Mourne Deposit.

Plate I. 3.

4. **Epithemia Zebra,** *Kütz.* V. equally arched; F. V. linear; extremities of V. gradually attenuate; striæ punctate, 33 in ·001″; canaliculi few, 8 in ·001″. Length ·0016″ to ·0035″. v.v.

Kütz. Bacill. v. 12. *Eunotia Zebra,* Ehr. Inf. xxi. 19. *Cymbella Zebra,* Hass. Alg. c. 8.

Fresh water. Wareham, Lewes, &c., Aug. 1850, *W. Sm.*

Plate I. 4.

5. **Epithemia Argus,** *W. Sm.* F. resembling the last; foramina conspicuous on the F. V. Length ·0013″ to ·0021″. v.v.

Epithemia alpestris, Kütz. Sp. Alg. p. 2. ad spec. authent. quæ misit cl. De Brébisson, Jan. 1853. Prit. Anim. xxiv. 11.

Fresh water. Near Aberdeen, *Dr. Dickie.*

Plate I. 5.

6. **Epithemia ocellata,** *Kütz.* F. V. inflated, extremities of V. rounded, foramina large. v.s.

Kütz. Bacill. xxix. 57.

Fresh water. Wray near Lancaster, *Mr. G. Smith.* Cantyre Peat.

Plate I. 6.

7. **Epithemia longicornis,** *Ehr.* F. V. inflated, extremities obtuse; dorsal ridge of V. somewhat angular; foramina few, large; striæ 27 in ·001″. Length ·0033″ to ·0058″. v.v.

Ehr. in Prit. Anim. xxiv. 6–9.

Fresh water. Isle of Arran, mixed with *Petalonema alatum,* Berk. collected by Professor Walker Arnott, Aug. 1852.

Supp. Plate XXX. 247.

8. **Epithemia alpestris,** *W. Sm.* F. V. linear; V. recurved at the obtuse extremities; foramina large; striæ 27 in ·001″. v.s.

Kütz. Bacill. v. 16?

Fresh water. Katefield near Lancaster, *Mr. G. Smith,* April 1851.

Plate I. 7.

9. **Epithemia proboscidea,** *Kütz.* F. V. inflated; V. recurved at the extremities; canaliculi large; foramina inconspicuous; striæ 30 in ·001″. v.v.

Kütz. Bacill. v. 13.

Fresh or brackish water. St. Ouen's Pond, Jersey, Aug. 1852, *W. Sm.* Raasay Earth.

Plate I. 8.

10. **Epithemia Sorex,** *Kütz.* F. V. inflated; V. attenuate, slightly recurved at the extremities, dorsal line highly arcuate; canaliculi few, minute; striæ 33 in ·001″. Length ·0009″ to ·0013″. v.v.

Kütz. Bacill. v. 12.

Fresh or brackish water. Lewes, May 1850, *W. Sm.* Lough Mourne Deposit, Cantyre Peat, &c. (New Zealand.)

Plate I. 9. Frustule with endochrome, Frontispiece, vol. i. fig. IX.

11. **Epithemia Musculus,** *Kütz.* V. regularly and highly arcuate, extremities acute; canaliculi distant; striæ 40 in ·001″. v.v.

Kütz. Bacill. xxx. 6.

Brackish water. Poole Bay. "Little Sea," Dorsetshire, Aug. 1848. Near Lewes, Sussex, Sept. 1850, *W. Sm.*

Plate I. 10.

12. **Epithemia Westermanii,** *Kütz.* F. V. elliptical; V. arcuate; canaliculi distinct; striæ faint, 40 in ·001″. Length ·0008″ to ·0013″. v.v.

Kütz. Bacill. v. 12? *Eunotia Westermanii,* Ehr. Inf. p. 190. taf. xiv. 6?

Brackish water. Near Lewes, Oct. 1850, *W. Sm.* (Ceylon, *Mr. Thwaites,* Nov. 1851.)

Plate I. 11.

13. **Epithemia rupestris,** n. sp. F. V. elliptical-lanceolate; V. acute, slightly arcuate; canaliculi distant, 6 in ·001″; striæ faint, 42 in ·001″. Length ·0012″ to ·0023″. v.v.

Fresh water. Backsbottom near Lancaster, *Mr. G. Smith,* April 1851. Plumpton, Sussex, April 1852, *W. Sm.* Aberdeenshire, *Dr. Dickie.* Killicrankie, *Mr. P. Grant.* Raasay Earth.

Plate I. 12.

The above species first fell under my notice in a gathering made by Mr. G. Smith from the surface of a rock moistened with water in the habitat I have mentioned; its frequent occurrence in other localities shows that it is widely distributed in subalpine districts. Together with the species last described, and the three which follow, its valves present a peculiar form: their convexity is so considerable, that a transverse section of the frustule would furnish an outline not unlike the figure 8, owing to which circumstance a side view is with difficulty obtained, the frustules naturally presenting their broadest surface to the eye.

14. **Epithemia constricta,** n. sp. F. V. elliptical with a more or less distinct constriction; V. acute, much arched; canaliculi distant, 8 in ·001″; striæ 30 in ·001″. Length ·0012″ to ·0026″. v.v.

"*Ep. constricta,*" cl. De Brébisson in litt. cum specim.

Brackish water. Excet, Sussex, March 1852, *W. Sm.*

Supp. Plate XXX. 248.

15. **Epithemia gibba,** *Kütz.* F. V. linear, slightly inflated at centre and extremities; S. V. linear, obtuse; striæ 36 in ·001″; canaliculi 15 in ·001″. Length ·0033″ to ·0104″. v.v.

Nav. gibba, Ehr. Inf. xiii. 19. Hass. Alg. cii. 4.
Ep. gibba, Kütz. Bacill. iv. 22.
Eunotia gibba, Prit. Anim. xv. 27. In Conjugation, Thw. Ann. vol. xx. pl. xxii. F.

Fresh water: frequently entangled in the mucus of *Sorospora virescens,* Hass. Wareham, Aug. 1847. Lewes, Oct. 1850, *W. Sm.* Lough Mourne Deposit. Peterhead ditto. Near Aberdeen, *Dr. Dickie.* Rescobie, *Mr. P. Grant.* (San Fiore, Italy; Ceylon, 1851, *Mr. Thwaites.*)

Plate I. 13.

16. **Epithemia ventricosa,** *Kütz.* F. V. elliptical, slightly constricted at the ends; V. with acute extremities; striæ and canaliculi as in the last. Length ·0009″ to ·0018″. v.v.

Kütz. Bacill. xxx. 9. *Nav. gibba,* Ehr. Inf. taf. xiii. fig. xix. 4.

Fresh or brackish water. "Brooks" near Lewes, Oct. 1850. St. Ouen's Pond, Jersey, Aug. 1852, *W. Sm.* Near Aberdeen and near Belfast, *Dr. Dickie.* Peterhead Deposit.

Plate I. 14.

Genus 2. **EUNOTIA,** *Ehr.*

Frustules free, oblong; valves arcuate, with terminal nodules and convergent striæ.

Closely allied to the former genus, but easily distinguished by the absence of canaliculi, the delicacy of the striæ and the dorsal ridges with which most of the species are provided. The F. V. is also uniformly linear, and the connecting membrane less fully developed than in many of the *Epithemiæ.* Isolated frustules of *Himantidium* might be confounded with the present species, but *Eunotia* never forms a tenacious filament, though several frustules may sometimes be found united; the genera are however closely allied, and with difficulty distinguished from each other.

1. **Eunotia Arcus,** *W. Sm.* V. regularly arcuate, acute, with a slight constriction at each extremity, and inflation in the centre of

the concave margin; striæ delicate, 36 in ·001″. Length ·0012″ to ·0029″. v.v.

Navicula Arcus, Ehr. Inf. xxi. 10. *Cymbella? Arcus,* Hass. Alg. c. 6. *Ceratoneis Arcus,* Kütz. Bacill. vi. 10.

Fresh water. In boggy pools, Dorsetshire, Jan. 1849, *W. Sm.* Wray near Lancaster, Jan. 1852, *Mr. Geo. Smith.* Mountains in Forfarshire, *Dr. Dickie.*

Plate II. 15. Frustules with endochrome, Frontispiece, v. i. fig. XV.

2. **Eunotia gracilis,** n. sp. V. arcuate, extremities recurved; striæ delicate, 42 in ·001″. Length ·0006″ to ·0018″. v.v.

Fresh water. Wareham, Sept. 1849, *W. Sm.* Jack's Wood Spring, Tunbridge Wells, *Mr. E. Jenner.*

Supp. Plate XXX. 249.

3. **Eunotia monodon,** *Ehr.* V. regularly arcuate, obtuse, extremities slightly produced; striæ 34 in ·001″. v.s.

Ralfs, Ann. vol. xiii. pl. xiv. 1.

Fresh water. Ben M^c Dhui, at an elevation of 3000 feet, *Mr. P. Grant.* Aberdeenshire, *Dr. Dickie.*

Plate II. 16.

4. **Eunotia diodon,** *Ehr.* V. with two dorsal ridges; striæ 32 in ·001″. v.s.

Ehr. Inf. xxi. 23. Ralfs, Ann. vol. xiii. pl. xiv. 2. Hass. Alg. xcvii. 6. Kütz. Bacill. v. 24.

Fresh water. Aberdeenshire, *Dr. Dickie.* Ben M^c Dhui, *Mr. P. Grant.*

Plate II. 17.

5. **Eunotia triodon,** *Ehr.* V. with three dorsal ridges; striæ 40 in ·001″. Length ·0015″ to ·0026″. v.s.

Ehr. Inf. xxi. 24. Prit. Anim. iii. 164. Hass. Alg. xcvii. 7. Kütz. Bacill. v. 25.

Fresh water. Ben M^c Dhui, at an elevation of 3000 feet, *Mr. P. Grant.* (Lapland.)

Plate II. 18.

6. **Eunotia tetraodon,** *Ehr.* V. with four dorsal ridges; striæ 24 in ·001″. Length ·0015″ to ·0022″. v.v.

Ehr. Inf. xxi. 25. Ralfs, Ann. vol. xiii. pl. xiv. 4. Hass. Alg. xcvii. 8. Kütz. Bacill. v. 26.

Himantidium tetraodon, Bréb. in Kütz. Sp. Alg. p. 10. ad spec. quæ misit amic. De Brébisson, Jan. 1853.

Fresh water. Ashdown Forest, Sussex, Aug. 1850, *W. Sm.* Curwen Hill, Lancashire, *Mr. G. Smith*, June 1851. Quernmore, Lancashire, April 1852, *Mr. Johnson.* Mountains in Aberdeenshire, *Dr. Dickie.* Dolgelly, *Mr. Ralfs.* Dolgelly Earth. Peterhead Deposit. (Manchester, Mass., communicated by *Prof. Williamson.*)

Plate II. 19.

7. **Eunotia Diadema,** *Ehr.* V. with six dorsal ridges; striæ 30 in ·001″. Length ·0016″ to ·0024″. v.s.

Ehr. Inf. xxi. 27. Kütz. Bacill. v. 28.

Fresh water. Dolgelly Earth.

Plate II. 20.

Genus 3. CYMBELLA, *Ag.*

Frustules free, cymbiform; valves striated, with a submedian line and central and terminal nodules.

Many frustules of *Cocconemata* detached from their stipes bear so close a resemblance to those of the *Cymbellæ*, that a discrimination can hardly be relied upon which depends solely upon the observation of prepared specimens. In a living state, the presence of a stipes at once removes such frustules from the present genus. *Cymbella* frequently forms a more or less distinct stratum, the frustules being retained in their position, even when exposed to a rapid current, by the presence of a delicate pellicle of mucus.

1. **Cymbella Ehrenbergii,** *Kütz.* V. elliptical-lanceolate, extremities slightly produced, obtuse; striæ distinct, 15 in ·001″. Length ·0028″ to ·0054″. v.s.

Kütz. Bacill. vi. 11. *Navicula inæqualis*, Ehr. Inf. xiii. 18. Prit. Anim. iii. 154.

Fresh water. Living, in Lough Mourne, Sept. 1849. Peterhead Deposit. Lough Mourne Deposit. Premnay Peat. Marl, Co. Down. (Near Manchester, Mass., communicated by *Prof. Williamson.* Very abundant in fossil earth, San Fiore, Italy.)

Plate II. 21.

2. **Cymbella cuspidata,** *Kütz.* F. smaller than the last, extremities prominent, somewhat acuminate; striæ indistinctly moniliform, 30 in ·001″. Length ·0012″ to ·0031″. v.s.

Kütz. Bacill. iii. 40.

Fresh water. Quernmore near Lancaster, April 1852, *Mr. Johnson.* Wray near Lancaster, Oct. 1852, *Mr. G. Smith.* Lough Mourne and Peterhead Deposits. Premnay and Cantyre Peats. (Nova Scotia.)

Plate II. 22.

3. **Cymbella affinis,** *Kütz.* V. elliptical-lanceolate, extremities slightly produced; striæ faint, 30 in ·001″. Length ·0009″ to ·0015″. v.v.

Kütz. Bacill. vi. 15. ad spec. authen. quæ dedit amic. De Brébisson.

Fresh water. Parham, Sussex, Feb. 1844, *Mr. Jenner.* Iford, Sussex, April 1852, *W. Sm.* Marl, Co. Down, and Dolgelly Earth.

Supp. Plate XXX. 250. Frustule with endochrome, Frontispiece, fig. CCL.

4. **Cymbella maculata,** *Kütz.* Larger segment of V. convex, smaller with a slight inflation in the centre, extremities obtuse; striæ 27 in ·001″. Length ·0008″ to ·0015″. v.v.

Kütz. Bacill. vi. 2?

Fresh water. River Frome near Wareham, Dorset, March 1848, *W. Sm.* Cantyre Peat and Peterhead Deposits.

Plate II. 23.

5. **Cymbella Helvetica,** *Kütz.* F. V. linear, slightly arched; V. elongated, segments as in the last, extremities acute; striæ 24 in ·001″. Length ·0016″ to ·0031″. v.v.

Kütz. Bacill. vi. 13? Prit. Anim. xvii. 24–28.

Fresh water. River Ouse near Lewes, *W. Sm.* Peterhead Deposit. Near Aberdeen, *Dr. Dickie.*

Plate II. 24.

6. **Cymbella Scotica,** n. sp. V. narrow, elongated, smaller segment straight, extremities acute; striæ 32 in ·001″. Length ·0012″ to ·0027″. v.s.

Fresh water. Pass of Killiecrankie, very plentiful, *Mr. P. Grant.* Dolgelly Earth.

Plate II. 25.

GENUS 4. **AMPHORA,** *Ehr.*

Frustules free, or adherent; valves cymbiform, with a central marginal nodule.

The valves in this genus are exceedingly convex, closely resembling those of *Epithemia rupestris*, and the section of the frustule is the same as that which I have described under that species. It is probable that most of the *Amphoræ* are at first adherent, but they are usually found detached, and sparingly diffused among other Algæ.

1. **Amphora ovalis,** *Kütz.* F. V. elliptical, internal margin of V. inflated at the nodule; striæ moniliform, distinct, 24 in ·001″. Length ·0012″ to ·0038″. v.v.

Kütz. Bacill. v. 25 & 39. *Nav. Amphora,* Ehr. Inf. xiv. 3. Prit. Anim. iii. 153.

Fresh water: frequent. Lewes, April 1852, *W. Sm.* Lough Mourne Deposit. Peterhead Deposit, &c.

Plate II. 26. Frustule with endochrome, Frontispiece fig. XXVI.

2. **Amphora affinis,** *Kütz.* F. V. oblong, with round or truncate extremities; striæ distinct, 27 in ·001″. Length ·0016″ to ·0022″. v.v.

Kütz. Bacill. xxx. 66.

Brackish water. Near Lewes, Sussex, Feb. 1852, *W. Sm.*

Plate II. 27.

3. **Amphora hyalina,** *Kütz.* F. V. elliptical, acute; V. imperfectly siliceous, longitudinally rugose; striæ obscure. Length ·0021″ to ·0032″. v.v.

Kütz. Bacill. xxx. 18.

Brackish water. Coast of Sussex, Nov. 1850, *W. Sm.* Near Lancaster, *Mr. Johnson.*

Plate II. 28.

4. **Amphora salina,** n. sp. F. V. elliptical, truncate, extremities

slightly produced ; V. scarcely siliceous ; striæ 64 in ·001″. Length ·0008″ to ·0016″. v.v.

Brackish water. Iford, Sussex, Sept. 1852, *W. Sm.*

Supp. Plate XXX. 251.

5. **Amphora ? tenera,** *W. Sm.* F. V. oblong, extremities round or truncate ; V. scarcely siliceous, longitudinally rugose ; striæ 62 in ·001″. Length ·0015″ to ·0025″. v.v.

Amphora lineolata, Kütz. Bacill. v. 36. ad specim. authen. quæ communicavit cl. De Brébisson.

Marine. Forms a thin pellicle on stones, &c. Seaford, May 1850. Lancing, Nov. 1852, *W. Sm.*

Supp. Plate XXX. fig. 252.

6. **Amphora membranacea,** n. sp. F. V. elliptical, with rounded extremities ; V. scarcely siliceous, with a central transverse band ; striæ very faint, 80 in ·001″. Length ·0013″ to ·0030″. v.v.

Brackish water. Poole Bay, Sept. 1848. Sussex, Sept. 1850, *W. Sm.* Near Belfast, *Dr. Dickie.* Near Harwich, *Mr. Brightwell.*

Plate II. 29.

7. **Amphora? costata,** n.sp. V. longitudinally costate, costæ marked with a double line of moniliform puncta ; extremities produced. Length ·0020″ to ·0027″. v.s.

Marine. Poole Bay, Sept. 1851, *W. Sm.*

Supp. Plate XXX. 253.

8. **Amphora minutissima,** n.sp. F. V. elliptical or oval ; V. marked with a transverse band ; striæ 64 in ·001″. v.v.

Fresh water. Parasitic on *Nitzschia sigmoidea.* Near Lewes, Dec. 1850 and Oct. 1852, *W. Sm.* In ponds near London, parasitic on *Nitzschia linearis, Mr. Shadbolt,* Mar. 1851.

Plate II. 30.

Genus 5. **COCCONEIS,** *Ehr.*

Frustules adherent, disciform; valves elliptical, plane, with a median line and central nodule.

In this genus the frustules are closely adherent by the surface of one valve to larger Algæ, and are usually detached with difficulty. The markings of the lower are less intense than those of the upper surface, but in other respects the valves are symmetrical, and Mr. West informs me that he has found the absence of a central nodule in the lower valve, as noted by some writers, by no means a constant character.

1. **Cocconeis Pediculus,** *Ehr.* F. arched; V. elliptical, somewhat angular; disc delicately striated; striæ 40 in ·001″. Length ·0008 to ·0014″. v.v.

Ehr. Inf. xxi. 11. Kütz. Bacill. v. 9.

Fresh water. Frequently attached to *Cladophora glomerata*. Lewes, Aug. 1851; Wareham, Sept. 1851, *W. Sm.* Lough Mourne Deposit. Peterhead Deposit, &c.

Plate III. 31. Frustules with endochrome, Frontispiece fig. XXXI.

The striæ on this species are seen by a higher power as lines, concentric with each extremity of the valve.

2. **Cocconeis Placentula,** *Ehr.* F. plane, valve elliptical, disc striated. Length ·0011″ to ·0016″. v.v.

Ehr. Inf. p. 194. Ehr. in Kütz. Bacill. xxviii. 13.

Fresh water: frequent. Wareham, July 1849, *W. Sm.* Lough Mourne and Peterhead Deposits. Cantyre Peat and Dolgelly Earth.

Plate III. 32.

3. **Cocconeis Thwaitesii,** *W. Sm.* F. arched; valve constricted towards the obtuse extremities; median line sigmoid; disc faintly striated; striæ 72 in ·001″. Length ·0009″ to ·0013″. v.v.

Cymbella flexella, Kütz. Bacill. iv. 14. *Achnanthidium flexellum,* Bréb. in Kütz. Sp. Alg. p. 54. ad specim. authen. quæ communicavit cl. De Brébisson, Jan. 1853.

Fresh water. Near Bristol, May 1848, *Mr. Thwaites.* Mountains in

Forfar, at an elevation of 2800 feet. Near Aberdeen and near Belfast, *Dr. Dickie*; Rescobie, *Mr. P. Grant.* Marl, Co. Down, &c.

Plate III. 33. *d.* outline of ditto in S. V.

4. **Cocconeis Scutellum,** *Ehr.* V. orbicular or elliptical; striæ concentric with extremities, moniliform, 18 in ·001″. Length ·0006″ to ·0016″. v.v.

β. Nodule dilated into a Stauros.

Ehr. Inf. xiv. 8. Kütz. Bacill. v. 6.

Marine. Very common, and exceedingly variable in size and outline.

Plate III. 34. *β,* Supp. Plate XXX. fig. 34.

5. **Cocconeis Grevillii,** n. sp. V. oval, furnished with transverse canaliculi; striæ moniliform, 15 in ·001″. Length ·0008″ to ·0025″. v.s.

Quek. H. C. pl. xii. 19 ?

Marine. Attached to *Phyllophora rubens,* Sidmouth, communicated by *Dr. Greville.* Hastings, *Mr. Shadbolt.* Poole Bay, *W. Sm.* (Algoa Bay, South Africa. Ichaboe Guano.)

Plate III. 35 *a.* lower valve; 35 *a**. upper valve; 35 *a′*. view of upper valve from within.

6. **Cocconeis diaphana,** n. sp. V. elliptical, scarcely siliceous, diaphanous; striæ obscure. Length ·0012″ to ·0018″. v.v.

β. Nodule dilated into a Stauros.

Marine. Sidmouth, *Miss Cutler,* communicated by *Dr. Greville.* Pontac, Jersey, Aug. 8, 1852, *W. Sm.*

Supp. Plate XXX. 254.

Genus 6. COSCINODISCUS, *Ehr.*

Frustules free or adherent, disciform; valves plane or slightly convex with a cellular structure.

This genus, though closely related to those which immediately follow it, finds its nearest allies in the *Melosireæ,* whose genera, from their filamentous character, stand widely apart in the present work.

Were the frustules of *Coscinodiscus eccentricus*, for example, permanently coherent after self-division, it would be difficult to separate them in a generic point of view from those of *Orthosira nivalis*, W. Sm., which have the same cellular structure of the siliceous valve, or from those of *Melosira aurichalcea*, Ralfs, or *Orthosira sulcata*, Kütz., which are furnished with a projecting fringe of silex, the homologues of the spinous processes in *C. eccentricus*. It is true that the *Melosireæ* I have mentioned have valves much more convex, occasionally even cylindrical; but in *Orthosira arenaria*, W. Sm., this difference disappears, and we have frustules as much compressed and in consequence as narrow on the F. V. as in *Coscinodiscus*, and differing principally in the firm and permanent coherence of their surfaces.

1. **Coscinodiscus minor,** *Ehr.* Cells of V. circular, margin smooth. v.s.

Ehr. in Kütz. Bacill. i. 12?

Fresh water. Aberdeenshire, *Dr. Dickie.*

Plate III. 36.

2. **Coscinodiscus radiatus,** *Ehr.* Cells distinctly hexagonal, arranged concentrically, largest in the centre of valve, margin smooth. Diameter ·0018″ to ·0055″. v.v.

Kütz. Bacill. i. 18. Prit. Anim. xiv. 39.

Marine. Poole Bay, 1848. Stomach of Scallop, coast of Sussex, *W. Sm.* Coast of Norfolk, *Mr. Brightwell.* Near Folkestone, *Mr. Capron.* (Peruvian and African Guano.)

Plate III. 37.

3. **Coscinodiscus eccentricus,** *Ehr.* Cells arranged in eccentric lines, margin spinous. Diameter ·0006″ to 0038″. v.v.

Kütz. Bacill. i. 9.

Marine or brackish water. Poole Bay, Aug. 1848. Near Lewes, July 1850. Stomach of Scallop in great numbers, Feb. 1851.

Plate III. 38.

Genus 7. **EUPODISCUS,** *Ehr.*

Frustules free or adherent, disciform; valves convex; disc with elevated processes.

Closely allied to the last, but differing from it in the less distinctly cellular structure of the valve, which in some species is wholly absent, and in the presence of the horn-like processes of the disc, which do not occur in *Coscinodiscus*. It differs from Genus 10. in its orbicular form and in the horns springing directly from the surface of the valve, while in *Triceratium* they are confined to the angles and are formed by the prolongation of the latter.

1. **Eupodiscus Argus,** *Ehr.* Cells of V. irregular in outline, processes three or four. Diam. ·0065″ to ·0113″. v.s.

Kütz. Bacill. i. 6. *E. Germanicus,* Kütz. Sp. Alg. p. 134. Prit. Anim. xiv. 41.

Marine or brackish water. Thames near Gravesend, *Mr. Poulton.* Near Faversham, *Mr. Shadbolt.* River Orwell near Ipswich, *Mr. Hodgson.*

Plate IV. 39.

2. **Eupodiscus fulvus,** n. sp. Cellular structure indistinct, radiate; colour of dry valve tawny. Diam. ·0018″ to ·0028″. v.v.

Marine. Poole Bay, Sept. 1851, *W. Sm.*

Plate IV. 40.

3. **Eupodiscus crassus,** n. sp. Cells circular; V. somewhat opaque; colour of dry V. purplish; margin smooth. Diam. ·0011 to ·0021. v.v.

Marine. Poole Bay, 1848, *W. Sm.* Near Ipswich, *Mr. Hodgson.*

Plate IV. 41.

4. **Eupodiscus radiatus,** *Bail.*? Cellular structure of V. distinct; cells circular; processes four, radiate, two larger than the others. v.s.

Marine. Detected by *Mr. West* among other Diatomaceæ from the rivers Orwell and Thames.

Supp. Plate XXX. 255.

5. **Eupodiscus sculptus,** n. sp. V. striated, the central striæ forming a quatrefoil; processes two. Diam. ·0013″ to ·0025″. v.s.

Marine. Poole Bay, Sept. 1851, *W. Sm.*

Plate IV. 42.

Genus 8. ACTINOCYCLUS, *Ehr.*

Frustules free or adherent, disciform; valves cellular, undulated; pseudo-nodule central, conspicuous.

The undulations on the surface of the valves appear on the side view as radiating bands; on the front view their true character is easily seen, and they at once distinguish this genus from its allies. It may also be noticed that the cellular structure of the disc is absent from a small portion (pseudo-nodule) in the centre of the valve.

1. **Actinocyclus undulatus,** *Kütz.* Valve with six rays. Diam. ·0009″ to ·0040″. v.v.

Kütz. Bacill. i. 24.

Marine or brackish water: frequent. Poole Bay, Sept. 1849. Near Lewes, Sept. 1850, *W. Sm.* Near Ipswich, *Mr. Hodgson.* (Peruvian Guano; Richmond, Virginia.)

Plate V. 43.

Genus 9. ARACHNOIDISCUS, *Bail.*

Frustules adherent, disciform; valves plane or slightly convex, cellular, marked with concentric and radiating lines; pseudo-nodule central, conspicuous.

This beautiful genus was, I believe, established by Professor Bailey of New York, and has been found in abundance upon Algæ collected in Japan, California and South Africa. The discovery of its British habitat is due to M. De Brébisson of Falaise, who detected a single frustule of the species described below on *Sphacelaria olivacea*, Ag., collected by Mr. Ralfs at Ilfracombe in North Devon. A minute description of this species with carefully executed figures has been given by Mr. Shadbolt in the Transactions of the Microscopical Society of London, vol. iii. p. 49.

1. **Arachnoidiscus Ehrenbergii,** *Bail.* Pseudo-nodule surrounded with a double row of puncta, the interior linear, the exterior circular. Diam. ·0051″ to ·0161″. v.s.

A. Ehrenbergii, Bail. sic cl. De Brébisson in lit. cum icone photographicâ pulcherrimâ! *A. Japonicus,* Prit. Anim. xxiv. 18–21.

Marine. Ilfracombe, *Mr. Ralfs.*

Supp. Plate XXXI. 256.

Genus 10. **TRICERATIUM,** *Ehr.*

Frustules free or attached, triangular; valves cellular, angles elevated or produced.

The triangular form of the frustules separates this genus from all its allies, from which it is also distinguished by the absence of a pseudo-nodule, the appearance of such in *T. striolatum*? being probably accidental in the single individual from which the figure was drawn. The frustules are probably at first attached to larger Algæ, but I have been unable to determine this point from the isolated specimens which have fallen under my notice. The species hitherto found in Britain have occurred on the southern and eastern coasts, in the mud of tidal rivers.

1. **Triceratium Favus,** *Ehr.* Cells hexagonal, angles produced into horn-like obtuse processes. v.s.

Kütz. Bacill. xviii. 11. Quek. H. C. xii. 22 *a*. Bail. Sound. fig. 54. Prit. Anim. xiv. 43, 44.

Marine or brackish water. Thames near Faversham, *Mr. Shadbolt.* River Orwell near Ipswich, *Mr. Hodgson.* (Near Charlestown, communicated by *Prof. Williamson.*)

Plate V. 44. Supp. Plate XXX. 44.

2. **Triceratium alternans,** *Bail.* Cells circular, angles slightly elevated. v.s.

Bail. Sound. figs. 55, 56.

Marine. Poole Bay, Aug. 1848. Hove, Sussex, Nov. 1852, very sparingly, *W. Sm.* Folkestone, Sept. 1852, *Mr. Capron.* (Peruvian Guano.)

Plate V. 45. Supp. Plate XXX. 45.

3. **Triceratium striolatum ?** *Ehr.* V. with acute angles, not elevated or produced; cellular structure faintly discernible. v.s.

Kütz. Bacill. xviii. 10?

Brackish water. Near Lewes, Oct. 1850, *W. Sm.* I refer this doubtfully to the species described and figured by Prof. Kützing.

Plate V. 46.

Genus 11. **CYCLOTELLA,** *Kütz.*

Frustules free or adherent, disciform; valves convex or plane, striated, striæ rayed.

Closely allied to *Coscinodiscus* and *Melosira*, the absence of a cellular structure separating it from the first, the shallow valve and non-adherent frustule from the second. The undulations on the F.V. of the species first described, which are by no means constant, are probably due to an irregular depression in the centre of the valve, a character which may be also noticed in the second species, but being less strongly marked in the latter, and the outline being more regular, the appearance of undulations is not so evident. I have also noticed in the first species, that although no undulations may be discernible in the dry frustule, they become apparent when the objects are immersed in balsam.

1. **Cyclotella Kützingiana,** *Thw.* V. undulated; striæ delicate, extending over half the disc, at margin 20 in ·001″; centre of V. smooth. Diam. ·0005″ to 0015″. v.v.

β. Valve without undulations.

Thw. Ann. 2nd Ser. vol. i. pl. xi. D. *C. operculata β. rectangula,* Kütz. Sp. Alg. p. 19. ad specimina quæ misit cl. De Brébisson, Oct. 1852.

Fresh or brackish water. Near Bristol, *Mr. Thwaites.* Wareham, Nov. 1848. *β.* Lewes, Oct. 1850, *W. Sm.* Thames, Northfleet, *Mr. Shadbolt,* Feb. 1851.

Plate V. 47. *b′*, Sporangial (?) frustule. Frustule with endochrome, Frontispiece, fig. XLVII.

2. **Cyclotella operculata,** *Kütz.* V. depressed in centre; striæ obscure, very short, 36 in 001″. Diam. ·0005″ to ·0012″. v.v.

Ag. Consp. p. 11. Kütz. Bacill. i. 1.

Fresh water. Plumpton, Sussex, Mar. 1852, *W. Sm.* Lough Neagh, *Dr. Dickie.* Cantyre Peat, &c.

Plate V. 48.

3. **Cyclotella antiqua,** n. sp. V. convex; striæ broad, not reaching the margin. Diam. ·0009″ to ·0013″. v.s.

Fresh water. Lough Mourne and Peterhead Deposits. Cantyre Peat, and Marl, Co. Down.

Plate V. 49.

4. **Cyclotella Rotula,** *Kütz.* V. plane; striæ numerous, distinct, 14 in ·001″. Diam. ·0015″ to ·0022″. v.s.

Kütz. Bacill. ii. 4. *Discoplea atmospherica,* Ehr. in Prit. Anim. xxiv. 1 & 2?

Fresh water. Lough Neagh, *Dr. Dickie.*

Plate V. 50.

Genus 12. CAMPYLODISCUS, *Ehr.*

Frustules free, saddle-shaped; valves equidistant; canaliculi radiated.

The species included under this genus may all be recognised by the characteristic bend or contortion of their surfaces. The costæ, as in *Epithemia,* appear to arise from the presence of minute canals which form means of communication between the internal cell-membrane and the surrounding fluid. In one species, *C. cribrosus,* these appearances are absent; but the presence of foramina on the margin in this species seems to indicate the existence of canaliculi, though these are not apparent as distinct costæ.

1. **Campylodiscus Horologium,** *Will.* V. circular; canaliculi about 50, in length one-third of the radius; centre of V. smooth. Diam. ·0051″ to ·0068″. v.s.

Prof. Williamson in Ann. Nat. Hist. May 1848.

Marine. Coast of Skye, dredged in 60 fathoms water by *Mr. G. Barlee,* communicated by *Prof. Williamson.*

Plate VI. 51.

2. **Campylodiscus costatus,** *W. Sm.* V. circular; canaliculi from 30 to 40, in length about half of the radius; centre of V. minutely punctate. Diam. ·0025″ to ·0050″. v.v.

Var. β. V. somewhat elliptical, disc distinctly punctate.

W. Sm. Ann. 2nd Ser. vol. vii. pl. i. 1. Bright. Inf. pl. ix. 10.

Fresh water. River Frome near Dorchester, May 1849. Near Lewes, Aug. 1850, *W. Sm.* Bramley Spring near Guildford, *Mr. Capron.* Norfolk, *Mr. Brightwell.* Lough Mourne Deposit. Peterhead Deposit. Dolgelly Earth, &c. &c. Var. β. Cantyre Peat.

Plate VI. 52. Var. β. Pl. VII. 52.

3. **Campylodiscus Hodgsonii,** n. sp. V. nearly circular; canaliculi very numerous, 100 or upwards, in length about one-third of the radius; centre of the disc cellular; cells circular, in radiating lines. Diam. ·0018″ to ·0052″. v.s.

Marine. Near Ipswich, *Mr. Hodgson,* July 1851. Poole Bay, Oct. 1851, *W. Sm.*

This beautiful species varies much in size, but presents throughout its characteristic features. The disc is frequently traversed by a smooth line corresponding with its longest diameter: a F. V. shows us that this line is formed by a ridge and two contiguous furrows passing across the valve. It is worthy of remark that the ridges on the two valves of the same frustule are not uniformly opposite, but cross each other at various angles: a similar circumstance may sometimes be noted in *Eupodiscus* and other disciform frustules.

Plate VI. ~~63~~. 53

4. **Campylodiscus spiralis,** *W. Sm.* F. twisted so as to present a spiral outline; V. elliptical; canaliculi about 60, nearly parallel; centre of the disc minutely punctate. Longest diam. ·0042″ to ·0083″. v.v.

W. Sm. Ann. 2nd Ser. vol. vii. pl. i. 2. *Surirella spiralis,* Kütz. Bacill. iii. 64?

Fresh water. Bramley near Guildford, Oct. 1848, *Mr. Capron.* Lanshaw Spa, near Katefield, Lancashire, Jan. 1852, *Mr. Geo. Smith.* Norfolk, *Mr. Brightwell.*

Plate VII. 54. Frustule with endochrome, Frontispiece, fig. LIV.

5. **Campylodiscus cribrosus,** *W. Sm.* V. nearly circular; disc cellular; cells irregularly circular, in radiating lines. Diam. ·0041″ to ·0052″. v.v.

W. Sm. 2nd Ser. vol. vii. pl. i. 3. *C. Argus,* Bail. Obs. pl. ii. 24. 25. ad specimina quæ communicavit Prof. Williamson, Jan. 1852.

Marine or brackish water. Poole Bay, Nov. 1848. Lewes, 1850, *W. Sm.* Coast of Norfolk, *Mr. Brightwell.* (Hudson River.)

Plate VII. 55.

6. **Campylodiscus parvulus,** *W. Sm.* Valves circular; canaliculi about 12, minute, in length about two-thirds of radius. Diam. ·0011″ to ·0019″. v.v.

W. Sm. Ann. 2nd Ser. vol. vii. pl. i. 4. Prit. Anim. xxiv. 22, 23.

Poole Bay, 1848, *W. Sm.*

Plate VI. 56.

7. **Campylodiscus Ralfsii,** n. sp. V. nearly circular, canaliculi reaching to the median line. Diam. ·0016″ to ·0019″. v.s.

Marine. Ilfracombe, *Mr. Ralfs.*

Supp. Plate XXX. 257.

Genus 13. **SURIRELLA,** *Turp.*

Frustules free, ovate or elliptical; valves with a longitudinal central line, and margins produced into alæ; canaliculi distinct, usually parallel.

The only genus with which the present stands in near alliance is *Tryblionella,* from which it is well distinguished by the prominency of its alæ, the distinctness of its canaliculi, and the usual cuneate form of its frustules: with no other is it at all likely to be confounded. The surface of the valve in *Surirella,* as in the other *Diatomaceæ,* is marked with transverse lines; these are usually very faint in the present genus, but in a few cases they are somewhat conspicuous and have been noted in the specific descriptions.

1. **Surirella biseriata,** *De Bréb.* F. V. linear, oblong; V. elliptical-lanceolate; alæ conspicuous; canaliculi large, 4 to 6 in ·001″, usually reaching to central line. Length ·0025″ to ·0083″. v.v.

De Bréb. Alg. Falaise, 1835, p. 53. pl. vii. ad spec. authen. quæ communicavit cl. auctor. Hass. Alg. cii. 1. W. Sm. Ann. 2nd Ser. vol. vii. pl. ii. 1. Prit. Anim. xviii. 20–26. Jen. Flo. Tun. p. 204. *Nav. bifrons*, Ehr. Inf. xiv. 2. *Surirella bifrons*, Kütz. Bacill. vii. 10.

Fresh water. Boggy pools frequent, elsewhere occasionally. Wareham, Dec. 1849; Lewes, Sept. 1851, *W. Sm.* Ashdown Forest, Sussex, *Mr. Jenner.* Lough Mourne and Lough Island-Reavey Deposits, and Premnay Peat.

Plate VIII. 57. Frustule with endochrome, Frontispiece, fig. LVII.

2. **Surirella linearis,** n. sp. V. linear, occasionally constricted, obtuse or acuminate. v.v.

With the last, and probably varieties of it and *S. splendida.* Curwen Hill Lot near Lancaster, *Mr. Geo. Smith,* 1851. Snow Mud, Ben M^c Dhui, *Dr. Dickie.* Cantyre Peat, &c.

Plate VIII. 58.

3. **Surirella constricta,** *W. Sm.* F. V. linear, oblong; V. elliptical, acute, usually with a central constriction; alæ conspicuous; canaliculi delicate, 10 to 12 in ·001″, reaching to central line, which is often inflated. Length ·0028″ to ·0055″. v.v.

W. Sm. Ann. 2nd Ser. vol. vii. p. 9.

Brackish water. Near Lewes, Dec. 1850. Poole Bay, Sept. 1851. Lancing, Sussex, Nov. 1852, *W. Sm.*

Plate VIII. 59.

4. **Surirella turgida,** n. sp. V. much inflated, irregular in outline, occasionally somewhat constricted towards the obtuse extremities; canaliculi few, conspicuous, 4 in ·001″. Length ·0033″ to 0052″. v.s.

Fresh water. Lough Neagh, *Dr. Dickie,* 1850.

Plate IX. 60.

5. **Surirella lata,** n. sp. V. elliptical, with rounded ends and frequently with a central constriction; canaliculi conspicuous, 3 or 4 in ·001″; margin striated; striæ 36 in ·001″. Length ·0041″ to ·0062″. v.s.

Marine. Coast of Skye, *Prof. Williamson.* Ilfracombe, *Mr. Ralfs.*

Plate IX. 61.

6. **Surirella splendida,** *Kütz.* F. V. ovate; V. ovate, elongated, alæ distinct; canaliculi conspicuous, 4 in ·001″, reaching the central line. Length ·0050″ to ·0072″. v.v.

Kütz. Bacill. vii. 9. ad specim. authen. quæ misit amic. De Brébisson. W. Sm. Ann. 2nd Ser. vol. vii. pl. ii. 2. *Nav. splendida,* Ehr. Inf. xiv. 1. Prit. Anim. iii. 151.

Fresh water. Near Lewes, Oct. 1850. Ashdown Forest, Sept. 1851, *W. Sm.* Premnay and Cantyre Peat. Dolgelly Earth.

Plate VIII. 62.

7. **Surirella nobilis,** n. sp. V. linear-ovate; canaliculi conspicuous, 3 in ·001″, not reaching to the central line. Length ·0083″ to ·0144″. v.s.

Surirella splendida, W. Sm. Ann. 2nd Ser. vol. vii. pl. ii. 3.

Fresh water. Lough Mourne Deposit. Dolgelly Earth. Raasay Earth. Lough Island-Reavey Deposit, &c.

Plate VIII. 63.

8. **Surirella striatula,** *Turp.* V. broadly ovate, faintly striated; striæ 40 in ·001″; canaliculi distant, 3 in ·001″, reaching the central line. Length ·0041″ to ·0061″. v.v.

Kütz. Bacill. vii. 6. W. Sm. Ann. 2nd Ser. vol. vii. pl. iii. 1. *Navicula striatula,* Ehr. Inf. xxi. 15. Prit. Anim. iii. 137. Bright. Inf. ix. 2.

Marine or brackish water: common. Poole Bay, July 1848. Newhaven, Sussex, Feb. 1852, *W. Sm.* Coast of Norfolk, *Mr. Brightwell.*

Plate IX. 64. Frustule with endochrome, Frontispiece, fig. LXIV.

9. **Surirella Gemma,** *Ehr.* F. V. ovate; V. ovate or elliptical; alæ distinct; canaliculi delicate, unequally distant, reaching central line; surface of V. striated; striæ 48 in ·001″. Length ·0025″ to 0058″. v.v.

Kütz. Bacill. vii. 11. W. Sm. Ann. 2nd Ser. vol. vii. pl. iii. 2. Prit. Anim. xv. 2, 3, 4.

Marine: common. Poole Bay, July 1849. Shoreham Harbour, Aug. 1850, &c., *W. Sm.*

Plate IX. 65.

10. **Surirella fastuosa,** *Ehr.* V. ovate, alæ small; canaliculi few, inflated towards the margin; median line turgid. Length ·0020″ to ·0025″. v.v.

Kütz. Bacill. xxviii. 19. W. Sm. Ann. 2nd Ser. vol. vii. pl. iii. 3.

Marine. Poole Bay, Sept. 1848; Pevensey Bay, Oct. 1850, *W. Sm.* (Peruvian Guano.)

Plate IX. 66.

11. **Surirella Craticula,** *Ehr.* V. lanceolate; alæ distinct; canaliculi few, small, divergent, reaching the median line. v.s.

Kütz. Bacill. xxviii. 22. W. Sm. Ann. 2nd Ser. vol. vii. pl. iii. 4. Prit. Anim. xv. 19–20.

Fresh water. Bramley Spring near Guildford, *Mr. Capron.* River Bann, *Mr. Cocken.* Lough Mourne Deposit.

Plate IX. 67.

12. **Surirella ovalis,** *Bréb.* V. ovate, acuminate, striated; striæ 36 in ·001″; alæ inconspicuous; canaliculi marginal, numerous, 12 in ·001″. Length ·0021″ to ·0038″. v.v.

Kütz. Bacill. xxx. 64. W. Sm. Ann. 2nd Ser. vol. vii. pl. iii. 7.

Fresh water. Near Lewes, Dec. 1852, *W. Sm.* Near Bristol, *Mr. Thwaites.* Norfolk, *Mr. Brightwell.* Pilling, Lancashire, *Rev. J. Bannister.*

Plate IX. 68.

13. **Surirella panduriformis,** n. sp. V. with a subcentral constriction; extremities rounded; canaliculi inconspicuous. Length ·0009″ to ·0016″. v.v.

Fresh water. Iford near Lewes, Oct. 1852, *W. Sm.*

Supp. Plate XXX. 258.

14. **Surirella Brightwellii,** *W. Sm.* V. orbicular, with one extremity acute, striated; striæ 32 in ·001″; alæ inconspicuous; canaliculi distinct, marginal, 10 in ·001″. Length ·0011″ to ·0016″. v.v.

Surirella Crumena, Bréb. in Kütz. Sp. Alg. p. 38. sic cl. De Brébisson in lit. cum specim., Sept. 1852.

Fresh or brackish water. Coast of Norfolk, *Mr. Brightwell,* 1850. Lewes, Sept. 1851, *W. Sm.*

Plate IX. 69.

15. **Surirella ovata,** *Kütz.* V. ovate, minute; alæ small; canaliculi marginal, 11 in ·001″. Length ·0008″ to ·0018″. v.v.

Kütz. Bacill. vii. 1, 2, 3.

Fresh or brackish water. Lewes, March 1851, *W. Sm.* Northfleet, Kent, *Mr. Shadbolt*, Feb. 1852.

Plate IX. 70.

16. **Surirella salina,** *W. Sm.* V. ovate-elliptical; alæ obsolete; canaliculi minute, marginal, numerous, 14 in ·001″. Length ·0005″ to ·0018″. v.v.

W. Sm. Ann. 2nd Ser. vol. vii. pl. iii. 6.

Marine or brackish water. Poole Bay, Sept. 1847; Hastings, Aug. 1851, *W. Sm.* Timber Pond, W. I. Docks, Feb. 1852, *Mr. Shadbolt.*

Plate IX. 71.

17. **Surirella pinnata,** n. sp. V. linear-ovate; alæ obsolete; canaliculi large, subdistant, marginal, 15 in ·001″. Length ·0006″ to ·0013″. v.v.

Fresh water. Near Lewes, Jan. and Dec. 1852, *W. Sm.*

Plate IX. 72.

18. **Surirella angusta,** *Kütz.* F. V. linear truncate; V. linear, acuminate; alæ obsolete; canaliculi 18 in ·001″. Length ·0008″ to ·0014″. v.v.

Kütz. Bacill. xxx. 52. ad specim. quæ misit amic. De Brébisson, Jan. 1853.

Fresh water. Lewes, Dec. 1852, *W. Sm.*

Supp. Plate XXXI. 260.

19. **Surirella subsalsa,** n. sp. F.V. oblong, inflated; V. elliptical-ovate, striated; striæ 30 in ·001″; larger extremity rounded, rarely attenuated; alæ conspicuous; canaliculi distinct, 8 in ·001″. Length ·0006″ to ·0016″. v.v.

Fresh or brackish water. "Brooks" near Lewes, Oct. 1852; Newhaven, Sussex, Dec. 1852, *W. Sm.*

Supp. Plate XXXI. 259.

20. **Surirella minuta,** *De Bréb.* V. ovate-elliptical; alæ inconspicuous; canaliculi marginal, 14 in ·001″. Length ·0005″ to ·0009″. v.v.

De Brébisson in Kütz. Sp. Alg. p. 38. ad specimina authentica quæ communicavit cl. Jenner. W. Sm. Ann. 2nd Ser. vol. vii. pl. iii. 5.

Fresh water. Corfe Castle, Dec. 1849; Lewes, March 1851, *W. Sm.*

Plate IX. 73.

Genus 14. **TRYBLIONELLA,** *W. Sm.*

Frustules free, elliptical or linear; valves plane; alæ submarginal or obsolete; canaliculi inconspicuous, parallel.

This genus differs from *Campylodiscus* in the more elongated form of its frustules and the absence of the characteristic bend in its valves; the canaliculi are also more minute and parallel rather than radiating. It agrees with *Surirella* in the presence of alæ, but these arise from the disc, and are not, as in *Surirella*, prolongations of the margin. It is also distinguished by its less conspicuous canaliculi, and by the frustule never assuming the cuneate form so notable in *Surirella*.

1. **Tryblionella Scutellum,** n. sp. V. elliptical, marked with a central depressed line; canaliculi obsolete; alæ very short. Length ·0058″ to ·0085″. v.v.

Surirella circumsuta, Bail. Obs. pl. ii. 36. ad specimina quæ communicavit Prof. Williamson.

Marine. Poole Bay, Nov. 1848, *W. Sm.* (Hudson River.)

Plate X. 74.

2. **Tryblionella gracilis,** n. sp. F. V. linear, attenuate towards the extremities; V. linear acuminate; canaliculi parallel, extending to the central line, 10 to 12 in ·001″; alæ distinct. Length ·0023″ to 0075″. v.v.

Fresh and brackish water. Near Lewes, Dec. 1850, and Oct. 1852, *W. Sm.*

Plate X. 75. Frustule with endochrome, Frontispiece, fig. LXXV.

3. **Tryblionella marginata,** n. sp. F. V. inflated, extremities obtuse; V. elliptical, acuminate; canaliculi distinct, marginal, 18 in ·001″; alæ conspicuous. Length ·0011″ to ·0026″. v.v.

Fresh and brackish water. Near Lewes, Sept. 1851, *W. Sm.* Pilling and Cockerham Marshes, Lancashire, *Mr. Johnson.* Near Belfast, *Dr. Dickie.*

Plate X. 76. Ideal section of frustule, Pl. X. fig. *s.*

4. **Tryblionella punctata,** n. sp. V. elliptical, acuminate, striated; striæ moniliform, 31 in ·001″; canaliculi obsolete. Length ·0012″ to ·0021″. v.v.

Marine. Coast of Sussex, sparingly, Sept. 1850, *W. Sm.*

Plate X. 76. *a′*. Supp. Plate XXX. 261.

5. **Tryblionella acuminata,** n. sp. V. linear, acuminate; canaliculi obscure; striæ delicate, 40 in ·001″, interrupted; alæ obsolete. Length ·0025″ to ·0042″. v.s.

Marine and brackish water. Poole Bay, June 1849; Belfast Bay, Sept. 1849; near Lewes, Dec. 1850, *W. Sm.*

Plate X. 77.

6. **Tryblionella angustata,** n. sp. V. as in the last species; striæ continuous, 36 in ·001″. Length ·0021″ to ·0040″. v.v.

Fresh water. Iford, Sussex, Oct. 1852, *W. Sm.* Guildford, *Mr. Capron.*

Supp. Plate XXX. 262.

Genus 15. **CYMATOPLEURA,** *W. Sm.*

Frustule free, oblong, or elliptical; valves undulated.

The undulations of the surface of the valves separate the present genus from both the last; the absence of alæ and canaliculi are further characters which leave no room for hesitation as to its distinctness.

1. **Cymatopleura Solea,** *W. Sm.* F. V. oblong, linear; V. fiddle-shaped, symmetrically divided by a central sinus on each margin; undulations six; surface of V. striated; striæ 18 in ·001″. Length ·0042″ to ·0115″. v.v.

W. Sm. Ann. 2nd Ser. vol. vii. pl. iii. 9. *Navicula librilis,* Ehr. Inf. xiii. 22. Prit. Anim. xviii. 9. *Surirella Solea,* Kütz. Bacill. iii. 61. *Sphincto-cystis librilis,* Hass. Alg. cii. 3.

Fresh water: common. Lewes, May 1850, and Oct. 1852, &c., *W. Sm.*

Plate X. 78. Frustule with endochrome, Frontispiece, fig. LXXVIII.

2. **Cymatopleura apiculata,** n. sp. V. fiddle-shaped, apiculated; undulations about four. Length ·0021″ to ·0051″. v.v.

C. Solea, W. Sm. Ann. 2nd Ser. vol. vii. pl. iii. 8.

In numerous localities with the former. I am not certain that the present is entitled to rank as a distinct species; it is usually much smaller than the former and of a more rounded outline, but intermediate specimens sometimes occur, and in Ehr. Inf. xiii. 22. fig. 2, copied in Prit. Anim. pl. iii. fig. 155, we have a form as large as *Solea* with distinct apicula as in the present species.

Plate X. 79.

3. **Cymatopleura parallela,** n. sp. V. linear, extremities attenuate, obtuse. Length ·0021″ to ·0048″.

Fresh water. Iford near Lewes, Oct. 1852, *W. Sm.*

Supp. Plate XXX. 263.

4. **Cymatopleura elliptica,** *W. Sm.* V. broadly elliptical, somewhat acuminate, with four or five undulations; surface obscurely striated. Length ·0016″ to ·0055″. v.v.

Surirella elliptica, Bréb. in Kütz. Spec. Alg. p. 37. ad specimina quæ communicavit cl. De Brébisson, Aug. 1852. W. Sm. Ann. 2nd Ser. vol. vii. pl. iii. 10 & 11. Prit. Anim. xviii. 7.

Fresh water: frequent. River Frome, May 1849. Plumpton, Sussex, April 1852. Guildford, *Mr. Capron,* &c. &c. The larger variety in Lough Mourne and Peterhead Deposits, Dolgelly Earth, &c.

Plate X. 80.

5. **Cymatopleura Hibernica,** *W. Sm.* V. orbicular, with prominent subacute extremities; undulations three; striæ obscure. Length ·0022″ to ·0052″. v.s.

W. Sm. Ann. 2nd Ser. vol. vii. pl. iii. 12.

Fresh water. Lough Neagh, Co. Antrim, *Dr. Dickie.* River Bann, *Mr. Cocken.*

Plate X. 81.

Genus 16. **NITZSCHIA,** *Hass.*

Frustules free, elongated, compressed; valves linear, keeled, with one or more longitudinal lines of puncta; keel frequently eccentric.

This genus embraces a large number of species, differing in form and size, but all agreeing in a few general characters. The most important of these is the keeled form of the valves, and the remarkable inequality, in many of the species, between the portions of the valve lying on either side of this prominency. This inequality, or, in other words, this eccentricity of the keel distinguishes *Nitzschia* from *Amphiprora*, in which the keel is also present, while the presence of a keel and its accompanying line or lines of puncta, together with the absence of any form of stipes, separate the present from the genus *Synedra*, with which several of its species have been united by previous authors. The true character of the valve may be detected by a careful examination of the desiccated frustule, and is easily seen in the figures given in Plates XIII. and XIV. The fractured valve shown in Pl. XIV. fig. 118. *a*, and the sections given in figs. 115. S. and 118. S. will more particularly serve to illustrate the form of valve peculiar to the genus.

Sect. I. Frustules sigmoid. (*Sigmatella*, Kütz.)

1. **Nitzschia sigmoidea,** *W. Sm.* F. linear, sigmoid, truncated; V. linear, suddenly tapering towards the acute extremities; keel with a single line of puncta; striæ 85 in ·001″. Length ·0116″ to ·0192″. v.v.

β. F. reflexed; striæ distinct, 42 in ·001″.

Navicula sigmoidea, Ehr. Inf. xiii. 15. *Synedra sigmoidea*, Kütz. Bacill. iv. 37. *Nitzschia elongata*, Hass. Alg. cii. 12. *Sigmatella Nitzschii*, Kütz. Sp. Alg. p. 18.

Fresh water: very common. Lewes, Dec. 1851, *W. Sm.*

β. Lough Mourne Deposit. Dolgelly Earth.

Plate XIII. 104. 104 β. F. V. of single valve of var. β. Frustule with endochrome, Frontispiece, fig. CIV.

2. **Nitzschia Brebissonii,** *W. Sm.* F. broader and less sigmoid than the last on the F. V.; V. linear; extremities attenuate, produced, obtuse; striæ 27 in ·001″. Length ·0034″ to ·0092″. v.v.

Synedra Armoricana, Kütz. Bacill. iv. 34. *Sigmatella Brebissonii*, Kütz. Sp. Alg. p. 18. ad specimina quæ misit cl. De Brébisson, Oct. 1852.

Fresh water. Near Lewes, Oct. and Dec. 1852, *W. Sm.*

Supp. Plate XXXI. 266.

3. **Nitzschia Sigma,** *W. Sm.* F. on F. V. linear, gradually tapering towards the truncated extremities; V. linear on F. V., somewhat lanceolate, acute; striæ 56 in ·001″; puncta of keel in a double row. Length ·0050″ to ·0116″. v.v.

Synedra Sigma, Kütz. Bacill. xxx. 14.

Marine or brackish water. Pevensey Bay, Sept. 1850, *W. Sm.*

Plate XIII. 108.

4. **Nitzschia obtusa,** n. sp. F. on F. V. linear, with rounded extremities; V. linear, obtuse; puncta double; striæ 56 in ·001″. Length ·0042″ to ·0121″. v.v.

Brackish water. Shagalieu Marsh, Poole Bay, June 1849, *W. Sm.*

Plate XIII. 109.

5. **Nitzschia spectabilis,** n. sp. F. on F. V. linear, sigmoid, truncate; keel nearly central; puncta in 4 rows, the more distant on each side larger; V. striated. v.s.

Brackish water. Near Ipswich, *Mr. Hodgson,* Aug. 1851.

Plate XIV. 116.

Sect. II. Valves linear, straight.

6. **Nitzschia scalaris,** *W. Sm.* F. V. linear, inflated towards the truncated extremities; V. linear, slightly tapering towards the extremities, which are somewhat acute; keel eccentric; puncta double, alternately produced into shorter and longer striæ; surface of valve distinctly striated; striæ 24 in ·001″. Length ·0125″ to ·0172″. v.v.

Synedra scalaris, Kütz. Bacill. xxviii. 32.

Brackish water. Shagalieu Marsh, Poole Bay, June 1849, *W. Sm.*

Plate XIV. 115. Ideal section of frustule, fig. 115 s.

7. **Nitzschia linearis,** *W. Sm.* F. V. linear, with rounded or truncated extremities, occasionally with a slight central constriction; V. linear, with acuminate extremities; keel nearly central; puncta in a single row; striæ obscure. Length ·0023″ to ·0075″.

Frustulia linearis, Ag. ex sp. authen. quæ misit cl. Dr. Greville.

Surirella multifasciata, Kütz. Bacill. iii. 47. et *Synedra oxyrhynchus*, Kütz. Sp. Alg. p. 44. ad specimina quæ misit cl. De Brébisson, Sept. 1852.

Fresh water: common. Lewes, March 1852, *W. Sm.* Wray, *Mr. G. Smith*, Nov. 1852. (Ceylon, *Mr. Thwaites*, Nov. 1850.)

Plate XIII. 110. Supp. Plate XXXI. 110.

8. **Nitzschia tenuis,** *W. Sm.* F. V. linear, occasionally slightly sigmoid, extremities truncate; V. narrow, lanceolate, acute; striæ obscure. Length ·0042″ to ·0083″. v.v.

Synedra tergestina, Kütz. Bacill. iv. 33. ad specimina quæ communicavit cl. De Brébisson, Oct. 1852.

Fresh water. Near Lewes, March 1850, *W. Sm.* Wray near Lancaster, *Mr. G. Smith.*

Plate XIII. 111.

SECT. III. Valves lanceolate.

9. **Nitzschia spathulata,** n. sp. F. V. linear-lanceolate, extremities inflated; V. lanceolate, acute, with a single row of puncta. Length ·0041″ to ·0083″. v.s.

"*Nitzschia spathulata,*" cl. De Brébisson in literis cum speciminibus, Sept. 1852.

Marine. Hull, *Mr. R. Harrison.*

Supp. Plate XXXI. 268.

10. **Nitzschia angularis,** n. sp. F. V. lanceolate, truncate; V. lanceolate; keel central; puncta in a single row; surface of V. longitudinally striated. Length ·0041″ to ·0065″. v.v.

Marine. Coast of Sussex, July 1850, *W. Sm.*

Plate XIII. 117.

11. **Nitzschia lanceolata,** *W. Sm.* F. V. lanceolate, extremities acute; V. linear lanceolate, acute; keel eccentric; surface of valve marked by longitudinal lines, 21 in ·001″; striæ faint, 80 in ·001″. Length ·0048″ to ·0085″. v.v.

Surirella curvula, Bréb. in Kütz. Sp. Alg. p. 36. ad specimina quæ communicavit cl. De Brébisson, Sept. 1852.

Marine. Pevensey Bay, Sussex, Nov. 1850, *W. Sm.*

Plate XIV. 118. Ideal section of frustule undergoing self-division, fig. 118. S.

Sect. IV. Valves arcuate.

12. **Nitzschia Amphioxys,** *W. Sm.* F. V. linear, quadrangular; V. elliptical-lanceolate, arcuate, with acute and somewhat prominent extremities; striæ distinct, 30 in ·001″. Length ·0016″ to ·0043″. v.v.

Eunotia amphioxys, Kütz. Bacill. xxix. 44, xxx. 1.

Fresh water: common. Lewes, Jan. 1851, *W. Sm.*

Plate XIII. 105.

13. **Nitzschia vivax,** n. sp. F. V. linear; V. linear-lanceolate, arcuate, extremities produced into a prominent beak; striæ distinct, 30 in ·001″. Length ·0026″ to ·0056″. v.v.

Fresh or slightly brackish water. Near Lewes, Oct. 1852, *W. Sm.*

Supp. Plate XXXI. 267.

14. **Nitzschia parvula,** n. sp. V. with central constriction, puncta obscure, extremities prominent; striæ faint, 70 in ·001″. Length ·0012″ to ·0015″. v.v.

Marine: encrusting a sponge, Poole Bay, Nov. 1849, *W. Sm.*

Plate XIII. 106.

15. **Nitzschia minutissima,** *W. Sm.* V. linear; puncta distinct, with prominent and acute extremities; striæ obscure, 72 in ·001″. Length ·0008″ to ·0011″. v.v.

Synedra dissipata, Kütz. Bacill. xiv. 3. xxx. 53. ad specimina quæ misit cl. De Brébisson, Sept. 1852.

Fresh water: on chalk rocks. Near Beachey Head, April 1852, *W. Sm.*

Plate XIII. 107.

Sect. V. Valves constricted.

16. **Nitzschia dubia,** *W. Sm.* F. V. elliptical, slightly constricted towards the centre, and tapering towards the somewhat truncate extremities; keel very eccentric; V. obscurely striated; striæ 60 in ·001″. Length ·0042″ to ·0066″. v.v.

β. A smaller form.

β. *Synedra constricta,* Kütz. Bacill. iii. 70. ad spec. quæ dedit amic. De Brébisson.

Brackish water. Near Lewes, Oct. 1851, *W. Sm.* Hull, *Mr. Harrison.* Coast of Norfolk, *Mr. Shadbolt.*

Plate XIII. 112. Plate XIV. 112.

Var. β. Supp. Plate XXXI. 112 β.

17. **Nitzschia bilobata,** *W. Sm.* F. on F. V. elliptical, with a central constriction, and round or truncate extremities; V. linear-lanceolate, acute; puncta double; keel central; striæ distinct, 56 in ·001″. Length ·0033″ to ·0058″. v.v.

Amphiprora latestriata, Bréb. in Kütz. Sp. Alg. p. 93. sic cl. De Brébisson in lit. Aug. 1852.

Brackish water. Poole Bay, Oct. 1849. Shoreham, Nov. 1852.

Plate XV. 113.

18. **Nitzschia plana,** n. sp. F. on F. V. elliptical, with a central constriction and acute extremities; V. linear-lanceolate, acute; puncta in a single row; keel eccentric; surface of V. obscurely striated; striæ interrupted, 56 in ·001″. Length ·0058″ to ·0076″. v.v.

Brackish water. Poole Bay, June 1849, *W. Sm.*

Plate XV. 114.

Sect. VI. Valves with extremities produced. (*Ceratoneis,* Kütz.)

19. **Nitzschia birostrata,** *W. Sm.* F. V. straight, in central portion somewhat lanceolate; extremities produced into extremely long beaks; keel nearly central; puncta in a single row; striæ obscure. Length ·0128″ to ·0169″. v.s.

Ceratoneis longissima, Kütz. Sp. Alg. p. 891. ad specimina quæ communicavit cl. De Brébisson, Sept. 1852.

Marine. Near Walton, Essex, *Mr. Topping.*

Plate XIV. 119.

20. **Nitzschia Closterium,** *W. Sm.* F. V. arcuate; V. faintly striated; striæ 90 in ·001″; otherwise as in the last. v.v.

Ceratoneis Closterium, Kütz. Bacill. iv. 11. Ehr. in Prit. Anim. xv. 59.

Marine and brackish water. Hove, Sussex, May 1851, *W. Sm.*

Plate XV. 120.

21. **Nitzschia reversa,** n. sp. F. V. lanceolate; extremities produced into beaks which are bent in contrary directions; striæ 48 in ·001″; puncta obsolete. v.v.

Brackish water. Near Lewes, Nov. 1851, *W. Sm.*

Plate XV. 121.

22. **Nitzschia acicularis,** *W. Sm.* F. V. lanceolate, extremities produced, beaks straight; V. faintly striated; striæ 98 in ·001″. v.v.

Synedra acicularis, Kütz. Bacill. iv. 3.

Fresh water. Near Lewes, May 1852, *W. Sm.*

Plate XV. 122.

23. **Nitzschia Tænia,** *W. Sm.* F. V. linear-lanceolate, occasionally sigmoid, extremities produced; beaks direct or curved; V. striated, striæ 72 in ·001″; endochrome in dry frustule apparently arranged in a spiral manner. v.v.

Ceratoneis gracilis, Bréb. in Kütz. Sp. Alg. p. 89. ad specim. quæ communicavit cl. De Brébisson, Oct. 1852.

Brackish water. Near Lewes, Sept. 1851, *W. Sm.* Braunton, Devonshire, *Mr. Ralfs*, Oct. 1849.

Plate XV. 123.

Genus 17. AMPHIPRORA, *Ehr.*

Frustules free, elliptical, constricted; valves convex, keeled; keel central, with a longitudinal line, and nodules at centre and extremities.

The very peculiar frustules of this genus cannot be confounded with any others, save with those of the fifth section of the last genus, and from these they are usually distinguished without much difficulty, owing to their deeper constriction, the central position of their keel, and their less firmly siliceous structure. They are frequently found in large numbers, and with the exception of one species are marine in their habitat. They are common in the estuaries of all our larger rivers, and the sheltered bays of the southern and western coasts of England. I have also examined specimens from the coast of Normandy, the shores of the United States, and the Arctic Regions.

1. **Amphiprora alata,** *Kütz.* F. twisted; F. V. elliptical, with rounded extremities; V. linear-elliptical; keel accompanied by a double line of puncta; surface of V. striated; striæ 42 in ·001″. Length ·0025″ to ·0052″. v.v.

Kütz. Bacill. iii. 63. Bright. Inf. x. 1. 3. Prit. Anim. xvi. 5 & 7. Bail. Obs. 8, 9, 10.

Marine and brackish water: very common. Coast of Sussex, April and Aug. 1850, *W. Sm.*

Plate XV. 124. Frustule with endochrome, Frontispiece, fig. CXXIV.

2. **Amphiprora paludosa,** n. sp. F. twisted; F. V. elliptical, with round or truncate extremities; constriction very deep; V. striated; striæ 60 in ·001″. Length ·0016″ to ·0042″. v.v.

In fresh or slightly brackish water. Near Lewes, Sept. 1852, *W. Sm.*

Supp. Plate XXXI. 269.

3. **Amphiprora didyma,** n. sp. F. straight, elliptical, deeply constricted; striæ faint, 72 in ·001″. v.v.

Marine. Lytham, Lancashire, Sept. 1849, *W. Sm.*

Plate XV. 125.

4. **Amphiprora vitrea,** n. sp. F. straight; F. V. elliptical, constriction very slight; V. lanceolate, striated; striæ 52 in ·001″. Length ·0023″ to ·0052″. v.v.

Marine. Shoreham Harbour, Sept. 1852, *W. Sm.*

Supp. Plate XXXI. 270.

5. **Amphiprora constricta,** *Ehr.* F. membranaceous, hyaline, straight, elliptical; V. linear-elliptical, with a central sinus and

transverse line; striæ faint, 68 in ·001″. Length ·0024″ to ·0054″. v.v.

Kütz. Bacill. xxix. 34. Prit. Anim. xvi. 6?

Marine and brackish water. Coast of Sussex, April 1850, *W. Sm.*

Plate XV. 126.

Genus 18. **AMPHIPLEURA,** *Kütz.*

Frustules free, linear; V. with longitudinal ridges.

The structure of the present genus is somewhat obscure. I have not been able to detect the nature of the ridges so conspicuous on the front view, nor to determine the parts of the valve from which they project. Ehrenberg, in his great work *Infusionsthierchen*, taf. xiii. fig. iii. 7, gives an *ideal* section of the frustule, which represents the ridges as springing from the surface of a convex valve, having between them a depression which corresponds in position with the ordinary median line of the *Naviculæ*. I am unable to confirm this description, although I have on frequent occasions examined the living and dry valves.

1. **Amphipleura pellucida,** *Kütz.* Frustules linear-lanceolate. Length ·0033″ to ·0054″. v.v.

Kütz. Bacill. iii. 52. *Aulacocystis pellucida,* Hass. Alg. cii. 8. *Nav. pellucida,* Ehr. Inf. xiii. 3. Prit. Anim. iii. 140. xvi. 1.

Fresh water. Lewes, Nov. 1850, *W. Sm.* Katefield, Lancashire, Jan. 1851, *Mr. G. Smith.*

Plate XV. 127.

2. **Amphipleura sigmoidea,** *W. Sm.* Frustules sigmoid. Length ·0058″ to ·0138″. v.v.

Amphipleura rigida, Kütz. Bacill. iv. 30. ad specim. authen. quæ communicavit cl. De Brébisson.

Marine and brackish water: forms a distinct pellicle or stratum. Bexhill, Sussex, Sept. 1850, *W. Sm.* Lancing, Nov. 19, 1852.

Plate XV. 128.

Genus 19. **NAVICULA,** *Bory.*

Frustules free, oblong or lanceolate; valves convex, with a median longitudinal line and nodules at centre and extremities, striated; striæ resolvable into circular dots.

In the present work, the genus *Navicula* of Kützing is divided into three; viz. *Navicula, Pinnularia,* and *Pleurosigma. Stauroneis* has already been placed apart both by Ehrenberg and Kützing.

The four genera are, I think, sufficiently distinguished from each other; *Navicula,* by the delicacy of its striæ and their moniliform character; *Pinnularia,* by the confluent nature of the cellular structure of its epiderm, which gives to its striæ the appearance of distinct ribs or costæ; *Stauroneis,* by the absence of a central nodule, which is supplied by a band of silex (Stauros) crossing the valve at right angles to the median line; and *Pleurosigma,* by the characteristic curve of its beautiful frustules.

In a few cases we meet with the semblance of a Stauros in the genus *Pinnularia*; but in these instances a closer examination will show that this appearance arises from the interruption of the costæ merely, and not from the dilatation of the central nodule, which is still found unchanged.

Sect. I. Valves lanceolate.

1. **Navicula rhomboides,** *Ehr.* V. nearly quadrangular; striæ very faint, parallel, 85 in ·001″. Length ·0022″ to ·0037″. v.v.

Ehr. in Kütz. Bacill. xxviii. 45, xxx. 44, sic Prof. Kützing in lit. 1851.

Fresh water. Boggy pools, Sept. 1849, *W. Sm.* Lancashire, *Mr. Johnson,* Aug. 1851. Ben Mc Dhui, at an elevation of 3000 feet, *Mr. P. Grant.*

Plate XVI. 129.

2. **Navicula lanceolata,** *Kütz.* V. lanceolate or elliptical-lanceolate; striæ parallel, ·44 in 001″. Length ·0012″ to ·0020″. v.v.

Kütz. Bacill. xxviii. 38. xxx. 48?

Fresh water. Newhaven, Sussex, Dec. 1852, *W. Sm.* Dolgelly Earth.

Supp. Plate XXXI. 272.

3. **Navicula Crassinervia,** *Bréb.* V. elliptical-lanceolate; extremities produced; striæ obscure. Length ·0013″ to ·0026″. v.s.

"*Navicula Crassinervia,*" ad specimina sub hoc nomine quæ misit cl. De Brébisson, Sept. 1852.

Fresh water. Wareham, Sept. 1849, *W. Sm.* Snow Mud, Grampians, *Dr. Dickie.* Dolgelly, *Mr. Ralfs.*

Supp. Plate XXXI. 271.

4. **Navicula serians,** *Kütz.* V. acute; transverse striæ faint, 60 in ·001″; longitudinal distinct, 36 in ·001″; frustules frequently cohering. Length ·0017″ to ·0035″. v.v.

Kütz. Bacill. xxviii. 43, xxx. 23, ad specimina quæ communicavit cl. De Brébisson in lit. Sept. 1852.

Fresh water: boggy pools. Wareham, Sept. 1849, *W. Sm.* Forest Row, Sussex, *Mr. Jenner,* Jan. 1844. Ben M[c] Dhui, at an elevation of 3000 feet, *Mr. P. Grant.* Lough Island-Reavey Deposit. (Lapland.)

Plate XVI. 130.

5. **Navicula cuspidata,** *Kütz.* V. acute; striæ parallel, distinct, 36 in ·001″. Length ·0027″ to ·0062″. v.v.

Kütz. Bacill. iii. 24 & 37. ad specim. authen. quæ misit amic. De Brébisson. *Navicula fulva,* Ehr. Inf. xiii. 6.

Fresh water: ditches. Lewes, Sept. 1850, *W. Sm.* Guildford, *Mr. Capron.* Belfast, *Dr. Dickie.* Cantyre Peat. Lough Mourne and Peterhead Deposits.

Plate XVI. 131.

6. **Navicula rhynchocephala,** *Kütz.* V. acute; extremities produced, linear; striæ distinct, radiate, 24 in ·001″. v.s.

Kütz. Bacill. xxx. 35?

Fresh water. Belfast, *Dr. Dickie.*

Plate XVI. 132.

SECT. II. Valves elliptical, extremities rounded.

7. **Navicula Liber,** n. sp. F. V. oblong; V. elliptical, with rounded extremities; striæ delicate, 48 in ·001″; colour of dry V. purplish. v.v.

Marine. Coast of Sussex, Sept. 1851, *W. Sm.*

Plate XVI. 133.

8. **Navicula firma,** *Kütz.* V. elliptical, somewhat attenuated towards the rounded extremities; striæ obscure, 42 in ·001″, parallel. Length ·0025″ to ·0045″. v.v.

β. Extremities suddenly attenuated; frustule smaller.

β. Kütz. Bacill. xxi. 10.

Fresh water. Near Lewes, Oct. 1851, *W. Sm.* Near Belfast, *Dr. Dickie.* β. Lough Mourne and Peterhead Deposits. Cantyre Peat. Marl, Co. Down. (Vermont, U.S., *Prof. Williamson.* San Fiore, Italy.)

Plate XVI. 138.

9. **Navicula elliptica,** n. sp. V. elliptical; striæ distinct, 21 in ·001″, interrupted towards the central line. Length ·0012″ to ·0032″. v.v.

Marine. Poole Bay, Sept. 1850; Seaford, Sussex, Aug. 1851, *W. Sm.*

Plate XVII. 152. Var. (Sporangial?) From Poole Bay, 152 *a**. Frustule with endochrome, Frontispiece, fig. CLII.

10. **Navicula ovalis,** *W. Sm.* V. elliptical, occasionally inflated; striæ distinct, 27 in ·001″, interrupted. Length ·0012″ to ·0020″. v.v.

Navicula elliptica, Kütz. Bacill. xxx. 55.

Fresh water. Plumpton, Sussex, April 1852, *W. Sm.* Guildford, *Mr. Capron.* Cantyre Peat. Lough Mourne and Peterhead Deposits. Rescobie and Killicrankie, *Mr. P. Grant.* (Ceylon, *Mr. Thwaites,* Nov. 1850.)

Plate XVII. 153.

11. **Navicula minutula,** n. sp. V. exactly elliptical; striæ faint, 80 in ·001″. Length ·0006″ to ·0011″. v.v.

Fresh water. Near Lewes, Oct. 1852, *W. Sm.*

Supp. Plate XXXI. 274.

SECT. III. Valves elliptical, extremities acute.

12. **Navicula Jennerii,** *W. Sm.* F. V. oblong; V. twisted, elliptical; extremities somewhat acute; striæ very distinct, 30 in ·001″, reaching the central line; colour of dry valve a pale purple. Length ·0025″ to ·0068″. v.v.

Navicula tumida, Bréb. in Kütz. Sp. Alg. p. 77. ad specimina quæ communicavit cl. De Brébisson in lit. Sept. 1852.

Marine or brackish water. Rye, *Mr. Jenner.* Belfast Bay, Aug. 1849, and Coast of Sussex, frequent, Feb. 1852, *W. Sm.* Menai Straits, *Prof. Williamson,* July 1852.

Plate XVI. 134. *b.* outline of F. V.

13. **Navicula Westii,** n. sp. F. V. oblong; V. straight, elliptical, acute; striæ delicate, scarcely reaching the central line, 38 in ·001″; colour of dry valve a dark purple. Length ·0032″ to ·0042″. v.v.

Marine: detected by *Mr. Tuffen West* with the last, May 1852. Shoreham Harbour, Nov. 1852, *W. Sm.*

Plate XVI. 135.

14. **Navicula convexa,** n. sp. F. V. oblong; V. twisted, acute; striæ very distinct, 21 in ·001″, not reaching the central line; dry valve colourless. Length ·0048″ to ·0062″. v.v.

Marine. Coast of Sussex, Sept. 1851. Harwich, *Mr. Shadbolt,* May 1852.

Plate XVI. 136. *b.* outline of F. V. Frustule with endochrome, Frontispiece, fig. CXXXVI.

15. **Navicula elegans,** n. sp. V. elliptical acuminate; striæ distinct, 24 in ·001″, waved, radiate, absent around the central nodule. Length ·0020″ to ·0032″. v.v.

Marine or brackish water. Poole Bay, June 1849, *W. Sm.* Cockerham Marsh, Lancashire, *Mr. Johnson.*

Plate XVI. 137.

16. **Navicula patula,** *W. Sm.* V. elliptical, somewhat acute; striæ delicate, 36 in ·001″, not reaching the central line; colour of dry valve purple. Length ·0030″ to ·0040″. v.s.

Navicula latiuscula, Kütz. Bacill. v. 40. specim. authen. misit cl. De Brébisson.

Fresh water. Marl, Co. Down.

Plate XVI. 139.

17. **Navicula palpebralis,** *Bréb.* V. elliptical, acute; striæ not reaching central line, 27 in ·001″. Length ·0015″ to ·0032″. v.s.

"*Navicula palpebralis,*" cl. De Brébisson in lit. Sept. 1852.

Marine. Poole Bay, Aug. 1848. Hull, *Mr. R. Harrison.*

Supp. Plate XXXI. 273.

Sect. IV. Valves inflated; extremities rounded.

18. **Navicula obtusa,** n. sp. V. elliptical, contracted towards the rounded extremities; striæ distinct, 33 in ·001″, not reaching the central line. v.s.

Fresh water. Raasay Earth. Marl, Co. Down. Lough Mourne Deposit.

Plate XVI. 140.

19. **Navicula Semen,** *Kütz.* V. oval, contracted towards the rounded extremities; striæ distinct, 26 in ·001″. v.s.

Kütz. Bacill. xxviii. 49.

Fresh water. Peterhead Deposit. Lough Mourne Deposit, &c.

Plate XVI. 141.

20. **Navicula affinis,** *Ehr.* V. elliptical, contracted, and linear towards the rounded extremities. v.s.

Ehr. in Kütz. Bacill. xxx. 45 ?

Fresh water. Guildford, *Mr. Capron.*

Plate XVI. 143.

21. **Navicula inflata,** *Kütz.* V. elliptical, inflated; extremities obtuse; striæ distinct, 28 in ·001″. v.s.

Kütz. Bacill. iii. 36.

Fresh water. Guildford, *Mr. Capron.* Peterhead Deposit.

Plate XVII. 158.

22. **Navicula gibberula,** *Kütz.* V. inflated at the centre, linear towards the rounded extremities. v.v.

Kütz. Bacill. iii. 50*.

Fresh water. Lewes, Feb. 1851, *W. Sm.* Guildford, *Mr. Capron.* Lough Mourne Deposit. Cantyre Peat. Marl, Co. Down. Dolgelly Earth. Ben Mc Dhui, *Mr. P. Grant.*

Plate XVII. 160.

Sect. V. Valves with extremities produced.

23. **Navicula amphirhynchus,** *Ehr.* V. linear, abruptly contracted towards the produced extremities; striæ faint, 48 in ·001″. Length ·0020″ to ·0036″. v.v.

Kütz. Bacill. xxi. 11.

Fresh water. Lewes, Oct. 1851, *W. Sm.* Lough Mourne and Peterhead Deposits. Premnay Peat and Dolgelly Earth. (San Fiore, Italy.)

Plate XVI. 142.

24. **Navicula producta,** n. sp. V. elliptical, abruptly contracted towards the produced extremities; striæ faint, 42 in ·001″. v.v.

Fresh water. Lewes, Oct. 1851, *W. Sm.* East Shalford, *Mr. Capron.*

Plate XVII. 144.

25. **Navicula ambigua,** *Ehr.* V. elliptical, gradually contracted towards the obtuse extremities, which are produced; striæ distinct, parallel, 36 in ·001″. Length ·0021″ to ·0033″. v.v.

Ehr. in Kütz. Bacill. xxviii. 66.

Fresh water. Lewes, Oct. 1851, *W. Sm.*

Plate XVI. 149. Frustule with endochrome, Frontispiece, fig. CXLIX.

26. **Navicula Amphisbæna,** *Bory.* V. elliptical, constricted towards the extremities, which are rounded and produced; striæ delicate, 40 in ·001″, not reaching the central line. Length ·0021″ to ·0032″.

β. Extremities slightly produced, obtuse. Length ·0017″ to ·0027″. v.v.

Kütz. Bacill. iii. 41 and 42 β. Ehr. Inf. xiii. 7. Prit. Anim. iii. 141. Hass. Alg. cii. 5.

Fresh water. Lewes, Feb. 1851, *W. Sm.* Wray, *Mr. G. Smith.* Guildford, *Mr. Capron.* Var. β. Lewes, April and October, 1852, and Feb. 1853, *W. Sm.*

Plate XVII. 147. Var. β. Pl. XVII. 147 β.

27. **Navicula sphærophora,** *Kütz.* V. elliptical, constricted towards the extremities, which are rounded and produced; striæ very delicate, 42 in ·001″. Length ·0022″ to ·0036″. v.v.

Kütz. Bacill. iv. 17. Sp. Alg. p. 75. ad specim. quæ misit amic. De Brébisson.

Fresh water. Lewes, Oct. 1851, *W. Sm.* Lough Mourne Deposit.

Plate XVII. 148.

28. **Navicula angustata,** n. sp. V. very narrow, elliptical, contracted towards the rounded and produced extremities; striæ 45 in ·001″. Length ·0016″ to ·0022″. v.s.

Fresh water. Killicrankie, *Mr. P. Grant.* Raasay Earth.

Plate XVII. 156.

29. **Navicula tumens,** n. sp. F. V. inflated; V. elliptical, extremities slightly produced; striæ interrupted, faint, 36 in ·001″. Length ·0025″ to ·0031″. v.v.

Brackish water. Newhaven, Sussex, Feb. 1852, *W. Sm.*

Plate XVII. 150. *b.* outline of F. V.

30. **Navicula punctulata,** n. sp. V. oval, extremities scarcely produced; striæ distinct, 33 in ·001″, moniliform. Length ·0016″ to ·0032″. v.v.

Marine. Poole Bay, Sept. 1850, and Seaford, Sussex, Aug. 1851, *W. Sm.*

Plate XVI. 151.

31. **Navicula pusilla,** n. sp. V. oval, extremities slightly produced; striæ distinct, 26 in ·001″, radiating, punctate. v.v.

Brackish water. Lewes, Oct. 1850, *W. Sm.* Near Belfast, *Dr. Dickie.*

Plate XVII. 145.

32. **Navicula tumida,** n. sp. V. elliptical, contracted at the extremities, which are rounded and produced; striæ very distinct, 24 in ·001″, reaching central line, punctate and radiate. v.s.

Fresh water. Bramley near Guildford, *Mr. Capron,* Nov. 1850.

Plate XVII. 146.

33. **Navicula dicephala,** *Kütz.* V. linear, constricted towards the rounded extremities; striæ distinct, 26 in ·001″, radiate. v.s.

Kütz. Bacill. xxviii. 60?

Fresh water. Guildford, *Mr. Capron.* Lough Mourne Deposit.

Plate XVII. 157.

34. **Navicula cryptocephala,** *Kütz.* V. minute, constricted towards the obtuse extremities; striæ faint, 56 in ·001″. v.v.

Kütz. Bacill. iii. 20 & 26.

Freshwater streams. Corfe Castle, Dec. 1849, *W. Sm.* Belfast, *Dr. Dickie.*

Plate XVII. 155.

Sect. VI. Valves with a central constriction.

35. **Navicula didyma,** *Kütz.* V. elliptical, more or less deeply constricted in the centre; striæ interrupted, distinct, 24 in ·001″. Length ·0014″ to ·0032″. v.v.

Kütz. Bacill. iv. 7. xxviii. 75. *Navicula interrupta,* Kütz. Bacill. xxix. 93. *Pinnularia Apis,* Ehr. in Kütz. Bacill. xxviii. 76.

Marine: very common. Sussex, July 1850, *W. Sm.* (New Zealand.)

Plate XVII. 154. *a.* and *a′*. ordinary forms; *b.* outline of ditto in S. D.; *a**. var. (Sporangial?) from Skye, *Prof. Williamson.* Frustule with endochrome, Frontispiece, fig. CLIV.

36. **Navicula binodis,** *Ehr.* V. constricted in the centre, extremities slightly produced; striæ obscure. v.s.

Kütz. Bacill. iii. 35.

Fresh water. Lewes, Aug. 1850, *W. Sm.*

Plate XVII. 159.

Genus 20. **PINNULARIA,** *Ehr.*

Frustules free, oblong or lanceolate; valves convex, with a median line, and nodules at centre and extremities; ribbed or pinnated with distinct costæ not resolvable into dots.

The species in which the costæ are absent from the centre of the valve, as noticed at page 46, belong to Ehrenberg's genus *Stauroptera*, but the limits of that genus are too indefinite to permit me to adopt it in the present work.

1. **Pinnularia nobilis,** *Ehr.* V. linear, obtuse, with a central and terminal inflation; costæ radiate, not reaching the median line, contiguous, 12 in ·001″. Length ·0112″ to ·0145″. v.s.

Navicula nobilis, Kütz. Bacill. iv. 24. Sp. Alg. p. 80. ad specim. quæ misit amic. De Brébisson. Quek. H. C. pl. xii. 1. *a*.

Fresh water. Lough Mourne Deposit. Dolgelly Earth. Premnay Peat. Cantyre Peat. (Nova Scotia. Vermont, U.S.)

Plate XVII. 161.

2. **Pinnularia major,** *W. Sm.* V. linear, obtuse, with a central inflation; costæ as in the last, 14 in ·001″. Length ·0072″ to ·0122″. v.s.

Navicula major, Kütz. Bacill. iv. 19. *Navicula viridis*, Ehr. Inf. xiii. 16. Hass. Alg. cii. 2.

Fresh water. Lough Mourne Deposit. Premnay Peat. Dolgelly Earth. Mountains of Aberdeen, *Dr. Dickie.* Cantyre Peat. Peterhead and Lough Island-Reavey Deposits.

Plate XVIII. 162.

3. **Pinnularia viridis,** *W. Sm.* V. elliptical, attenuated; costæ as in the last, 16 in ·001″. Length ·0021″ to ·0068″. v.v.

β. Costæ parallel, absent from centre of valve.

Navicula viridis, Ehr. Inf. xxi. 12. Prit. Anim. iii. 133–136. xviii. 1–6. Kütz. Bacill. iv. 18, 20. Quek. H. C. xii. 1. *b*. *Navicula viridula*, Ehr. Inf. xiii. 17.

Fresh water: very common. Wareham, Feb. 1848, *W. Sm.* Lough Mourne, Lough Island-Reavey, and Peterhead Deposits. Premnay Peat. Dolgelly Earth. Cantyre Peat. (New Zealand, Nova Scotia, &c.) Var. *β*. Lewes, Mar. 1852, *W. Sm.* Ben Mc Dhui, *Mr. P. Grant.*

Plate XVIII. 163. Frustule with endochrome, Frontispiece, fig. CLXIII. Var. *β*. Pl. XVIII. 163 *β*.

4. **Pinnularia acuminata,** n. sp. V. linear, suddenly attenuated towards the acute extremities; costæ parallel, not reaching the central line. v.s.

Fresh water. Premnay Peat.

Plate XVIII. 164.

5. **Pinnularia oblonga,** *W. Sm.* V. lanceolate, extremities rounded; costæ radiate, reaching central line, distant, 11 in ·001″. Length ·0042″ to ·0066″. v.v.

Navicula macilenta, Ehr. Inf. xxi. 13. *Navicula oblonga,* Kütz. Bacill. iv. 21.

Fresh water: common. Lewes, Oct. 1852, *W. Sm.* Belfast, *Dr. Dickie.* Peterhead Deposit. Marl, Co. Down.

Plate XVIII. 165. Frustule with endochrome, Frontispiece, fig. CLXV.

6. **Pinnularia cardinalis,** *Ehr.* V. linear, extremities rounded; costæ radiate, absent from the centre of V., distant, 9 in ·001″. v.s.

Stauroneis cardinalis, Kütz. Bacill. xxix. 10. Prit. Anim. xv. 72.

Fresh water. Lough Mourne Deposit. Cantyre Peat.

Plate XIX. 166.

7. **Pinnularia lata,** *W. Sm.* V. linear, slightly inflated at the centre; costæ scarcely radiate, not reaching central line, distant, 7 in ·001″. Length ·0025″ to ·0044″. v.v.

Navicula lata, De Brébisson in lit. cum specim. Kütz. Sp. Alg. p. 79.

Fresh water: subalpine. Fell End, Lancashire, at an elevation of 900 feet, *Mr. Johnson,* May 1851. Snow Mud, on Ben Mc Dhui, at an elevation of 3840 feet, *Dr. Dickie.*

Plate XVIII. 167. *d.* outline of ditto in S. D.

8. **Pinnularia alpina,** n. sp. V. elliptical-lanceolate, obtuse; costæ radiate, not reaching central line, distant, 7 to 9 in ·001″. Length ·0038″ to ·0083″. v.s.

Fresh water: subalpine. Mountains of Aberdeen, *Dr. Dickie.* Ben Mc Dhui, *Mr. P. Grant.* (Falaise, *M. De Brébisson.*)

Plate XVIII. 168. *b.* outline of F. V.

9. **Pinnularia distans,** n. sp. V. lanceolate, acute; costæ radiate, not reaching central line, distant, 10 in ·001″. Length ·0036″ to ·0052″. v.s.

Marine. Stomach of Scallop, Feb. 1851. Coast of Sussex, *W. Sm.*

Plate XVIII. 169. *b.* outline of F. V.

10. **Pinnularia peregrina,** *Ehr.* V. lanceolate, obtuse; costæ radiate, reaching central line, subdistant, 13 in ·001″. Length ·0032″ to ·0058″. v.v.

Ehr. in Kütz. Bacill. xxviii. 52.

Brackish water. Near Lewes, Nov. 1851, *W. Sm.* Cockerham Marsh, Lancashire, *Mr. Johnson,* Mar. 1852.

Plate XVIII. 170.

11. **Pinnularia acuta,** n. sp. V. lanceolate, acute; costæ radiate, reaching central line, 22 in ·001″. Length ·0026″ to ·0046″. v.v.

Fresh water. Plumpton, Sussex, Mar. 1852, *W. Sm.* Lough Mourne Deposit. Near Aberdeen, *Dr. Dickie.* Cantyre Peat. Marl, Co. Down. Dolgelly Earth. Peterhead Deposit.

Plate XVIII. 171.

12. **Pinnularia directa,** n. sp. V. linear-lanceolate, acute; costæ parallel, reaching central line, 20 in ·001″. Length ·0025″ to ·0037″. v.v.

Marine. Coast of Sussex, Feb. 1852, *W. Sm.*

Plate XVIII. 172. *b.* outline of F. V.

13. **Pinnularia radiosa,** *W. Sm.* V. lanceolate, obtuse; costæ radiate, contiguous, 24 in ·001″. Length ·0016″ to ·0025″. v.v.

Navicula radiosa, Kütz. Bacill. iv. 23?

Fresh water: frequent. Corfe Castle, Dec. 1849, *W. Sm.* Wray, *Mr. G. Smith.* Peterhead Deposit. Lough Mourne Deposit. Cantyre Peat. Dolgelly Earth.

Plate XVIII. 173.

14. **Pinnularia gracilis,** *Ehr.* V. elliptical-lanceolate, attenuated towards the extremities; costæ radiate, contiguous. Length ·0016″ to ·0022″. vv.

Navicula gracilis, Ehr. Inf. xiii. 2? Kütz. Bacill. iii. 48? *Navicula lanceolata,* Hass. Alg. cii. 14.

Fresh water: frequent. Lewes, May 1850, *W. Sm.* Shalford, *Mr. Capron.*

Plate XVIII. 174.

15. **Pinnularia viridula,** *W. Sm.* V. elliptical-lanceolate, obtuse; costæ faint. Length ·0006″ to ·0016″. v.v.

Navicula viridula, Kütz. Bacill. xxx. 47?

Fresh water. Kingston, Sussex, Nov. 1851, *W. Sm.*

Plate XVIII. 175.

16. **Pinnularia Cyprinus,** *Ehr.* V. elliptical, with a central inflation; extremities somewhat acute; costæ radiate, reaching central line, subdistant, 18 in ·001″. Length ·0016″ to ·0035″. v.v.

Ehr. in Kütz. Bacill. xxix. 35?

Marine. Belfast Bay, Aug. 1849, and Coast of Sussex, frequent, Sept. 1851, *W. Sm.* Harwich, *Mr. Shadbolt.*

Plate XVIII. 176. *b.* outline of F. V.

17. **Pinnularia divergens,** n. sp. V. linear-elliptical, somewhat attenuated towards the rounded extremities; costæ radiate at centre, afterwards divergent, absent from the middle of valve, subdistant, 11 in ·001″.

Fresh water. Premnay Peat. Dolgelly Earth.

Plate XVIII. 177.

18. **Pinnularia stauroneiformis,** *W. Sm.* V. elliptical; costæ absent from the centre of V., not reaching the central line, contiguous, 30 in ·001″. Length ·0011″ to ·0025″. v.v.

Navicula Brebissonii, Kütz. Bacill. iii. 49. xxx. 39. Sp. Alg. p. 72. ad specim. quæ dedit amicus De Brébisson.

Fresh water. Lewes, Feb. 1852, *W. Sm.* Ben M[c] Dhui, at an elevation of 3000 feet, *Mr. P. Grant.*

Plate XIX. 178.

19. **Pinnularia Johnsonii,** n. sp. V. linear, with central and terminal inflations; costæ reaching central line, 56 in ·001″. Length ·0042″ to ·0072″. v.v.

β. Inflations very slight. Length ·0025″ to ·0035″. v.v.

Marine or brackish water. Pilling near Lancaster, *Mr. Johnson,* Feb. 1851. β. Shoreham, Sussex, Mar. 1851, *W. Sm.*

Plate XIX. 179. Var. β. Pl. XIX. 179 β.

20. **Pinnularia gibba,** *Ehr.* V. linear, with central and terminal inflations; costæ not reaching central line, contiguous, 30 in ·001″. v.v.

Navicula acrosphæria, Kütz. Bacill. v. 2. Sp. Alg. p. 78. ad specim. quæ misit amic. De Brébisson.

Fresh water. Boggy pools, Wareham, Sept. 1847, *W. Sm.* Curwen Hill, Lancashire, *Mr. G. Smith.* Cantyre Peat. Premnay Peat.

Plate XIX. 180.

21. **Pinnularia Tabellaria,** *W. Sm.* V. as in the last, but central inflation more distinct; costæ subdistant, 22 in ·001″. v.v.

Navicula tabellaria, Kütz. Bacill. xxviii. 79. Prit. Anim. xv. 21.

Fresh water. Lewes, Sept. 1850, *W. Sm.*

Plate XIX. 181.

22. **Pinnularia acrosphæria,** *W. Sm.* V. as in the last two; inflations more distinct; costæ distant, 16 in ·001″. v.v.

Fresh water. Near Lewes, Sept. 1850, *W. Sm.* Premnay Peat. Dolgelly Earth.

Plate XIX. 183.

23. **Pinnularia mesolepta,** *Ehr.* V. linear, with three central inflations, deeply constricted towards the obtuse extremities; costæ reaching central line, 24 in ·001″. v.v.

Navicula mesolepta, Kütz. Bacill. xxviii. 73. xxx. 34? *Navicula nodosa,* Ehr. Inf. xiii. 9.

Fresh water. Ashdown Forest, Sept. 1850, *W. Sm.* Gardner Street, Sussex, *Mr. Jenner.* Near Aberdeen, *Dr. Dickie.* Marl, Co. Down. Lough Mourne Deposit. Dolgelly Earth. Premnay Peat. Cantyre Peat.

Plate XIX. 182.

24. **Pinnularia interrupta,** *W. Sm.* V. linear, constricted at the rounded extremities; costæ absent from the centre of the valve, contiguous, 24 in ·001″. Length ·0012″ to ·0022″. v.v.

Stauroneis parva, Kütz. Bacill. xxix. 23. Sp. Alg. p. 92. specim. misit cl. De Brébisson.

Fresh water. With the last, and probably only a variety of the same.

Plate XIX. 184.

GENUS 21. STAURONEIS, *Ehr.*

Frustules free, oblong or lanceolate; valves convex; striated, with a median line and terminal nodules; central nodule dilated into a band (Stauros) free from striæ.

1. **Stauroneis Phœnicenteron,** *Ehr.* V. lanceolate, obtuse; stauros linear, reaching the margin; striæ 33 in ·001″. Length ·0055″ to ·0066″. v.v.

Kütz. Bacill. iii. 53. *Navicula Phœnicenteron,* Ehr. Inf. xiii. 1. Prit. Anim. iii. 139. xv. 17 & 18.

Fresh water: very common. Wareham, Sept. 1847; Lewes, Aug. 1850; Jersey, Aug. 1852, *W. Sm.* Lough Mourne and Peterhead Deposits. Premnay Peat. Cantyre Peat. (North America.)

Plate XIX. 185.

2. **Stauroneis gracilis,** *Ehr.* V. lanceolate, obtuse; stauros linear, scarcely reaching the margin; striæ very delicate, 45 in ·001″. Length ·0028″ to ·0036″. v.v.

Ehr. in Kütz. Bacill. xxix. 3?

Fresh water. Bindon Abbey, Dorsetshire, May 1849, *W. Sm.* Wray near Lancaster, Oct. 1852, *Mr. G. Smith.* Dolgelly Earth. Lough Mourne Deposit. Cantyre Peat. (Little Falls, New York, and Nova Scotia.)

Plate XIX. 186.

3. **Stauroneis acuta,** n. sp. F. V. oblong; V. lanceolate, acute, inflected at the extremities; stauros dilated towards the margin of valve; striæ 30 in ·001″. Length ·0033″ to ·0057″. v.v.

"A species of *Navicula,*" Quek. H. C. xii. 26.

Fresh water. Near Guildford, *Mr. Capron*, Nov. 1852. Lough Mourne Deposit. Cantyre Peat. Premnay Peat. (New Zealand: Nova Scotia.)

Plate XIX. 187. Frustule with endochrome, Frontispiece, fig. CLXXXVII.

4. **Stauroneis salina,** n. sp. V. elliptical-lanceolate; stauros linear; striæ faint, 45 in ·001″. Length ·0016″ to ·0022″. v.v.

Marine. Shoreham, Aug. 1851, *W. Sm.* Folkestone, Nov. 1852, *Mr. Capron.*

Plate XIX. 188.

5. **Stauroneis dilatata,** n. sp. V. elliptical, extremities slightly produced; stauros linear, not reaching the margin; striæ 30 in ·001″. v.s.

Fresh water. Aberdeenshire, *Dr. Dickie.* Cantyre Peat.

Plate XIX. 191.

6. **Stauroneis crucicula,** n. sp. V. elliptical, extremities slightly produced; stauros very narrow, linear, reaching the margin. v.v.

Marine. Belfast Bay, Aug. 1849, *W. Sm.*

Plate XIX. 192.

7. **Stauroneis anceps,** *Ehr.* V. elliptical, constricted towards the produced extremities; stauros linear, not reaching the margin; striæ very delicate, 45 in ·001″. v.v.

Ehr. in Kütz. Bacill. xxix. 4?

Fresh water. Swanage, Dorset, March 1849; Lewes, Oct. 1852, *W. Sm.* Lanshaw Spa, Katefield, Lancashire, *Mr. G. Smith,* Jan. 1852. Ben M^c^ Dhui, *Mr. P. Grant.* Marl, Co. Down.

Plate XIX. 190.

8. **Stauroneis linearis,** *Ehr.* V. elliptical, inflated at centre and at the extremities, which are apiculated; stauros linear, reaching the margin; striæ obscure. v.v.

Kütz. Bacill. xxx. 26.

Fresh water. Plumpton and Lewes, Sussex, Apr. 1852, *W. Sm.* Shalford, *Mr. Capron.* Premnay Peat.

Plate XIX. 193.

9. **Stauroneis punctata,** *Kütz.* V. elliptical, extremities produced; stauros linear, central; striæ radiate, punctate, 27 in ·001″. v.s.

Kütz. Bacill. xxi. 9.

Fresh water. Lough Mourne and Peterhead Deposits. Premnay Peat. Ben M[c] Dhui, *Mr. P. Grant.* Cantyre Peat. (San Fiore, Italy.)

Plate XIX. 189.

10. **Stauroneis pulchella,** n. sp. F. V. oblong, constricted at the centre; V. elliptical; stauros central, dilated towards the margin; striæ very distinct, 30 in ·001″, punctate; puncta hexagonal. Length ·0048″ to ·0096″. v.v.

β. Dry valve purplish, somewhat acuminate.

Marine. Coast of Sussex, Aug. 1850, and Poole Bay, Sept. 1851, *W. Sm.* *β.* Torbay, July 1846. Coast of Sussex, Aug. 1850, *W. Sm.* Near Ipswich, *Mr. Hodgson,* Aug. 1851. Harwich, *Mr. Shadbolt.* (Peruvian Guano.)

Plate XIX. 194. *b.* outline of F. V. Var. *β.* Pl. XIX. 194 *β.*

Genus 22. **PLEUROSIGMA,** *W. Sm.*

Frustules free, elongated; valves convex, sigmoid, with a central longitudinal line, and nodules at centre and extremities, striated; striæ resolvable into dots, which are frequently hexagonal.

The sigmoid form of the valve more or less present in all our native species, at once distinguishes this genus from its allies; but even in the absence of this feature, which I have noticed to be wanting in at least one species, discovered by M. De Brébisson, on the coast of Normandy, the structure of the siliceous valve retains its characteristic peculiarities. The striæ are invariably so closely arranged, that their discovery and resolution are among the most difficult operations in microscopy. Their true character has been, in consequence, frequently mistaken; some observers having considered these appearances of striæ to arise from series of perforations, and others from rows of beads, or minute elevations. With the latter I have been disposed to coincide, until, aided by the careful manipulation and excellent object-glasses of Mr. Richard Beck, who has shown me the hexagonal outline of these supposed beads, I have been led to conclude, as I have stated in the Introduction, that the lines arise from internal structure; that the appearance both of perforations and elevations may be produced in the same object by a slight alteration in the focus of the instrument; and that such appearances are merely optical illusions, produced by the reflection and refraction of the rays passing through the minute cellular structure of the siliceous epiderm.

It is evident that no optical effect can confer upon circular elevations or perforations hexagonal outlines, while it is easy to see how the latter, when out of focus, or viewed by an object-glass of imperfect definition, may assume the semblance of rounded beads or dots. And, moreover, as the view which regards the striæ of *Pleurosigma* as arising from the cellular arrangement of the epiderm, harmonises the structure of this extensive genus with that of the other members of the family, it seems recommended to our acceptance by claims too strong to be resisted.

Nothing is known of the Reproduction, properly so called, either of this or of the three preceding genera, multiplication by self-division being the only mode of increase hitherto detected. While this process is actively going forward, the mucus generated by the dividing frustules is often so considerable as to produce the appearance and effect of a distinct frond, which assumes the form of a thin pellicle of some little tenacity. At other times, when the mucous secretion does not assume the continuity of a pellicle, it invests the individual frustule with a transparent envelope, which has the appearance of an exterior membrane, and has been sometimes mistaken for such. On one occasion I also met with the frustules of *P. Hippocampus* enclosed in mucous or gelatinous tubes, precisely like those of a *Colletonema*; but these conditions must be regarded, for the present at least, as temporary or accidental, and cannot be admitted into the specific or generic descriptions.

Owing to the compression of the valves, the scanty development of the connecting-membrane, and the elongate form of the frustule in the present genus, the front view is either of a linear or linear-lanceolate form; two examples are given in Pl. XXIII. 203 & 207; but I have omitted a special notice in the case of each species, as I have not found this feature of much assistance in their discrimination. On the other hand, as the colour of the dry valve is often conspicuous, and seems to depend on the structural character of the silicified membrane, and also supplies a ready means of discrimination, I have endeavoured to record it with as much precision as possible. From notices forwarded by Mr. Beck, I am disposed to conclude that a yellow tint in the valve indicates the presence of a distinct hexagonal structure in its cellular condition, and a purple colour an absence of such character.

In several species the striæ are so closely arranged—or, in other words, the cellular structure is so minute,—that the power I have ordinarily employed has proved insufficient for their resolution. In such cases I have availed myself of Mr. Beck's aid, who has succeeded, with an object-glass of $\frac{1}{8}$-inch focal length and angular aperture of 120°, in resolving the lines on most of the species alluded to.

Sect. I. Striæ oblique.

1. **Pleurosigma formosum,** *W. Sm.* V. linear-lanceolate, twisted, flexure considerable, extremities obtuse; median line not central; colour light chestnut-brown; striæ 36 in ·001″. Length ·0141″ to ·0178″. v.v.

W. Sm. Ann. 2nd Ser. vol. ix. p. 5. pl. i. 1. Prit. Anim. xix. 1.

Marine. Shoreham Harbour, Aug. 1850, *W. Sm.* Walton, Essex, *Mr. C. Topping.*

Plate XX. 195. Frustule with endochrome, Frontispiece, fig. CXCV.

2. **Pleurosigma decorum,** n. sp. V. lanceolate, acute, angular, twisted, flexure considerable; median line not central; colour pale chestnut; striæ 36 in ·001″. Length ·0098″ to ·0125″. v.s.

Brackish water. Ipswich, *Mr. T. Hodgson,* Aug. 1851. Felixstow, Essex, *Mr. C. Topping.*

Plate XXI. 196.

3. **Pleurosigma speciosum,** *W. Sm.* V. linear-lanceolate, obtuse; flexure slight, twisted; median line subcentral; colour a pale straw; striæ 44 in ·001″. Length ·0083″ to ·0152″. v.s.

W. Sm. Ann. 2nd Ser. vol. ix. p. 6. pl. i. 3. Prit. Anim. xix. 3.

Marine. Walton, Essex, Aug. 1851, *Mr. C. Topping.*

Plate XX. 197.

4. **Pleurosigma rigidum,** n. sp. V. linear-lanceolate, flexure slight, extremities rounded, median line central; colour pale straw; striæ 48 in ·001″. Length ·0112″ to ·0152″. v.s.

Brackish water. Ipswich, *Mr. T. Hodgson*, Aug. 1851.

Plate XX. 198.

5. **Pleurosigma elongatum,** *W. Sm.* V. lanceolate, flexure moderate, extremities acute; colour a clear straw; striæ 48 in ·001″. Length ·0083″ to ·0152″. v.v.

W. Sm. Ann. 2nd Ser. vol. ix. p. 6. pl. i. 4. Prit. Anim. xix. 4.

Marine and brackish water. Poole Bay, June 1849; Coast of Sussex, Oct. 1850, *W. Sm.* Hull, *Mr. R. Harrison.*

Plate XX. 199.

6. **Pleurosigma intermedium,** n. sp. V. lanceolate, flexure very slight, extremities acute; colour pale straw; "striæ 55 in ·001″." (R. B.) Length ·0066″ to ·0088″. v.v.

Marine. Newhaven, Sussex, Mar. 1852, *W. Sm.* Ipswich Harbour, *Mr. Topping*, April 1852.

Plate XXI. 200.

7. **Pleurosigma Nubecula,** n. sp. V. linear-lanceolate, obtuse, flexure hardly perceptible; colour very pale; "striæ 55 in ·001″." (R. B.) Length ·0055″ to ·0066″. v.v.

Marine. Seaford, Sussex, Mar. 1852.

Plate XXI. 201.

8. **Pleurosigma delicatulum,** *W. Sm.* V. lanceolate, acute, flexure moderate; colour pale pink; striæ 64 in ·001″. Length ·0058″ to ·0108″. v.v.

W. Sm. Ann. 2nd Ser. vol. ix. p. 6. pl. i. 5. Prit. Anim. xix. 5.

Brackish water. "Brooks" near Lewes, Oct. 1850 and Sept. 1852, *W. Sm.*

Plate XXI. 202.

9. **Pleurosigma strigosum,** *W. Sm.* V. lanceolate, obtuse, flexure slight; colour pale straw; striæ 44 in ·001″. Length ·0066″ to ·0112″. v.v.

W. Sm. Ann. 2nd Ser. vol. ix. p. 7. pl. i. 6. Prit. Anim. xix. 6.

Marine. Coast of Sussex, Aug. 1850 and Mar. 1852, *W. Sm.* Rye, *Mr. Jenner*. Hull, *Mr. R. Harrison*.

Plate XXI. 203. Outline of F. V. Pl. XXIII. 203.

10. **Pleurosigma quadratum,** n. sp. V. quadrangular, acute, flexure moderate; colour chestnut; striæ 45 in ·001″. Length ·0030″ to ·0105″. v.v.

Pleurosigma angulatum, W. Sm. Ann. 2nd Ser. vol. ix. p. 7. pl. i. 7 & 9. Prit. Anim. xix. 7 & 9.

Marine or brackish water. Poole Bay, Aug. 1849; Coast of Sussex, Aug. 1850; Braunton, Devonshire, *Mr. Ralfs.* Menai Straits, *Professor Williamson,* July 1852. Folkestone, *Mr. Capron,* Nov. 1852.

Plate XX. 204. Outline of a young (?) specimen, 204 β.

11. **Pleurosigma angulatum,** *W. Sm.* V. lanceolate, angular, acute; colour pale chestnut; striæ 52 in ·001″. Length ·0066″ to ·0100″. v.v.

Pleurosigma angulatum β, W. Sm. Ann. 2nd Ser. vol. ix. p. 7. pl. i. 8. Prit. Anim. xix. 8. *Navicula angulata,* Quekett on the Microscope, 1848, p. 438. pl. viii. 4, 5, 6, 7.

Marine or brackish water. Poole Bay, Aug. 1848; Belfast Bay, Aug. 1849; Coast of Sussex, April, May and Aug. 1852, *W. Sm.* Coast of Lancashire, *Mr. Johnson.* Rye, *Mr. Jenner.* Hull, *Mr. R. Harrison.* Coast of Norfolk, *Mr. Brightwell.*

Plate XXI. 205.

12. **Pleurosigma Æstuarii,** *W. Sm.* F. frequently direct; V. broadly lanceolate; extremities obtuse, somewhat produced, flexure of median line considerable; colour a pale purple; striæ 54 in ·001″. Length ·0028″ to ·0052″. v.v.

Navicula Æstuarii, De Bréb. in Kütz. Sp. Alg. p. 890. ad specim. authen. quæ misit cl. De Brébisson, Oct. 1852.

Marine or brackish water. Shoreham Harbour, Nov. 1852, *W. Sm.*

Supp. Plate XXXI. 275.

13. **Pleurosigma obscurum,** *W. Sm.* V. linear, slightly attenuated, obtuse, median line not central; colour pale pink; "striæ 75 in ·001″." (R. B.) Length ·0036″ to ·0062″. v.v.

β. A much smaller form: marine.

W. Sm. Ann. 2nd Ser. vol. ix. p. 8. pl. i. 11 & 12. Prit. Anim. xix. 11 & 12.

Marine or brackish water. "Brooks," Lewes, Sept. 1850. Var. β. investing a sponge, Poole Bay, Nov. 1849, *W. Sm.*

Plate XX. 206. Outline of smaller var. 206 β.

Sect. II. Striæ transverse and longitudinal.

14. **Pleurosigma Balticum,** *W. Sm.* V. linear, attenuated towards the obtuse extremities, flexure terminal; colour dark brown; long. and trans. striæ 38 in ·001″. Length ·0083″ to ·0142″. v.v.

β. Smaller, more gradually attenuated.

γ. Attenuated throughout; striæ obscure.

W. Sm. Ann. 2nd Ser. vol. ix. p. 8. pl. ii. 1, 2 & 3. Prit. Anim. iii. 144. xx. 1, 2, 3. *Navicula Baltica,* Ehr. Inf. pl. xiii. 10. Kütz. Bacill. iv. 32.

Marine or brackish water: frequent. Poole Bay, Aug. 1848. Belfast Bay, Aug. 1849. Coast of Sussex, Aug., Sept., Oct. and Nov. 1850, *W. Sm.* Cockerham Marsh, Lancashire, Oct. 1849, *Mr. Johnson.* β. & γ. Coast of Sussex, Oct. 1851, *W. Sm.*

Plate XXII. 207. Outline of young (?) specimens, 207 β. & 207 γ. Outline of F. V. Pl. XXIII. 207. Frustule with endochrome, Frontispiece, fig. CCVII.

15. **Pleurosigma Strigilis,** *W. Sm.* V. lanceolate, acute, flexure considerable; colour pale brown; long. striæ 40 in ·001″; trans. striæ 36 in ·001″. Length ·0116″ to ·0142″. v.v.

W. Sm. Ann. 2nd Ser. vol. ix. p. 8. pl. ii. 4. Prit. Anim. xx. 4.

Brackish water. Hull, *Mr. R. Harrison.* Iford, Sussex, Oct. 1852, *W. Sm.*

Plate XXII. 208.

16. **Pleurosigma acuminatum,** *W. Sm.* V. lanceolate, acute, flexure considerable; colour pale brown; long. striæ 40 in ·001″; trans. striæ 52 in ·001″. Length ·0050″ to ·0065″. v.v.

W. Sm. Ann. 2nd Ser. vol. ix. p. 9. pl. ii. 5. Prit. Anim. xx. 5. *Navicula Sigma,* Ehr. Inf. xiii. 12. Prit. Anim. iii. 146. Kütz. Bacill. iv. 26.

Marine. Shoreham Harbour, June 1850, *W. Sm.* Menai Straits, *Prof. Williamson.* Higham, *Mr. Shadbolt.* Folkestone, *Mr. Capron,* Nov. 1852.

Plate XXI. 209.

17. **Pleurosigma distortum,** *W. Sm.* V. lanceolate, abruptly bent towards the obtuse extremities; colour pale pink; "trans. striæ 75 in ·001″; long. striæ 65 in ·001″." (R. B.) Length ·0026″ to ·0042″. v.v.

W. Sm. Ann. 2nd Ser. vol. ix. p. 7. pl. i. 10. Prit. Anim. xix. 10.

Marine. Coast of Sussex, Aug. 1850, *W. Sm.* Folkestone, *Mr. Capron.*

Plate XX. 210.

18. **Pleurosigma Fasciola,** *W. Sm.* V. lanceolate, extremities produced, flexure considerable; colour pale pink; trans. striæ 64 in ·001″. Length ·0036″ to ·0048″. v.v.

β. Extremities abruptly bent.

Ceratoneis Fasciola, Kütz. Bacill. iv. 4.

Marine. Belfast Bay, Aug. 1849. Poole Bay, Sept. 1850. Hastings, Nov. 1851, *W. Sm.* Hull, *Mr. R. Harrison.*

Plate XXI. 211. Var. β. 211 *a′*.

19. **Pleurosigma macrum,** n. sp. V. lanceolate, extremities produced, flexure terminal, moderate; "trans. striæ 85 in ·001″." (R. B.) Length ·0083″ to ·0106″. v.v.

Brackish water. Iford, Sussex, Oct. 1852, *W. Sm.*

Supp. Plate XXXI. 276.

20. **Pleurosigma prolongatum,** *W. Sm.* V. lanceolate, narrow, acute, flexure moderate; "trans. striæ 65 in ·001″." (R. B.) Length ·0043″ to ·0060″. v.v.

W. Sm. Ann. 2nd Ser. vol. ix. p. 9. pl. ii. 7. Prit. Anim. xx. 7.

Marine. Poole Bay, Oct. 1849. Shoreham, Sept. 1852, *W. Sm.*

Plate XXII. 212.

21. **Pleurosigma tenuissimum,** n. sp. V. very narrow, linear-lanceolate, acute, flexure considerable; striæ 48 in ·001″. v.s.

Brackish water. Walton, Essex, *Mr. Topping,* April 1852.

Plate XXII. 213.

22. **Pleurosigma littorale,** *W. Sm.* V. broadly lanceolate, acute, flexure considerable; colour purplish; long. striæ 24 in ·001″; trans. striæ 50 in ·001″. Length ·0046″ to ·0063″. v.v.

W. Sm. Ann. 2nd Ser. vol. ix. p. 10. pl. ii. 8. Prit. Anim. xx. 8.

Marine. Coast of Sussex, Nov. 1850, *W. Sm.* Southampton, *Mr. Jenner.* River Orwell, near Ipswich, *Mr. Hodgson.* (Coast of Normandy, *M. De Brébisson.*)

Plate XXII. 214.

23. **Pleurosigma Hippocampus,** *W. Sm.* V. broadly lanceolate, obtuse, flexure considerable; colour pale brown; long. striæ 32 in ·001″; trans. striæ 40 in ·001″. Length ·0050″ to ·0066″. v.v.

W. Sm. Ann. 2nd Ser. vol. ix. p. 10. pl. ii. 9, 10. Prit. Anim. xx. 9, 10. *Navicula Hippocampus,* Ehr. Inf. xiii. 11? Kütz. Bacill. iv. 29? Prit. Anim. iii. 145.

Brackish water. "Brooks" near Lewes, Sept. 1850, *W. Sm.* Hull, *Mr. R. Harrison.* Titchwell, Norfolk, *Mr. Brightwell,* Sept. 1851.

Plate XXII. 215. Outline of young (?) specimen, 215 *β*.

24. **Pleurosigma attenuatum,** *W. Sm.* V. lanceolate, obtuse, flexure moderate; colour purplish brown; long. striæ 30 in ·001″, trans. striæ 40 in ·001″. Length ·0075″ to ·0108″. v.v.

W. Sm. Ann. 2nd Ser. vol. ix. p. 11. pl. ii. 11, 12 & 13. Prit. Anim. xx. 11, 12 & 13. *Navicula Hippocampus,* Quekett on the Microscope, pl. viii. figs. 1, 2, 3. Dujar. Inf. xx. 1. *Gyrosigma Hippocampa,* Hass. Alg. cii. 11? *Navicula attenuata,* Kütz. Bacill. iv. 28.

Fresh water: frequent in streams and ditches. River Froome, Dorsetshire, May 1849; Plumpton, Sussex, and many other places, Apr. 1851, *W. Sm.* Guildford, *Mr. Capron.* Lough Mourne Deposit. Peterhead Deposit. Cantyre Peat.

Plate XXII. 216. Outline of F. V. in S. D. 216 *d*. Outline of young (?) specimen, 216 *β*.

25. **Pleurosigma lacustre,** *W. Sm.* V. lanceolate, acute, flexure considerable; colour pale brown; long. and trans. striæ 48 in ·001″. Length ·0052″ to ·0068″. v.v.

W. Sm. Ann. 2nd Ser. vol. ix. p. 12. pl. ii. 14. Prit. Anim. xx. 14.

Fresh water. Brooks and ponds near Lewes, Oct. 1851, *W. Sm.*

Plate XXI. 217.

26. **Pleurosigma Spencerii,** *W. Sm.* V. lanceolate, obtuse, flexure slight; colour pale brown; "trans. striæ 50 in ·001″, long. striæ 55 in ·001″." (R. B.) Length ·0033″ to ·0041″. v.v.

W. Sm. Ann. 2nd Ser. vol. ix. p. 12. pl. ii. 15. Prit. Anim. xx. 15. *Navicula Spencerii,* Quekett on the Microscope, pl. ix.

Fresh water. Near Lewes, Sept. 1850, *W. Sm.* Reading, *Mr. C. Poulton.*

Plate XXII. 218.

GENUS 23. **SYNEDRA,** *Ehr.*

Frustules attached, elongate, rectangular; valves linear or lanceolate, plane or convex.

In the present genus the frustules, though often found in a free state, are at first invariably attached to larger Algæ, or other plants, by a cushion-like pedicel, which, in a few cases, becomes developed into a more or less distinct stipes. In some species the frustules, after self-division, are speedily detached from this gelatinous cushion, which in such cases rarely presents us with more than two or four individuals, as in *S. lunaris.* In others, the frustules, after repeated division, still remain adherent to their pedicel; and the result is a fan-like band of frustules, as in *S. pulchella,* or a stellate cluster, as in *S. radians.* The valves are usually furnished with a central pseudo-nodule and median line, the extremities of which are slightly dilated; but these characters are variable, and not unfrequently absent, and are therefore inadmissible in the generic description.

SECT. I. Pseudo-nodule obsolete or very minute; frustule arcuate.

1. **Synedra lunaris,** *Ehr.* V. narrow, linear, slightly attenuated, obtuse; striæ 36 in ·001″. Length ·0025″ to ·0038″. v.v.

Ehr. Inf. xvii. 4. Kütz. Bacill. xiii. i. 5. xv. 1. Prit. Anim. iv. 185. *Exilaria lunaris,* Hass. Alg. xcvii. 4.

Fresh water. Boggy pools, Dorsetshire, Dec. 1849; near Lewes, Nov. 1852, *W. Sm.* Coldbath Spring, Tunbridge Wells, *Mr. Jenner,* Apr. 1842. Lancashire, *Mr. Johnson,* Apr. 1852.

Plate XI. 82.

2. **Synedra biceps,** *W. Sm.* V. linear, inflated at the obtuse extremities; striæ 48 in ·001″. Length ·0042″ to ·0075″. v.v.

Eunotia flexuosa, Kütz. Sp. Alg. p. 6. ad specim. authen. quæ misit cl. De Brébisson, Jan. 1853.

Fresh water. Boggy pools, Dorsetshire, Dec. 1849, *W. Sm.* Dolgelly, *Mr. Ralfs.*

Plate XI. 83.

Sect. II. Pseudo-nodule definite, annular.

3. **Synedra pulchella,** *Kütz.* V. lanceolate, slightly constricted towards the obtuse extremities; pedicel frequently dilated into a compressed dichotomous stipes; frustules forming flabella; striæ 33 in ·001″. Length ·0018″ to ·0046″. v.v.

Kütz. Bacill. xxix. 87. "*Ctenophora pulchella,*" Bréb. sic cl. De Brébisson in literis cum specim. Oct. 1852.

Fresh water. Penzance, *Mr. Ralfs.* Jersey, Aug. 1852, *W. Sm.*

Plate XI. 84. Supp. Plate XXX. 84*.

4. **Synedra gracilis,** *Kütz.* V. as in the last; pedicel not dilated; pseudo-nodule less distinct; frustules scattered; striæ 39 in ·001″. Length ·0018″ to ·0041″. v.v.

Kütz. Bacill. iii. 14. xiv. 2. xv. 8.

Brackish water. Poole Bay, Mar. 1848. "Brooks" near Lewes, Apr. 1851, *W. Sm.*

Plate XI. 85. Frustules with endochrome, Frontispiece, fig. LXXXV.

5. **Synedra acicularis,** *W. Sm.* V. lanceolate, acute; striæ very faint, 36 in ·001″. Length ·0022″ to ·0055″. v.v.

Synedra lævis, Kütz. Bacill. xv. 8?

Brackish water. Poole Bay, June 1849. Excet, Sussex, March 1850. Lancing, Sussex, Aug. 1852.

Plate XI. 86.

6. **Synedra minutissima,** *Kütz.* V. linear-lanceolate, extremities obtuse; striæ 36 in ·001″. Length ·0009″ to ·0021″. v.v.

Kütz. Bacill. iii. 30?

Fresh water. Birkenhead, Cheshire, *Mr. Shadbolt.* Near Lewes, Oct. 1850, *W. Sm.*

Plate XI. 87.

SECT. III. Pseudo-nodule indefinite.

7. **Synedra salina,** n. sp. V. lanceolate, gradually attenuated towards the somewhat obtuse extremities; striæ distinct, 32 in ·001″. Length ·0075″ to ·0142″. v.v.

Marine. Poole Bay, June 1848, *W. Sm.*

Plate XI. 88.

8. **Synedra radians,** *W. Sm.* V. linear-lanceolate, extremities somewhat dilated, obtuse; frustules arranged in a radiate manner; striæ 24 in ·001″. Length ·0050″ to ·0116″. v.v.

Synedra splendens, Kütz. Bacill. xiv. 16. ad specim. quæ misit amic. De Brébisson. *Exilaria Ulna,* Hass. Alg. xcvii. 2. ad specimina quæ communicavit cl. Jenner. *Diatoma truncatum,* Grev. B. F. p. 407.

Fresh water: very common. Plumpton, Sussex, Apr. 1852, *W. Sm.* Speldhurst, Kent, May 1843, *Mr. Jenner.* Cheshunt, Dec. 1842, *Mr. Hassall.* Lough Mourne and Peterhead Deposits.

Plate XI. 89. Pl. XII. 89 β. 89 γ. Frustules with endochrome, Frontispiece, fig. LXXXIX.

9. **Synedra Ulna,** *Ehr.* V. lanceolate-acute; frustules not radiating; striæ 24 in ·001″. Length ·0028″ to ·0085″. v.v.

β. V. linear, suddenly acuminated.

β. Kütz. Bacill. xxx. 28.

Fresh water: common. St. Brelades, Jersey, Aug. 1852.

Plate XI. 90. Var. β. Pl. XI. 90 β.

10. **Synedra Oxyrhynchus,** *Kütz.* V. lanceolate, suddenly attenuated towards the very acute extremities. v.v.

Kütz. Bacill. xiv. 8, 9, 10, 11?

Fresh water. Near Lewes, Feb. 1852, *W. Sm.*

Plate XI. 91.

11. **Synedra obtusa,** *W. Sm.* V. linear, extremities rounded; striæ 24 in ·001″. v.v.

Synedra Ulna, Ehr. Inf. xvii. 1? *S. æqualis,* Kütz. Sp. Alg. p. 45. ad specim. quæ dedit amic. De Brébisson.

In ponds: not uncommon. Lewes, Feb. 1852, *W. Sm.*

Plate XI. 92.

The last four species are so closely allied, that it is difficult, by a verbal description, to assign precise characters to each; a close inspection of the figures will assist in their discrimination, but it will probably be found necessary, upon a further and wider examination, to unite some of those that I have here felt myself obliged to separate.

12. **Synedra capitata,** *Ehr.* V. linear, dilated towards the acute extremities into a triangular head; striæ 23 in ·001″. Length ·0078″ to ·0185″. v.v.

Ehr. Inf. xxi. 29. Prit. Anim. iv. 185. Kütz. Bacill. xiv. 19. *Exilaria capitata,* Hass. Alg. xcvii. 1.

Fresh water: common. Wareham, Sept. 1849, *W. Sm.* Lough Mourne and Peterhead Deposits.

Plate XII. 93.

13. **Synedra delicatissima,** n. sp. V. elongated, very narrow and gradually tapering to the somewhat acute extremities; striæ 27 in ·001″. Length ·0048″ to ·0092″. v.s.

Fresh water. Lough Neagh, *Dr. Dickie,* 1850.

Plate XII. 94.

14. **Synedra longissima,** n. sp. V. much elongated, slightly and gradually attenuated towards the inflated and obtuse extremities; striæ 28 in ·001″. Length ·0093″ to ·0183″. v.s.

Fresh water. Pond in Botanic Garden, Belfast, 1850, *Dr. Dickie.*

Plate XII. 95.

15. **Synedra tabulata,** *Kütz.* V. slightly tapering towards the somewhat inflated and obtuse extremities; striæ marginal, 27 in ·001″; frustules united into rectangular tablets. Length ·0058″ to ·0087″. v.v.

Kütz. Bacill. xv. 10?

Brackish water. Near Lewes, Sept. 1851, *W. Sm.*

Plate XII. 96.

16. **Synedra affinis,** *Kütz.* V. lanceolate, acute; striæ marginal, 32 in ·001″; frustules united in flabellate or radiating bundles. Length ·0021″ to ·0046″. v.v.

Kütz. Bacill. xv. 6, et 11. ad specim. authen. quæ dedit amic. De Brébisson.

Marine. Pevensey Bay, Sussex, Apr. 1851.

Plate XII. 97.

17. **Synedra Arcus,** *Kütz.* V. lanceolate, acute; striæ marginal, 30 in ·001″; frustules on F. V. arcuate, flabellate. Length ·0028″ to ·0038″. v.v.

Kütz. Bacill. xxx. 50?

Marine. Cuckmere, Sussex, Mar. 1851; Jersey, Aug. 1852; Hastings, Oct. 1852, *W. Sm.*

Plate XI. 98. Plate XII. 98.

18. **Synedra hamata,** n. sp. V. linear, or linear-lanceolate, suddenly attenuated constricted and bent towards the extremities; striæ marginal, 30 in ·001″. Length ·0024″ to ·0052″. v.v.

Fresh water. Plumpton, Sussex, Apr. 1852, *W. Sm.*

Supp. Plate XXX. 264.

19. **Synedra Vaucheriæ,** *Kütz.* V. linear-lanceolate; striæ marginal, 30 in ·001″; frustules somewhat flabellate. Length ·0011″ to ·0018″. v.v.

Kütz. Bacill. xiv. 4?

Fresh water: frequently attached to *Vaucheria dichotoma* and *V. cæspitosa.* Lewes, Oct. 1851.

Plate XI. 99.

20. **Synedra fasciculata,** *Kütz.* V. linear-lanceolate; striæ reaching across the valve, 40 in ·001″; frustules in rectangular tablets. v.v.

Kütz. Bacill. xv. 5? *Exilaria fasciculata,* Hass. Alg. xcvii. 3. ad specim. authen. quæ communicavit cl. Jenner.

Fresh water. Plumpton, Sussex, Apr. 1852, *W. Sm.*

Plate XI. 100.

Sect. IV. Pseudo-nodule obsolete; frustule straight.

21. **Synedra crystallina,** *Kütz.* V. much elongated, slightly inflated at the centre and extremities; striæ reaching across the valve, 26 in ·001″. Length ·0180″ to ·0266″. v.v.

Kütz. Bacill. xvi. 1. *Diatoma crystallinum,* Ag. Consp. p. 52. et Grev. B. F. p. 407. ad specim. authen. quæ communicavit cl. Dr. Greville.

Marine. Poole Bay, Sept. 1851, *W. Sm.*

Plate XII. 101.

22. **Synedra superba,** *Kütz.* V. linear, slightly attenuated from the centre towards the rounded extremities; striæ very distinct, 27 in ·001″, reaching across the valve; pedicel somewhat elongated. Length of frustule ·0098″ to ·0208″. v.v.

Kütz. Bacill. xv. 13.

Marine. Poole Bay, Nov. 1849, *W. Sm.*

Plate XII. 102.

23. **Synedra Gallionii,** *Ehr.* V. attenuate, extremities obtuse; striæ not reaching across the valve, 36 in ·001″; pedicel not elongated. Length of frustule ·0060″ to ·0112″. v.v.

β. A shorter and stouter form.

Ehr. Inf. xvii. 2. Kütz. Bacill. xxx. 42.

Marine. Isle of Man, *Mr. Johnson.* *β.* Beachy Head, Aug. 1852, *W. Sm.*

Supp. Plate XXX. 265. Var. *β.* Supp. Pl. XXX. 265 *β.*

24. **Synedra fulgens,** *W. Sm.* V. slightly inflated at the centre and at the rounded extremities; striæ reaching across the valve, 36 in ·001″; frustules arranged in a flabellate manner upon a branched pedicel. Length ·0068″ to ·0164″. v.v.

Exilaria fulgens, Grev. S. C. F. pl. 291. *Licmophora fulgens,* Kütz. Bacill. xiii. 5. ad spec. authen. quæ misit amicus De Brébisson, Jan. 1853. Prit. Anim. xvi. 20.

Marine. Poole Bay, Sept. 1851; Jersey, Aug. 1852, *W. Sm.*

Plate XII. 103.

There is nothing in the structure of the frustule to warrant the separation of this species from the present genus.

Genus 24. **COCCONEMA,** *Ehr.*

Frustules stipitate, cymbiform; valve with a submedian line, having nodules at centre and extremities.

The frustules of this genus differ in no respect from those of *Cymbella* (Genus 3), and are placed apart solely from the presence of a stipes. Whether the development of this accessory be esteemed a generic difference or not, it cannot be denied that it gives a notable physiognomy to the plant, and affords a ready means of discrimination. The stipes seems to be an exudation from the frustule, secreted only during the progress of self-division. It assumes, in the present and other genera, a membranous consistency and filamentous form; while the same secretion is present in *Cymbella* and many of the free Diatomaceous forms as a mucous stratum, and in others as a gelatinous cushion or prolonged pedicel.

Where it possesses a filamentous character it invariably branches in a dichotomous manner,—a necessary consequence of the self-division of the frustules, and the circumstance that each filament or branch is the secretion of a separate frustule. Thus, when self-division is completed, the extension of the filament below the frustules is suspended, a joint or articulation is formed at the base of the dividing frustule, and each of the half-new frustules begins anew, in its progress towards special self-division, the secretion of a new joint or internode; and a dichotomy is the result. Conjugation and the formation of Sporangia in the present genus have been observed by Mr. Thwaites in *C. lanceolatum* and *C. Cistula*, and by myself in both these species and *C. parvum*.

1. **Cocconema lanceolatum,** *Ehr.* F.V. lanceolate, obtuse; V. elongated, slightly inflated at the centre of the concave margin; striæ moniliform, 21 in ·001″. Length ·0043″ to ·0058″. v.v.

β. Much elongated (Sporangial?). Length ·0083″ to ·0098″.

Ehr. Inf. xix. 6. Kütz. Bacill. vi. 3. Dujar. Inf. xx. 4. Prit. Anim. iv. 195. Hass. Alg. ci. 1. In Conjugation, Thw. Ann. vol. xx. pl. xxii. C.

Fresh water: frequent. In Conj. River Froome, Dorsetshire, Mar. 1847. Cockshut stream near Lewes, Ap. 1850. Plumpton, Sussex, Ap. 1852, *W. Sm.*

Aberdeenshire, frequent, *Dr. Dickie.* Lough Mourne and Peterhead Deposits. Premnay Peat. Dolgelly Earth. Marl, Co. Down. Cantyre Peat. Lough Island-Reavey Deposit. (Little Falls, N. Y., Oregon, and Nova Scotia; New Zealand.) *β.* Lough Neagh, *Dr. Dickie.*

Plate XXIII. 219. Frustules with endochrome, Frontispiece, fig. CCXIX.

2. **Cocconema cymbiforme,** *Ehr.* F.V. linear-oblong; V. narrow, concave margin scarcely inflated; striæ moniliform, 21 in ·001″. Length ·0016″ to ·0032″. v.v.

Ehr. Inf. xix. 8. Kütz. Bacill. vi. 12. Hass. Alg. ci. 2.

Fresh water: not so frequent as the last, and scarcely distinct from it. Near Wareham, Apr. 1848; Lewes, May 1851, *W. Sm.* Near Bristol, *Mr. Thwaites.* Wray, Lancashire, *Mr. G. Smith.* Lough Mourne and Peterhead Deposits. Marl, Co. Down. Cantyre Peat.

Plate XXIII. 220.

3. **Cocconema Cistula,** *Ehr.* F. V. nearly linear, obtuse; V. much bent, distinctly inflated on the concave margin, obtuse; striæ moniliform, 24 in ·001″. Length ·0008″ to ·0034″. v.v.

Ehr. Inf. xix. 7? Kütz. Bacill. vi. 1. Hass. Alg. ci. 3. In Conjugation, Thw. Ann. vol. xx. pl. xxii. E. *Cymbella reniformis,* Ag. Consp. p. 10. ad specim. authen. quæ misit cl. Dr. Greville.

Fresh water: frequent. Near Lewes, Mar. 1850. In Conj. Plumpton, Sussex, Apr. 1852, &c., *W. Sm.* Aberdeenshire, *Dr. Dickie.* Lough Mourne Deposit. Dolgelly Earth, &c. &c.

Plates XXIII. 221. XXIV. 221. Frustules with endochrome, Frontispiece, fig. CCXXI.

4. **Cocconema parvum,** n. sp. F. nearly direct; F. V. oblong; V. scarcely inflated on concave margin; striæ moniliform, 21 in ·001″. Length ·0009″ to ·0016″. v.v.

Fresh water. Surface of Chalk cliff, Beachy Head, Aug. 1850. In Conj. Apr. 1851, *W. Sm.*

Plates XXIII. 222. XXIV. 222.

Genus 25. **DORYPHORA,** *Kütz.*

Frustules stipitate, lanceolate, or elliptical; valve with a median line; nodules obsolete.

Distinguished from the last by the median line dividing the valve into two symmetrical parts, and by the absence of distinct nodules. The second species, upon which the genus has been founded by Professor Kützing, has been seen by him in its living state, attached by a short stipes to larger Algæ. I have only found it in my gatherings after the frustules have become detached from their filaments; but the first species has occurred to me abundantly in a living state, and I have been able to refer it with confidence to the present genus, to which it is more closely allied than to *Cocconema*, with which genus writers have hitherto classed it.

1. **Doryphora Boeckii,** *W. Sm.* F. V. lanceolate, obtuse; V. lanceolate, acute; striæ moniliform, 24 in ·001″. Length ·0026″ to ·0053″. v.v.

Cocconema Boeckii, Ehr. Inf. xix. 5. Kütz. Bacill. vi. 5. Quek. H. C. xii. 7.

Marine. Poole Bay, Mar. 1849, *W. Sm.*

Plate XXIV. 223.

2. **Doryphora Amphiceros,** *Kütz.* V. orbicular, elliptical, or elliptical-lanceolate; striæ moniliform, 18 in ·001″. Length ·0012″ to ·0033″. v.s.

Kütz. Bacill. v. 10. xxi. 2. Prit. Anim. xvii. 21. *Rhaphoneis*, Ehr. in Bail. Sound. 61–65.

Marine. Poole Bay, Sept. 1851, &c., *W. Sm.* River Thames, *Mr. Shadbolt.* Near Ipswich, *Mr. Hodgson.*

Plate XXIV. 224. *a′* and *a″*, outlines of other forms.

Genus 26. **GOMPHONEMA,** *Ag.*

Frustules stipitate, cuneate; valves variable in outline, striated, with a median line and nodules at centre and extremities.

The cuneate form of its frustules, arising from the unequal development of the connecting-membrane, distinguishes *Gomphonema* from the genera which have preceded it, and the presence of nodules in its valves from *Podosphenia* and *Rhipidophora*, with which the present genus has sometimes been confounded. The latter genera are also exclusively marine, while the species of *Gomphonema*, with one exception (and that a species doubtfully connected with the present genus), are all inhabitants of freshwater streams and ponds. The same mode of branching characterizes the stipes of the present genus as that noticed under the genus *Cocconema*; and excluding the exceptional species just mentioned, this appendage, in the present as in that genus, when fully developed, consists of an elongated dichotomous filament. Conjugation and the formation of Sporangia have been observed by Mr. Thwaites in *G. Berkeleyi*, *G. tenellum*, and *G. curvatum*; and by myself in those species, *G. capitatum* and *G. marinum*.

1. **Gomphonema geminatum,** *Ag.* F. V. slightly cuneate, truncate; V. inflated at the centre and constricted towards each extremity, of which the one more distant from the stipes (the upper) is enlarged and rounded; striæ moniliform, 24 in ·001″. Length ·0041″ to ·0052″. v.v.

Ag. Syst. p. 12. Grev. C. F. pl. 244. fig. 2. Harv. Man. p. 207. Ralfs, Ann. vol. xii. pl. xviii. 3. Hass. Alg. xcviii. 1. Kütz. Bacill. xiii. 2. *Echinella geminata*, Lyng. Tent. lxx. D. *Gomp. ampullaceum*, Grev. B. F. p. 410. ex specim. authen. quæ communicavit cl. Dr. Greville.

Fresh water: subalpine streams, not uncommon. Pentland Hills, *Dr. Greville*. Dolgelly, *Mr. Ralfs*. Wray, Lancashire, *Mr. G. Smith*. Ben M[c] Dhui, *Mr. P. Grant*. Aberdeenshire, *Dr. Dickie*. Lough Mourne Deposit. Dolgelly Earth.

Plate XXVII. 235. Frustules with endochrome, Frontispiece, fig. CCXXXV.

2. **Gomphonema constrictum,** *Ehr.* F.V. distinctly cuneate; upper extremity rounded, lower obtuse; V. more or less constricted towards the upper extremity, attenuated below; striæ 27 in ·001″. Length ·0012″ to ·0024″. v.v.

Kütz. Bacill. xiii. 4. *Gomp. truncatum*, Ehr. Inf. xviii. 1. Hass. Alg. xcviii. 2. *Gomp. pohliæforme*, Ralfs, Ann. vol. xii. pl. xviii. 4. *Gomp. geminatum*, Quek. H. C. xii. 4.

Fresh water: frequent. Lewes, May 1850, &c., *W. Sm.* Harrison's Rocks, Sussex, *Mr. Jenner*. Lough Mourne Deposit. Peterhead Deposit. Dolgelly Earth, &c.

Plate XXVIII. 236.

3. **Gomphonema acuminatum,** *Ehr.* F. V. cuneate, slightly inflated at centre, and crested at the upper extremity; V. constricted triangular and apiculate above, attenuated below; striæ 24 in ·001″. Length ·0011″ to ·0028″. v.v.

β. V. much elongated and slightly constricted below. Length ·0031″ to ·0042″.

γ. V. cuneate at larger extremity, constriction often obsolete.

Ehr. Inf. xviii. 4. Kütz. Bacill. xiii. 3. ad specim. quæ dedit amic. De Brébisson. Prit. Anim. xvi. 23. Hass. Alg. xcix. 1. *Gomp. minutum,* Ralfs, Ann. vol. xii. pl. xviii. 5.

Var. β. *Gomp. coronatum,* Kütz. Bacill. xxi. 12.

Fresh water: frequent. Lewes, Nov. 1851, *W. Sm.* Lough Mourne and Peterhead Deposits. Var. β. Dolgelly Earth. Rescobie, *Mr. P. Grant.* Var. γ. Lewes, Feb. 1853, &c. *W. Sm.* (San Fiore, Italy. Little Falls, New York.)

Plate XXVIII. 238. *a, a′, & b.* Var. β. 238 β. Var. γ. 238 *a″* & *a‴*.

4. **Gomphonema cristatum,** *Ralfs.* F. V. obovate, crested; V. obovate, apiculate; lower extremity acute; striæ 24 in ·001″. Length ·0009″ to ·0022″. v.v.

Ralfs, Ann. vol. xii. pl. xviii. 6. Hass. Alg. c. 1. *Gomp. Augur,* Kütz. Bacill. xxix. 74?

Fresh water. Shoreham, Kent, Dec. 1842; Farnham, Surrey, Jan. 1844, *Mr. Jenner.* Pond, St. James's Park, London, Jan. 1852, *Mr. Shadbolt.*

Plate XXVIII. 239. Frustules with endochrome, Frontispiece, fig. CCXXXIX.

5. **Gomphonema dichotomum,** *Kütz.* F.V. slightly cuneate, truncated; V. lanceolate, acute; striæ 34 in ·001″. Length ·0011″ to ·0018″. v.v.

β. Stipes incrassate; frustules flabellate, obtuse.

Ralfs, Ann. vol. xii. pl. xviii. 7. Kütz. Bacill. viii. 14. Hass. Alg. xcix. 2. *Gomp. minutum,* Ag. Consp. p. 34. ex specim. authen. quæ communicavit cl. Dr. Greville. *Gomp. gracile,* Ehr. Inf. xviii. 3.

Fresh water. Wareham, Jan. 1850. Penzance, *Mr. Ralfs.* Marl, Co. Down. Premnay Peat. Var. β. Plumpton, Sussex, Apr. 1852, *W. Sm.*

Plate XXVIII. 240. Var. β. 240 β. Frustules with endochrome, Frontispiece, fig. CCXL.

6. **Gomphonema tenellum,** *W. Sm.* Stipes very short; F.V. linear, truncate; V. lanceolate, extremities slightly produced; striæ 30 in ·001″. Length ·0006″ to ·0014″. v.v.

Gomp. micropus, Kütz. Bacill. viii. 12. ad specim. quæ dedit amic. De Brébisson. In Conjugation, Thw. Ann. vol. xx. pl. xxii. fig. D.

Fresh water. Wareham, Dorsetshire, Mar. 1848; near Lewes, Sept. 1850, *W. Sm.* Near Bristol, *Mr. Thwaites.* Wray, near Lancaster, *Mr. G. Smith.* Cantyre Peat. Marl, Co. Down.

Plate XXIX. 243.

7. **Gomphonema capitatum,** *Ehr.* Stipes quite distinct; F.V. cuneate; V. slightly attenuated towards the upper extremity, which is rounded; much attenuated towards the lower, which is somewhat acute; striæ 27 in ·001″. Length ·0009″ to ·0014″. v.v.

Ehr. Inf. xviii. 2. Kütz. Bacill. xvi. 2.

Fresh water. Lewes, May 1850, *W. Sm.*

Plate XVIII. 237.

8. **Gomphonema olivaceum,** *Ehr.* Frustules and stipes forming mucous masses; F. V. distinctly cuneate; V. slightly attenuated; upper extremity rounded, lower acute; striæ 28 in ·001″. Length ·0004″ to ·0018″. v.v.

Ehr. Inf. xviii. 9. Kütz. Bacill. vii. 13, 15. ad specim. quæ dedit amic. De Brébisson. *Echinella olivacea,* Lyng. Tent. lxx. c. 1, 2, 3. *Gomp. minutissimum,* Grev. S. C. F. tab. ccxliv. 1. ex specim. quæ communicavit cl. Auctor. *Gomp. Berkeleyi,* Ralfs, Ann. vol. xii. pl. xviii. 8. Hass. Alg. c. 2.

Fresh water: in streams, frequent in winter and spring. River Froome, Dorset, in vast quantities, Dec. 1849. River Ouse, Sussex, equally abundant, Feb. 1852. Henfield, Sussex, *Mr. Jenner.* Duddingston Loch, *Dr. Greville,* Mar. 1826.

Plate XXIX. 244.

9. **Gomphonema intricatum,** *Kütz.* F. V. almost linear, truncate; V. lanceolate, obtuse; striæ 30 in ·001″. Length ·0007″ to ·0021″. v.v.

Kütz. Bacill. ix. 4.

Fresh water: forming a velvet-like stratum on the surface of a chalk cliff. Beachy Head, Sussex, Aug. 1850, *W. Sm.*

Plate XXIX. 241.

10. **Gomphonema Vibrio,** *Ehr.* V. almost linear, very slightly attenuated, obtuse; striæ 22 in ·001″. Length ·0021″ to ·0031″. v.v.

Ehr. in Kütz. Bacill. xxix. 75.

Fresh water. Wray near Lancaster, *Mr. G. Smith,* Aug. 1851. Lough Mourne and Peterhead Deposits. Marl, Co. Down.

Plate XXVIII. 242.

11. **Gomphonema ? curvatum,** *Kütz.* Stipes elongated, filamentous and dichotomous; F. V. curved; V. enlarged towards the upper extremity, which is rounded and inflected, attenuated towards the lower, which is acute; nodules absent in the convex (outer) valve; striæ 30 in ·001″. Length ·0007″ to ·0021″. v.v.

β. Striæ more distinct, 22 in ·001″.

Kütz. Bacill. viii. 1. *Gomp. minutissimum,* Ehr. Inf. xviii. 5. Ralfs, Ann. vol. xii. pl. xviii. 9. Hass. Alg. c. 3. In Conj. Thw. Ann. vol. xx. pl. xxii. fig. B. Prit. Anim. xiv. 9, 10, 11, 12 & 17.

Fresh water: ponds, very common. Near Belfast, Aug. 1849; Plumpton, Sussex, Apr. 1852, *W. Sm.* Pond, St. James's Park, Jan. 1852, *Mr. Shadbolt.* Var. β. Shoreham, Kent, *Mr. Jenner,* 1843.

Plate XXIX. 245.

12. **Gomphonema ? marinum,** *W. Sm.* Stipes incrassated, branching in an irregular manner; F. and V. as in the last species; striæ 35 in ·001″. Length ·0005″ to ·0021″. v.v.

Gomp. curvatum, β. marinum, Kütz. Bacill. viii. 3. Prit. Anim. xvi. 11.

Marine: frequent. Coast of Sussex, Oct. 1851, &c. In Conj. Mar. 1852, *W. Sm.*

Plate XXIX. 246.

The last two species are characterized by several peculiarities. The curved form of their frustules, and the want of symmetry in the valvular markings are notable circumstances, which seem to place them apart, while the inflection of the upper extremity of the valve, easily recognised upon a side view, is a feature not found in any other species of *Gomphonema.* The last circumstance would seem to point to *Rhipidophora* as their appropriate position; but the presence of a central nodule on the inner surface, and the more perfectly siliceous nature of the valves, forbid their union with that genus. The species are so closely allied to each other, that it becomes difficult to distinguish them by a verbal description, if we confine our attention merely to the frustules; but the general appearance of the growing plants, arising from the characters of their stipes, is very different, and their habitats are so wide apart, that there can be no doubt of their distinctness.

Genus 27. **PODOSPHENIA,** *Ehr.*

Frustules attached, sessile, cuneate; valves convex, obovate, inflected at the larger extremity, striated, traversed by a longitudinal median line.

This genus is placed by Professor Kützing at the head of his second tribe, viz. *Diatomeæ vittatæ*. The *Vittæ,* upon the presence of which he has constituted this division, do not seem to me to be special organs, but modifications in the outline of the valve, which in the present genus is slightly inflected at its larger extremity, causing on a front view the appearance of notches at the spot where the valves unite with the connecting membrane, and the foramina exist. The apparent prolongation of this notch to the lower extremity of the frustule, is nothing more than the valvular suture which is seen in all the Diatomaceæ. The appearance of two notches at one extremity in the same frustule arises from the progress of self-division; for on the first formation of the new half frustules, the inflected portions of each valve are in close proximity, and but one notch and one "vitta" can be detected. An examination of the frustules, given in Plate XXIV. figs. 225 and 229, will show the gradual progress of self-division, and the various appearances consequent thereupon. A side view of a single valve after maceration in acid, as in Pl. XXIV. 225 *a*, shows the true form of the valve, and the outline of the inflected portion. We have here the first stage in a modification of the form of the valve, which, in its more complete development in *Tabellaria* and *Grammatophora,* will remind us of the binate form of many of the Desmidieæ, in which the loculi of the cell are united by a narrow connecting isthmus.

The only very evident distinction between the present and succeeding genus, is the presence in *Rhipidophora* of an elongated and frequently dichotomous stipes; but a close examination of the frustules shows us that the distinct and even moniliform striæ, so conspicuous in *Podosphenia,* are almost wholly wanting in our native species of *Rhipidophora.*

1. **Podosphenia Ehrenbergii,** *Kütz.* F. V. truncate at the upper extremity; V. acute at both extremities; striæ moniliform, 27 in ·001″. Length ·0025″ to ·0055″. v.v.

Kütz. Bacill. ix. 13. Prit. Anim. xvi. 14. *Podosphenia cuneata,* Ehr. Inf. xvii. 8.

Marine. Shoreham Harbour, Aug. 1850, *W. Sm.* Torbay, *Mrs. Griffiths.*

Plate XXIV. 225.

2. **Podosphenia ovata,** n. sp. F. V. rounded at the upper extremity; V. rounded at upper, and acute at lower extremity; striæ moniliform, 24 in ·001″. Length ·0033″ to ·0042″. v.v.

Marine. Shoreham Harbour, Aug. 1850, *W. Sm.*

Plate XXIV. 226.

3. **Podosphenia Lyngbyei,** *Kütz.* F. V. truncate at upper extremity; V. rounded at upper, and acute at lower extremity; striæ delicate, 46 in ·001″. Length ·0011″ to ·0033″. v.v.

Kütz. Bacill. x. 1, 2. Prit. Anim. xvi. 13. *Podosphenia abbreviata,* Ehr. Inf. xvii. 7.

Marine. Coast of Sussex, frequent; June and Aug. 1850, *W. Sm.*

Plate XXIV. 227.

4. **Podosphenia Jurgensii,** *Kütz.* F. V. truncate at upper extremity; V. rounded at upper, and acute at lower extremity; striæ very faint, 48 in ·001″. Length ·0025″ to ·0031″. v.s.

Kütz. Bacill. ix. 12. *Styllaria cuneata,* Ag. in Grev. B. F. p. 408. ad specim. authen. quæ communicavit cl. Dr. Greville.

Marine. Torbay, *Mr. Ralfs.*

Plate XXV. 228.

5. **Podosphenia gracilis,** *Ehr.* F. V. almost linear, truncate; V. scarcely siliceous; striæ obscure. Length ·0011″ to ·0021″. v.v.

Ehr. Inf. xvii. 6. Kütz. Bacill. ix. 10.

Marine. Jersey, Aug. 1852, *W. Sm.*

Plate XXIV. 229.

GENUS 28. **RHIPIDOPHORA,** *Kütz.*

Frustules stipitate, cuneate; valves convex, obovate, inflected at larger extremity, traversed by a median line.

1. **Rhipidophora paradoxa,** *Kütz.* Stipes dichotomous; frustules on F. V. obovate, rounded at the upper extremity; V. rounded at upper, acute at lower extremity, occasionally faintly striated. Length ·0016″ to ·0025″. v.v.

Kütz. Bacill. x. 5. *Echinella paradoxa,* Lyng. Tent. lxx. fig. E. *Gomphonema paradoxum,* Ag. Consp. p. 34. ad specim. quæ communicavit cl. Dr. Greville. Ralfs, Ann. vol. xii. pl. xviii. 10.

Marine: frequent. Jersey, Aug. 1852, *W. Sm.* Penzance, *Mr. Ralfs.* Aberdeen, *Dr. Dickie.* Frith of Forth, *Dr. Greville.*

Plate XXV. 231.

2. **Rhipidophora elongata,** *Kütz.* Stipes dichotomous; F.V. nearly linear, truncate; V. somewhat acute; striæ obscure. Length ·0032″ to ·0042″. v.s.

Kütz. Bacill. x. 6? *Gomphonema tinctum,* Ag. Consp. p. 35. ad specimina quæ communicavit cl. Dr. Greville.

Marine. Frith of Forth, *Dr. Greville,* 1849. Cromarty, *Mr. Johnson.*

Plate XXV. 232.

3. **Rhipidophora Dalmatica,** *Kütz.* Stipes incrassated, irregularly branched; F.V. truncate; V. very narrow, somewhat acute; striæ obscure. Length ·0008″ to ·0016″. v.v.

Kütz. Bacill. ix. 7?

Marine. Hastings and Beachy Head, Sussex, July 1850, *W. Sm.*

Plate XXV. 230.

Genus 29. **LICMOPHORA,** *Ag.*

Frustules cuneate, stipitate; stipes incrassate, irregularly branched; valves convex, elongated, inflected at larger extremity, and traversed by a longitudinal median line.

The frustules of the present genus differ in no essential respect from those of *Rhipidophora.* They are, it is true, longer and narrower, and probably less firmly siliceous; but none of these circumstances seem to be of generic importance. The separation of the genera must therefore rest upon the fan-like arrangement of the frustules, upon the summit of an incrassate and irregularly dichotomous pedicel, which occurs in *Licmophora.* This character is however of more importance than might at first view appear, as it indicates a peculiarity in the self-dividing process. In *Rhipidophora paradoxa* and *elongata,* self-division is immediately followed by the separation of the half-new frustules and a dichotomy in the filamentous stipes; while in the present genus the frustules remain for some time coherent, and continue dividing and multiplying on the summit of the pedicel, which becomes elongated and incrassated at each successive repetition of the process. A branching, or rather longitudinal rupture of the pedicel takes place at irregular intervals, and the entire plant presents us with more or less complete flabella on the summit of the branches, and imperfect flabella or single frustules irregularly scattered throughout the entire length of the pedicel. *Rhipidophora Dalmatica* possesses the same character to a certain extent; but the flabella are much less perfect than in the present genus, while its pedicel is occasionally so abbreviated as to ally it to *Podosphenia.*

I have given, in accordance with the authority of my predecessors, two species of the present genus; but I am far from satisfied that they are truly distinct; and I am disposed to believe that a wider comparison of specimens will necessitate their union. The fronds of both are parasitic upon the larger marine Algæ, upon *Zostera marina,* and upon various species of Zoophytes.

1. **Licmophora splendida,** *Grev.* F. V. nearly linear, frequently attenuate, and rounded at the upper extremity; V. imperfectly

siliceous, attenuate towards the larger extremity. Length of F. ·0033″ to ·0078″. v.s.

Grev. B. F. p. 408. *Echinella flabellata*, Ehr. Inf. xix. 1. Prit. Anim. iv. 192. *Licmophora flabellata*, Kütz. Bacill. tab. xii. figs. 1, 2, 3 & 4. ad sp. authen. quæ misit amicus De Brébisson, Jan. 1853.

Marine. Appin, *Captain Carmichael*, and Saltcoats, *Rev. Dr. Landsborough*, from specimens in *Dr. Greville's* herbarium.

Plate XXVI. 233. Plate XXXII. 233.

2. **Licmophora flabellata,** *Ag.* F.V. cuneate, truncate; V. rounded at the upper extremity, nearly linear. Length of F. ·0033″ to ·0058″. v.v.

Ag. Consp. p. 41. *L. radians*, Kütz. Bacill. xi. 4. *Exilaria flabellata*, Grev. S. C. F. pl. 289. ad specimina quæ communicavit cl. Auctor.

Marine. Torbay, July 1846; Poole Bay, Sept. 1848 and Oct. 1851, *W. Sm.* Appin, *Captain Carmichael*, 1826. Torbay, *Mrs. Griffiths*. Salcombe, *Mr. Ralfs*. Aberdeen and Larne, *Dr. Dickie.*

Plate XXVI. 234. Pl. XXXII. 234. Frustules with endochrome, Frontispiece, fig. CCXXXIV.

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MICROSCOPIC PREPARATIONS OF THE DIATOMACEÆ.

Smith and Beck supply the following Diatomaceæ described in the Synopsis. As each specimen has been examined by the author of that work, the authority of these mountings may be relied upon by those desirous of correctly identifying these interesting and beautiful objects.

Diatomaceous Earths in Balsam.

Peterhead Deposit.
Premnay Peat.
Dolgelly Earth.
Lough Mourne Deposit.
Lough Island-Reavey Deposit.
Cantyre Peat.
Marl Co. Down.

Diatomaceæ in Balsam, or mounted Dry.

No. of Species.

2. Epithemia turgida.
4. Epithemia Zebra.
5. Epithemia Argus.
8. Epithemia proboscidea.
9. Epithemia Sorex.
11. Epithemia Westermanii.
12. Epithemia rupestris.
13. Epithemia gibba.
14. Epithemia ventricosa.
15. Eunotia Arcus.
18. Eunotia triodon.
23. Cymbella maculata.
24. Cymbella Helvetica.
25. Cymbella Scotica.
31. Cocconeis Pediculus.
32. Cocconeis Placentula.
33. Cocconeis Thwaitesii.
34. Cocconeis Scutellum.
35. Cocconeis Grevillii.
37. Coscinodiscus radiatus.
38. Coscinodiscus eccentricus.
40. Eupodiscus fulvus.
41. Eupodiscus crassus.

No. of Species.

45. Triceratium alternans.
47. Cyclotella Kützingiana.
50. Cyclotella Rotula.
57. Surirella biseriata.
59. Surirella constricta.
62. Surirella splendida.
64. Surirella striatula.
65. Surirella Gemma.
68. Surirella ovalis.
70. Surirella ovata.
71. Surirella salina.
75. Tryblionella gracilis.
76. Tryblionella marginata.
77. Tryblionella acuminata.
78. Cymatopleura Solea.
80. Cymatopleura elliptica.
81. Cymatopleura Hibernica.
82. Synedra lunaris.
83. Synedra biceps.
84. Synedra pulchella.
89. Synedra radians.
90. Synedra Ulna.
96. Synedra tabulata.

No. of Species.

97. Synedra affinis.
102. Synedra superba.
103. Synedra fulgens.
105. Nitzschia Amphioxys.
108. Nitzschia Sigma.
109. Nitzschia obtusa.
110. Nitzschia linearis.
112. Nitzschia dubia.
114. Nitzschia plana.
115. Nitzschia scalaris.
124. Amphiprora alata.
130. Navicula serians.
131. Navicula cuspidata.
134. Navicula Jennerii.
137. Navicula elegans.
138. Navicula firma.
147. Navicula Amphisbæna.
147. Navicula Amphisbæna, var. β.
148. Navicula sphærophora.
149. Navicula ambigua.
151. Navicula punctulata.
152. Navicula elliptica.
154. Navicula didyma.
165. Pinnularia oblonga.
168. Pinnularia alpina.
171. Pinnularia acuta.
173. Pinnularia radiosa.
176. Pinnularia cyprinus.
178. Pinnularia stauroneiformis.
185. Stauroneis Phœnicenteron.
186. Stauroneis gracilis.
194. Stauroneis pulchella.
195. Pleurosigma formosum.
203. Pleurosigma strigosum.
207. Pleurosigma Balticum.
208. Pleurosigma strigilis.
216. Pleurosigma attenuatum.
219. Cocconema lanceolatum.
221. Cocconema cistula.
222. Cocconema parvum.
223. Doryphora Boeckii.
235. Gomphonema geminatum.

No. of Species.

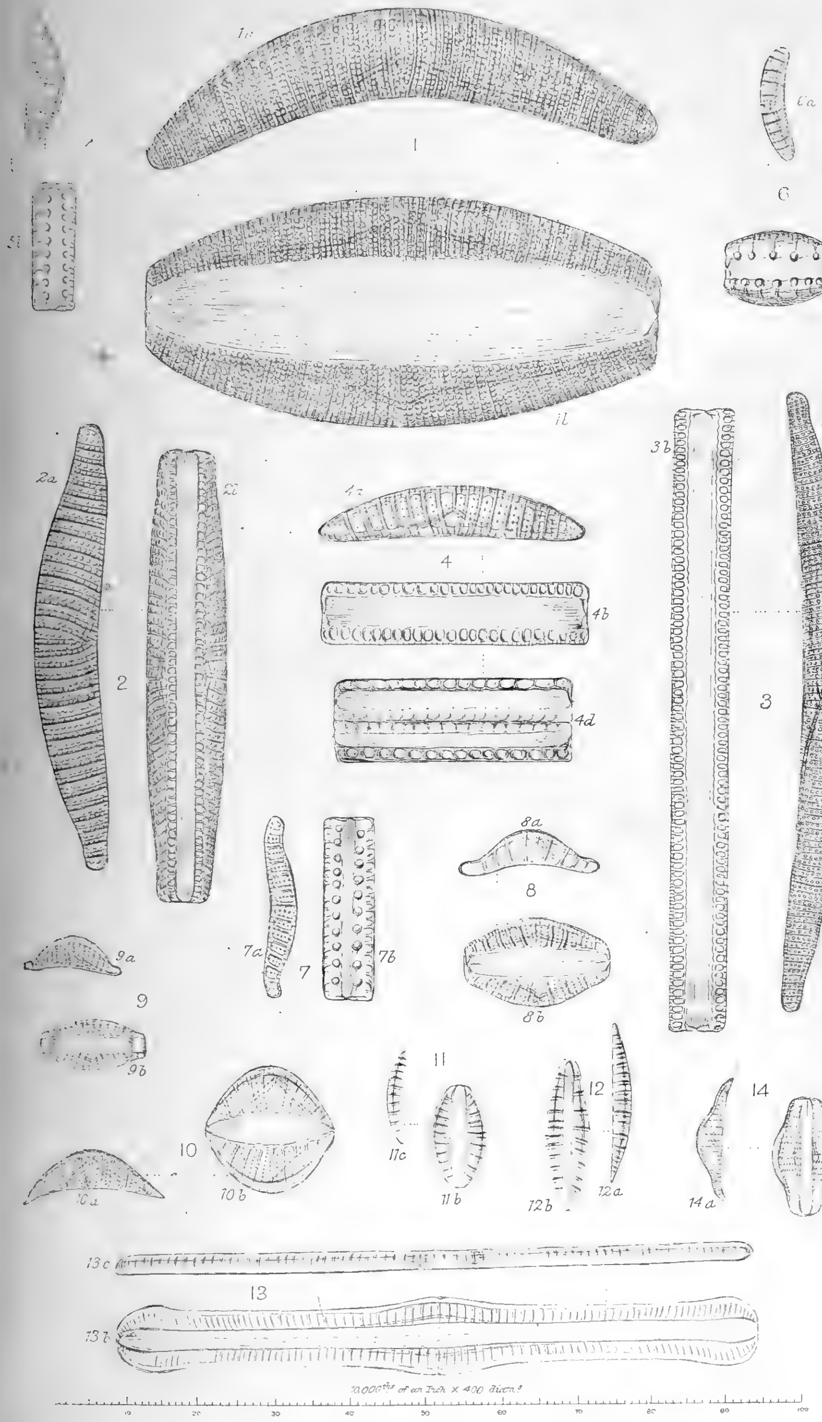
236. Gomphonema constrictum.
238. Gomphonema acuminatum.
238 a'' & a'''. Gomphonema acuminatum, var. γ.
239. Gomphonema cristatum.
241. Gomphonema intricatum.
243. Gomphonema tenellum.
244. Gomphonema olivaceum.
245. Gomphonema curvatum.
246. Gomphonema marinum.
247. Epithemia longicornis.
248. Epithemia constricta.
250. Cymbella affinis.
259. Surirella subsalsa.
260. Surirella angusta.
263. Synedra hamata.
265. Synedra Gallionii, & β.
266. Nitzschia Brébissonii.
267. Nitzschia vivax.
270. Amphiprora vitrea.

The following are mounted as Test Objects.

104. Nitzschia sigmoidea.
118. Nitzschia lanceolata.
129. Navicula rhomboides.
199. Pleurosigma elongatum.
200. Pleurosigma intermedium.
201. Pleurosigma Nubecula.
202. Pleurosigma delicatulum.
204. Pleurosigma quadratum.
205. Pleurosigma angulatum.
206. Pleurosigma obscurum.
209. Pleurosigma acuminatum.
211. Pleurosigma Fasciola.
214. Pleurosigma littorale.
215. Pleurosigma Hippocampus.
216. Pleurosigma attenuatum.
217. Pleurosigma lacustre.
275. Pleurosigma macrum.

For other Objects, Microscopes, &c. see Catalogue.

6 Coleman Street, March 1853.



1. E. Hyndmanii. 2. E. Turgida. 3. E. Granulata. 4. E. Zebra. 5. E. Argus.
6. E. Ocellata. 7. E. alpestris. 8. E. Proboscidea. 9. E. Sorex. 10. E. musculus.
11. E. Westermanii. 12. E. rupestris. 13. E. gibba. 14. E. ventricosa.

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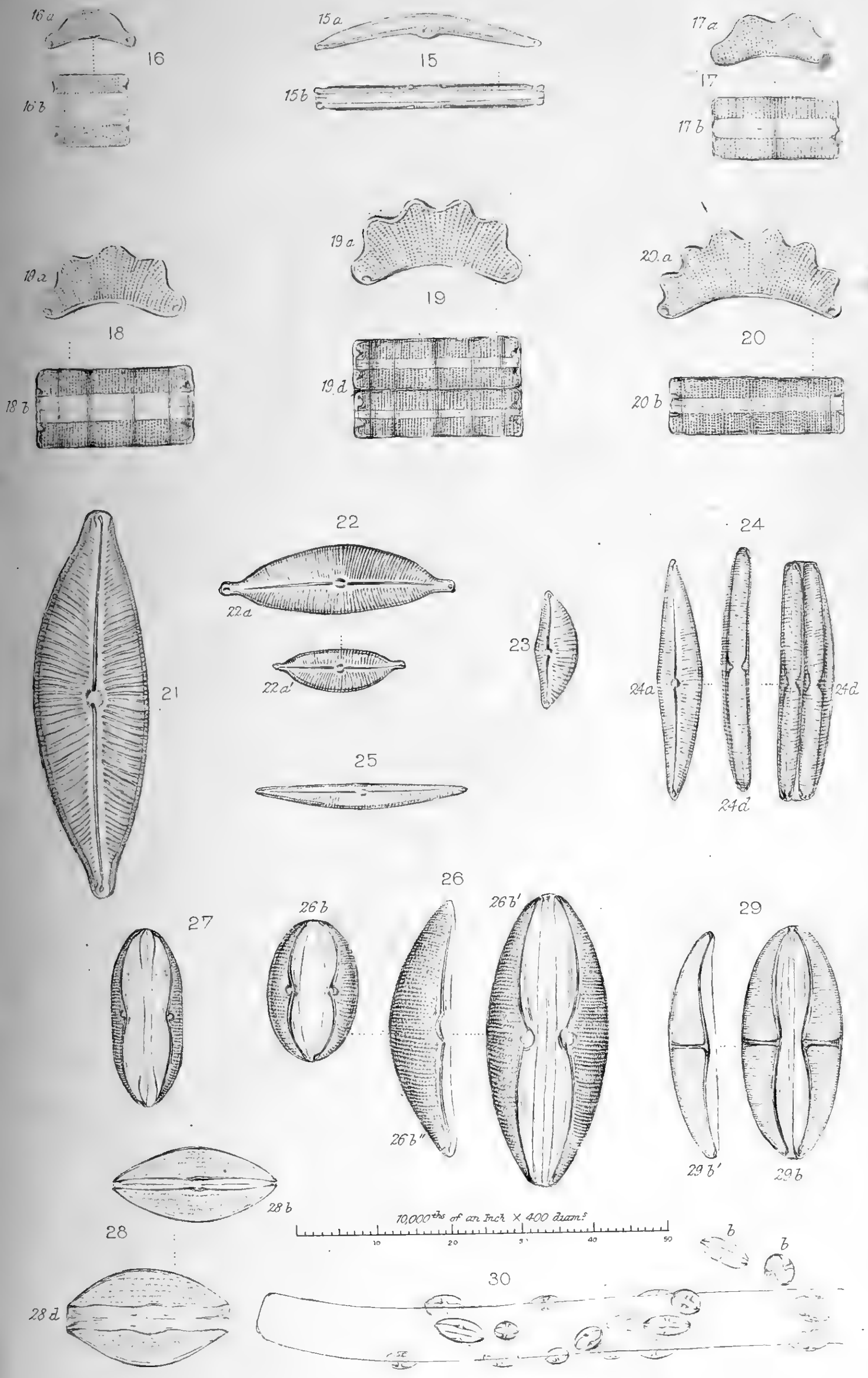

15. E. arcus. 16. E. Monodon. 17. E. diodon. 18. E. Triodon.
19. E. Tetraodon. 20. E. diadema. 21. C. Ehrenbergii. 22. C. Cuspidata.
23. C. Maculata. 24. C. Helvetica. 25. C. Scotica. 26. A. ovalis.
27. A. affinis. 28. A. Hyalina. 29. A. Membranacea. 30. A. minutissima.

Tuffen West sculp ad nat.

31 C. Pediculus. 32 C. Placentula. 33 C. Thwaitesii. 34 C. Scutellum. 35 C. Grevillii.
36. C. minor. 37. C. radiatus. 38. C. eccentricus.

Tuffen West, sculp. ad nat.

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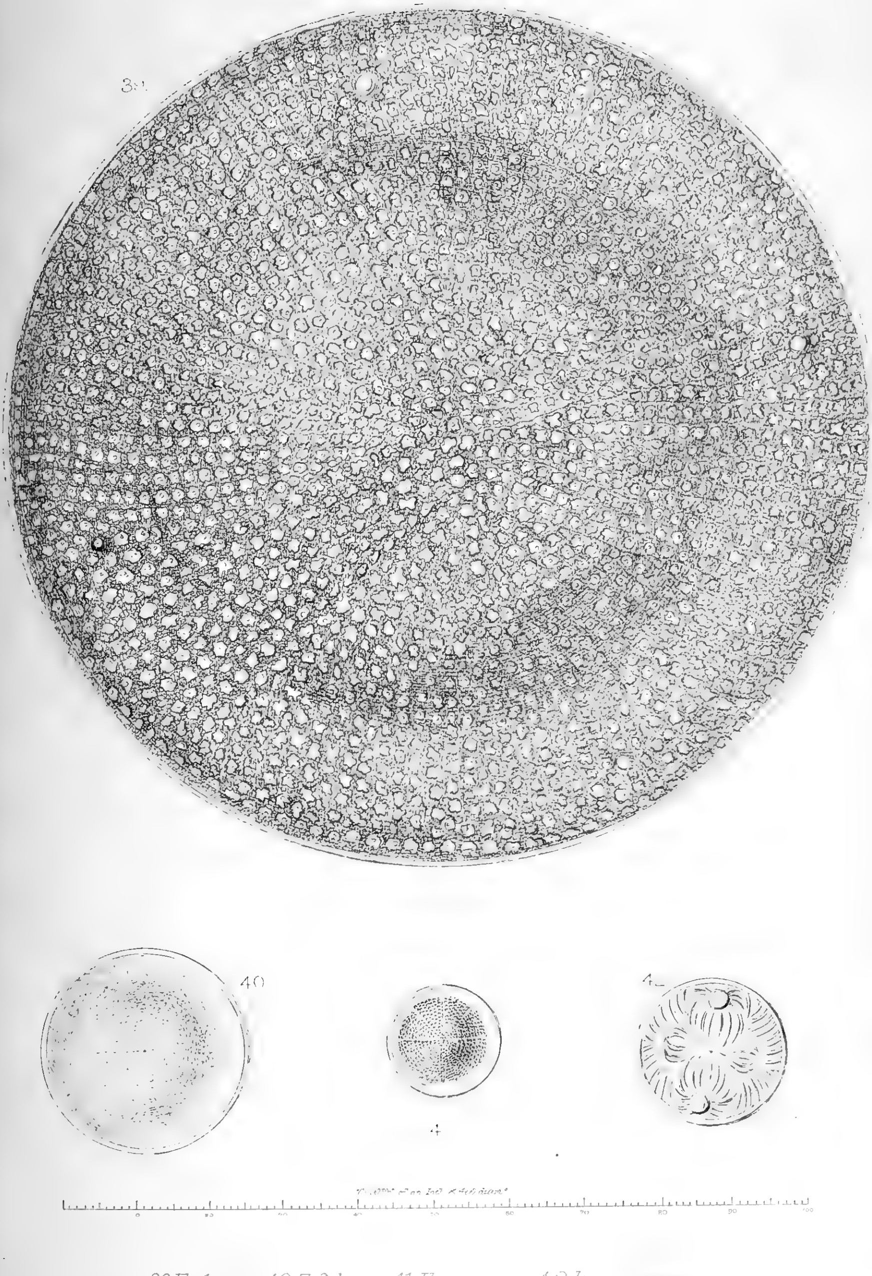

39. E. Argus. 40. E. fulvus. 41. E. crassus. 42. E. scu…

Tuffen West, Sculp. ad nat.

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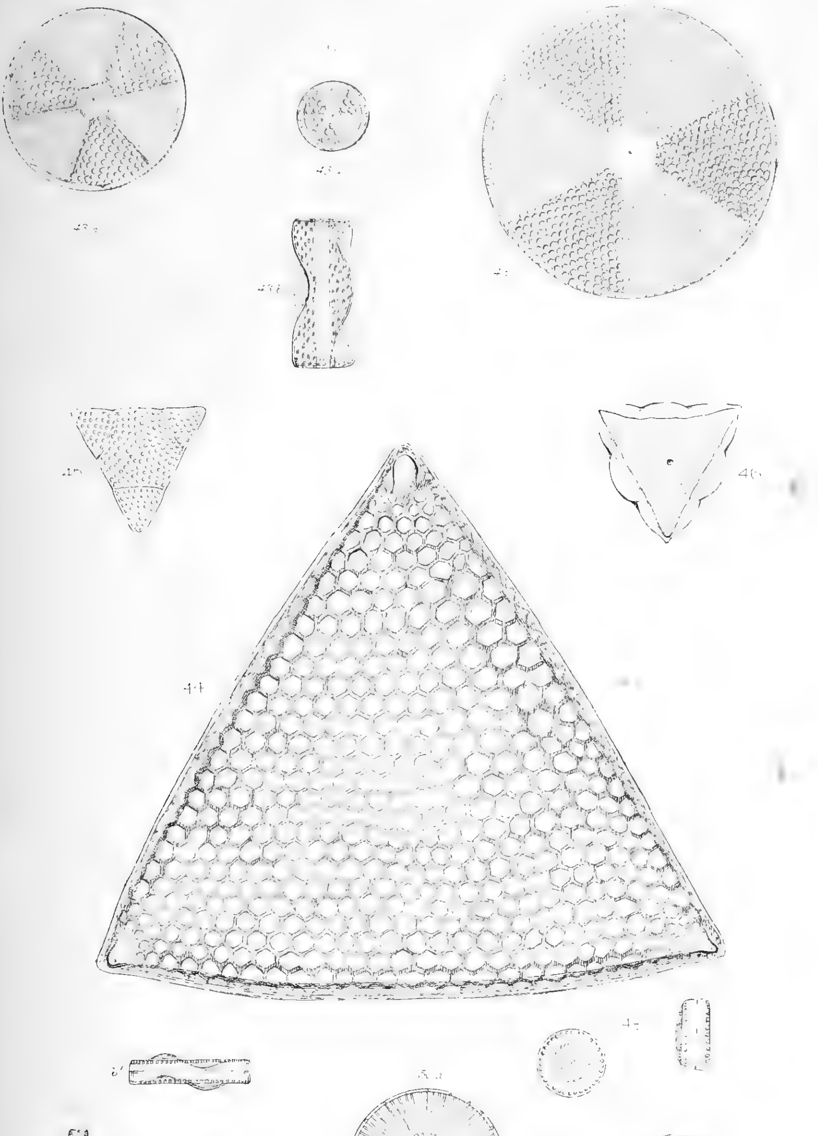
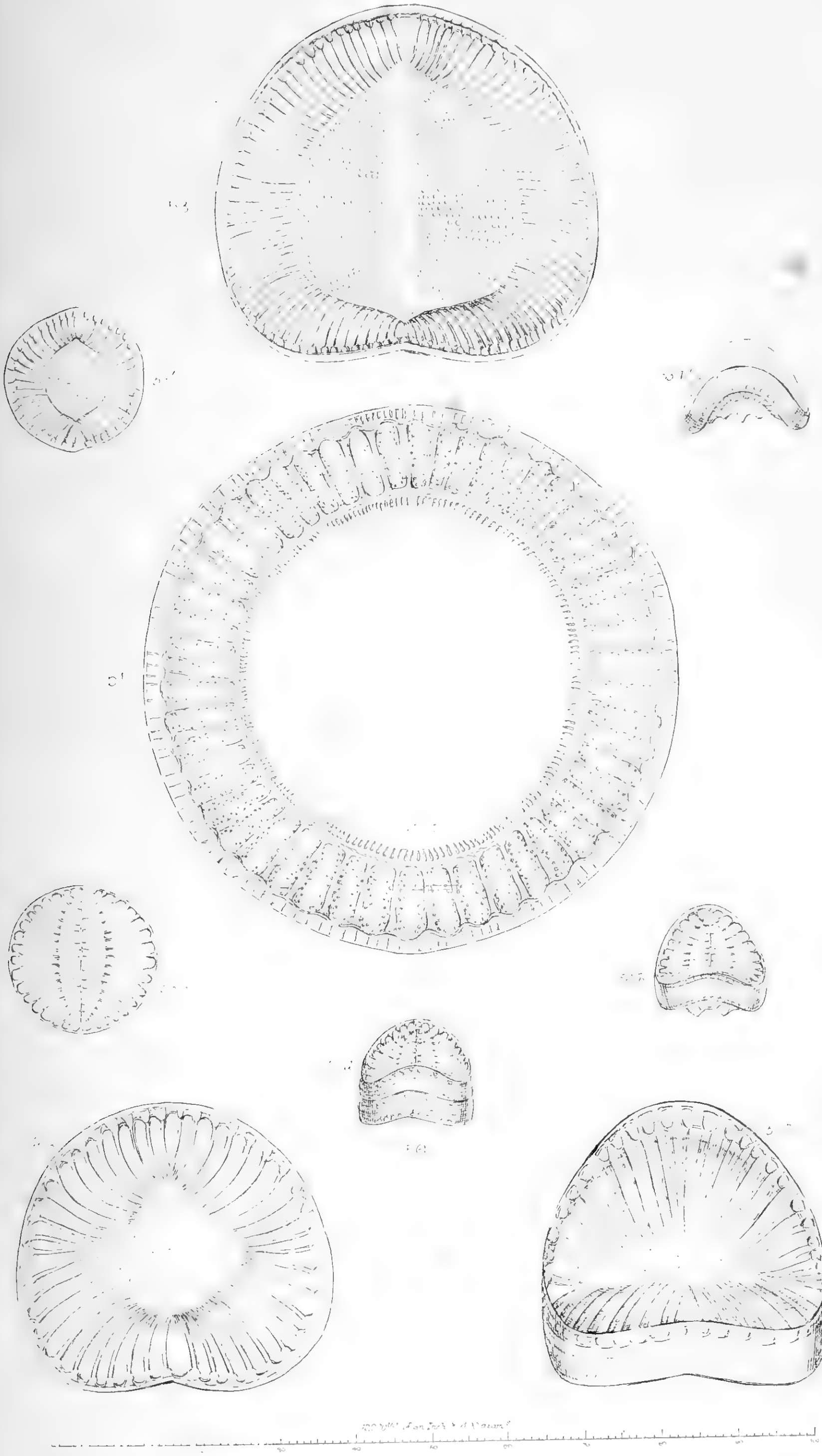


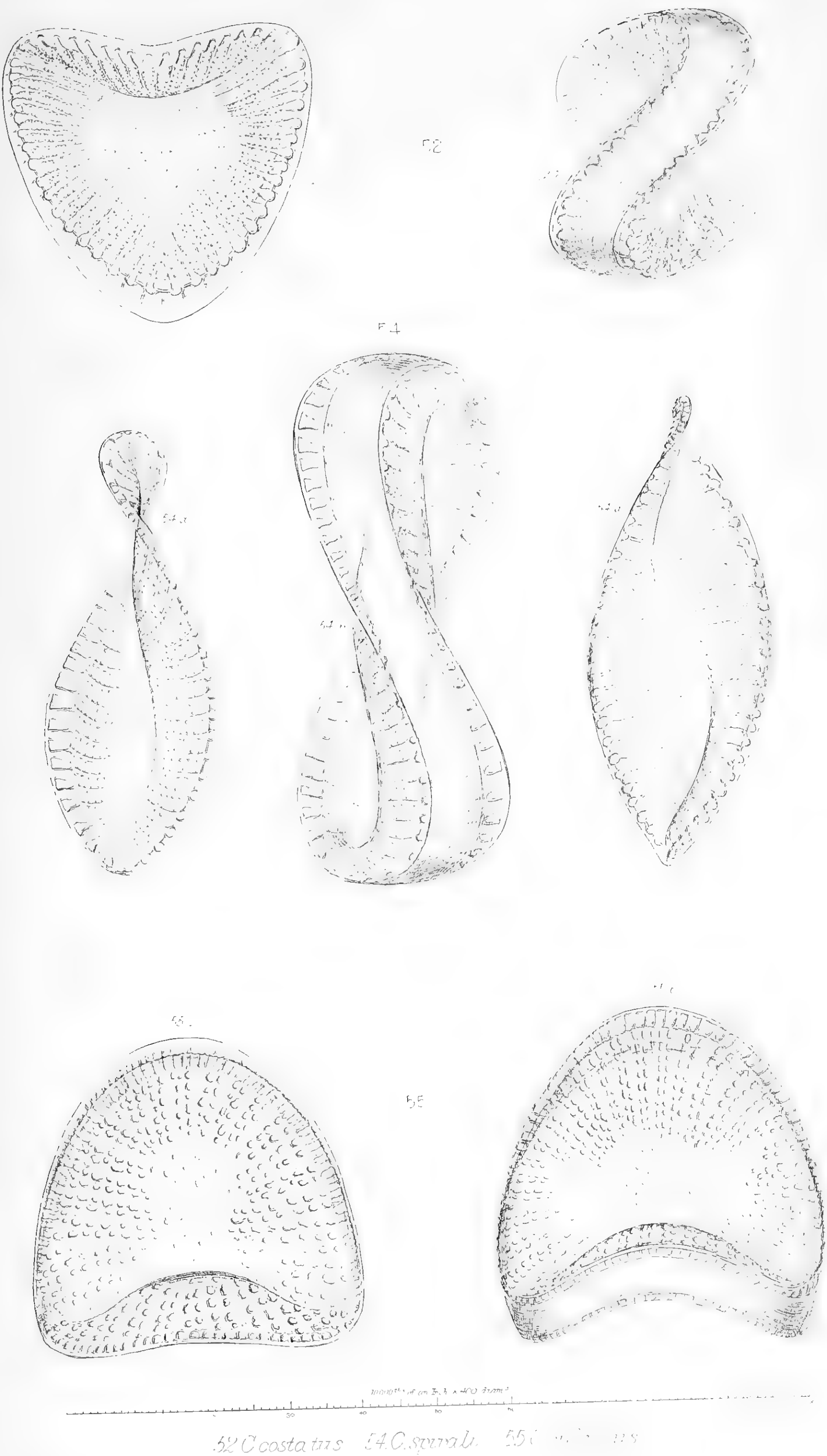
43. A. undulatus. 44. T. Favus. 45 T. alternans. 46 T. striolatum ?
47. C. Kutzingiana. 48. C. operculata. 49. C. antiqua. 50 C. Rotula.

Tuffen West sculp. ad nat.



51.C.Horologium. 52.C.costatus. 53.C.Hodgsonii. 56.C.parvulus.

Tuffen West, sculp ad nat.



52 C costatus. 54 C. spiralis. 55 C

Tuffen West del. ad nat.

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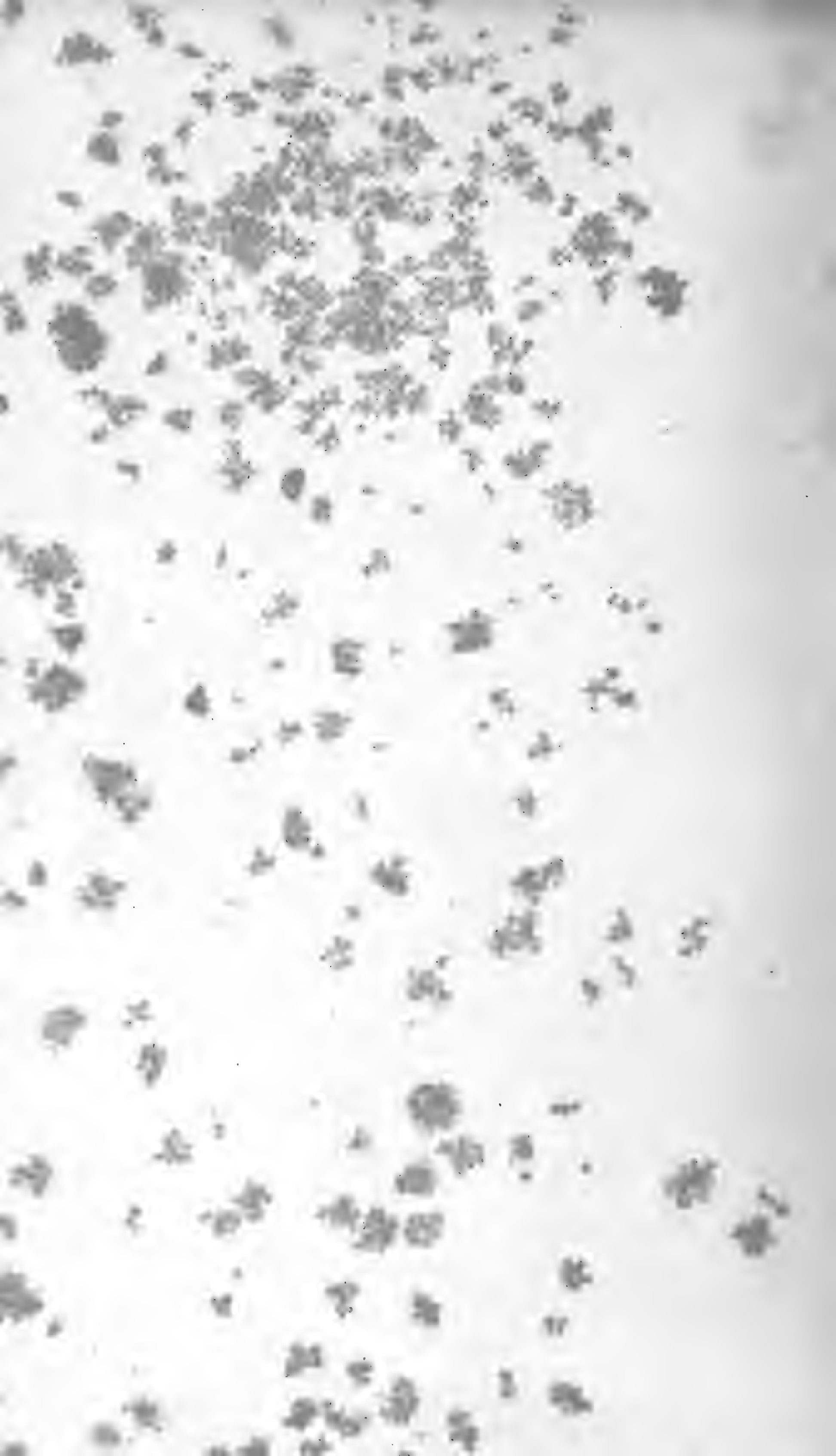
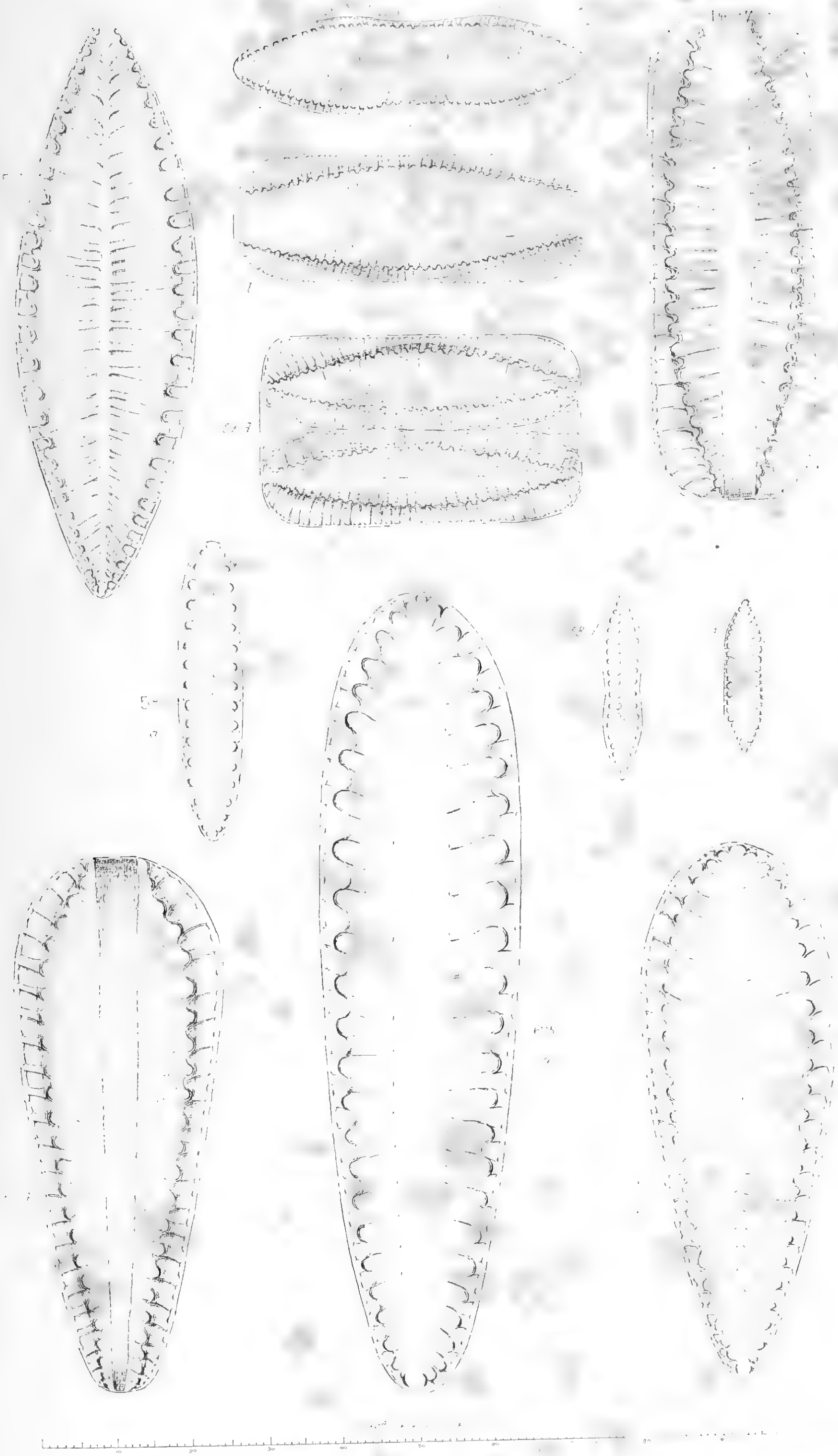


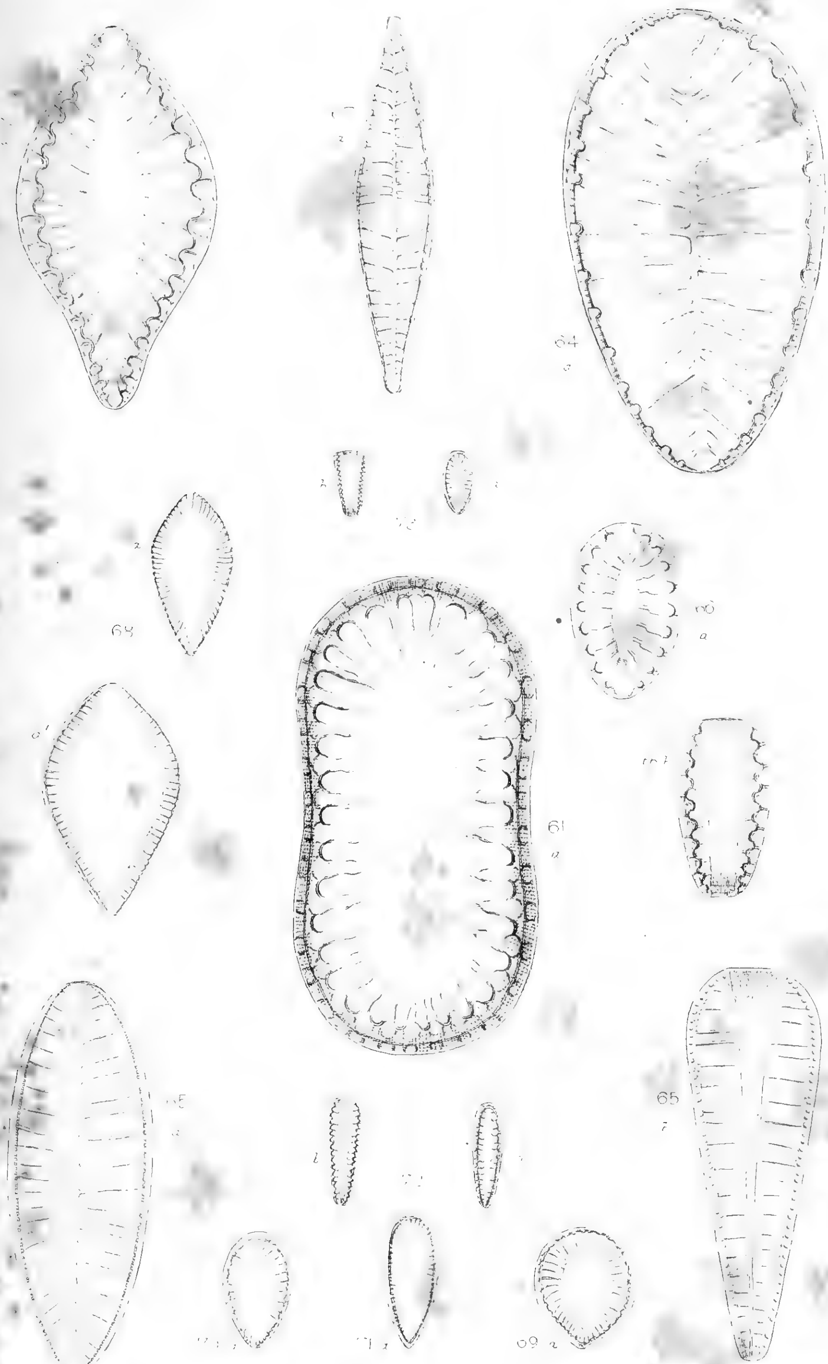
SURIRELLA.



57. S. biseriata 58. S. linearis 59. S. constricta 62. S. splendida 63. S. nobilis

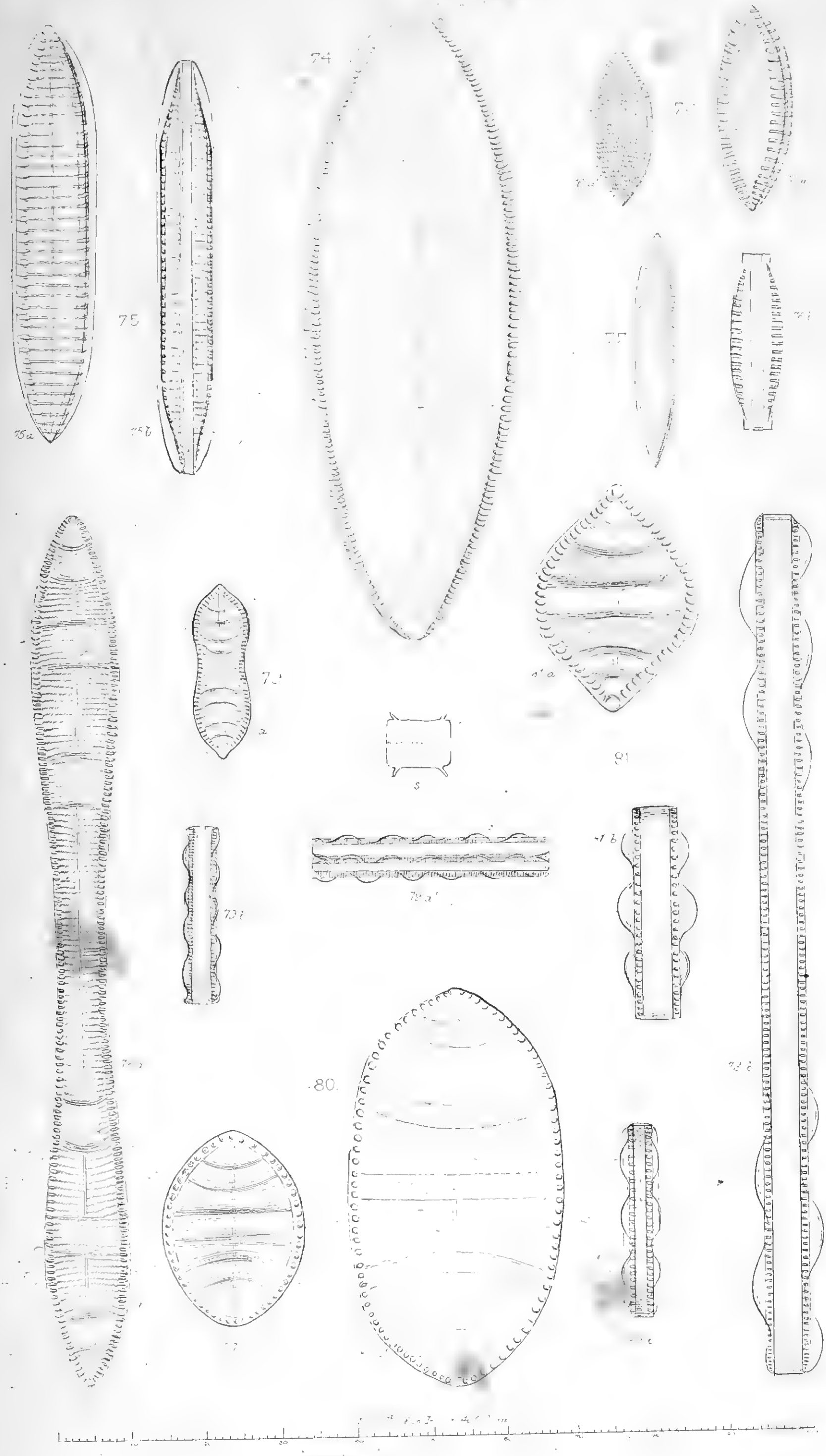
Tuffen West, sculp. ad nat.

Ford & West Lithographers 54 Hatton Garden



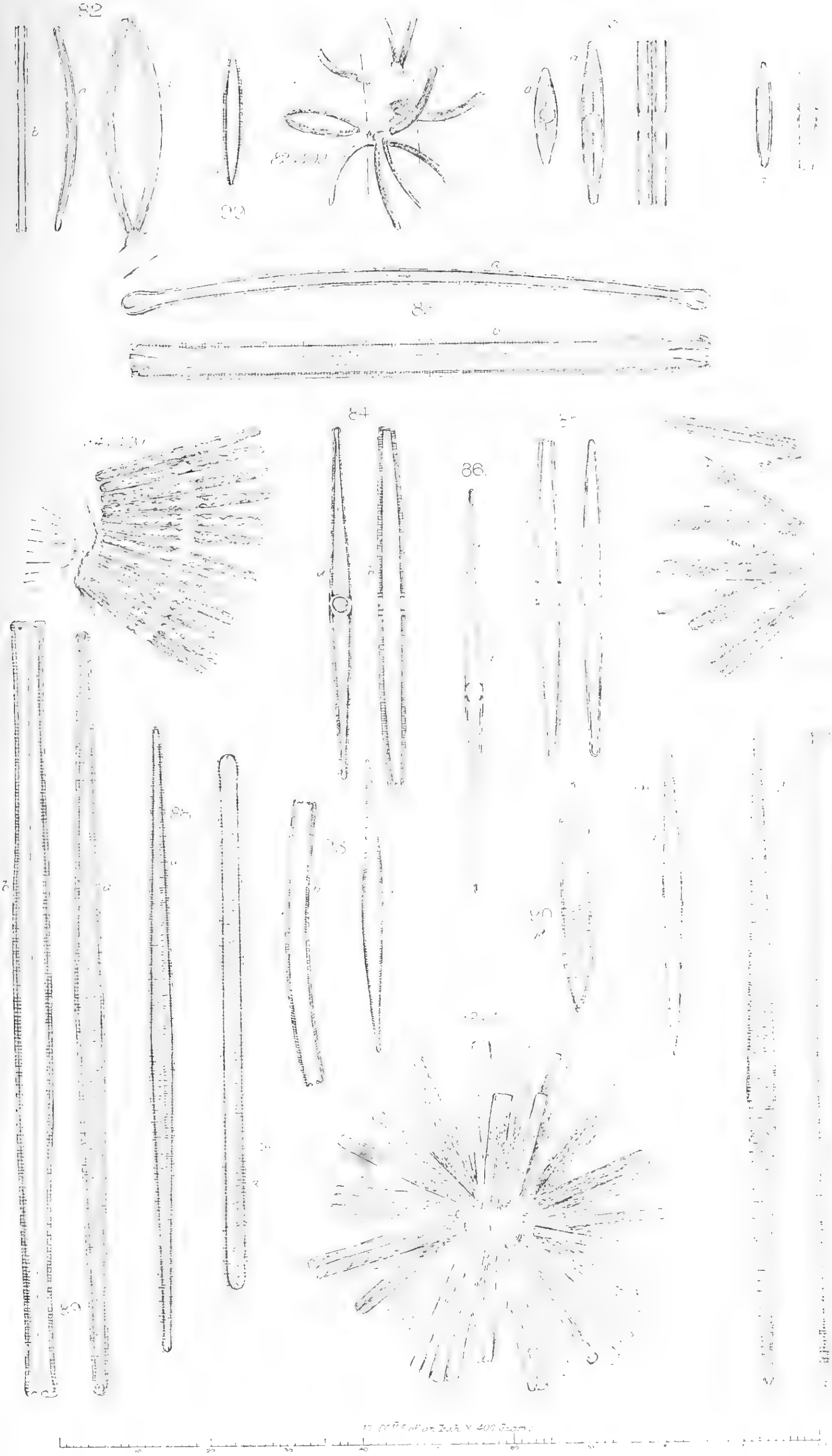
62. S. turgida. 63. S. lata. 64. S. striatula. 65. S. Gemma.
66. S. fastuosa. 67. S. Craticula. 68. S. ovalis. 69. S. Brightwellii.
70. S. ovata. 71. S. salina. 72. S. pinnata. 73. S. minuta.

Tuffen West, sculp. ad nat. Ford & West Lith. 54 Hatton Garden.



74. T. Scutellum. 75. T. gracilis. 76. T. marginata. 77. T. acuminata.
78. C. Solea. 79. C. apiculata. 80. C. elliptica. 81. C. Hibernica.

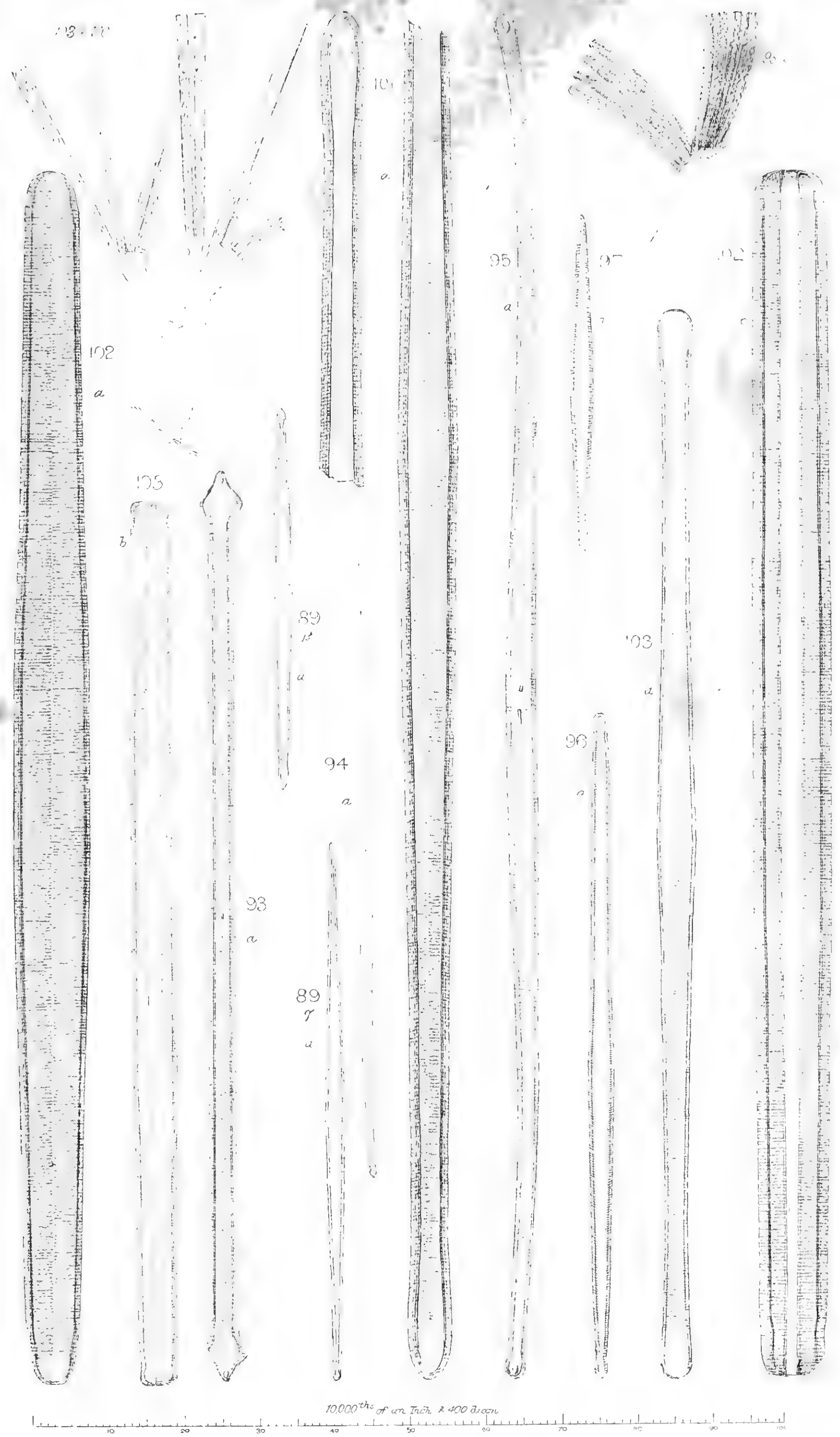
Tuffen West, sculp. ad nat.



82. S. lunaris. 83. S. biceps. 84. S. pulchella. 85. S. gracilis
86. S. acicularis 87. S. minutissima. 88. S. salina. 89. S. radians
90. S. Ulna. 91. S. oxyrhynchus 92. S. obtusa. 93. S. Arcus.
99. S. Vaucherii. 100. S. fasciculata.

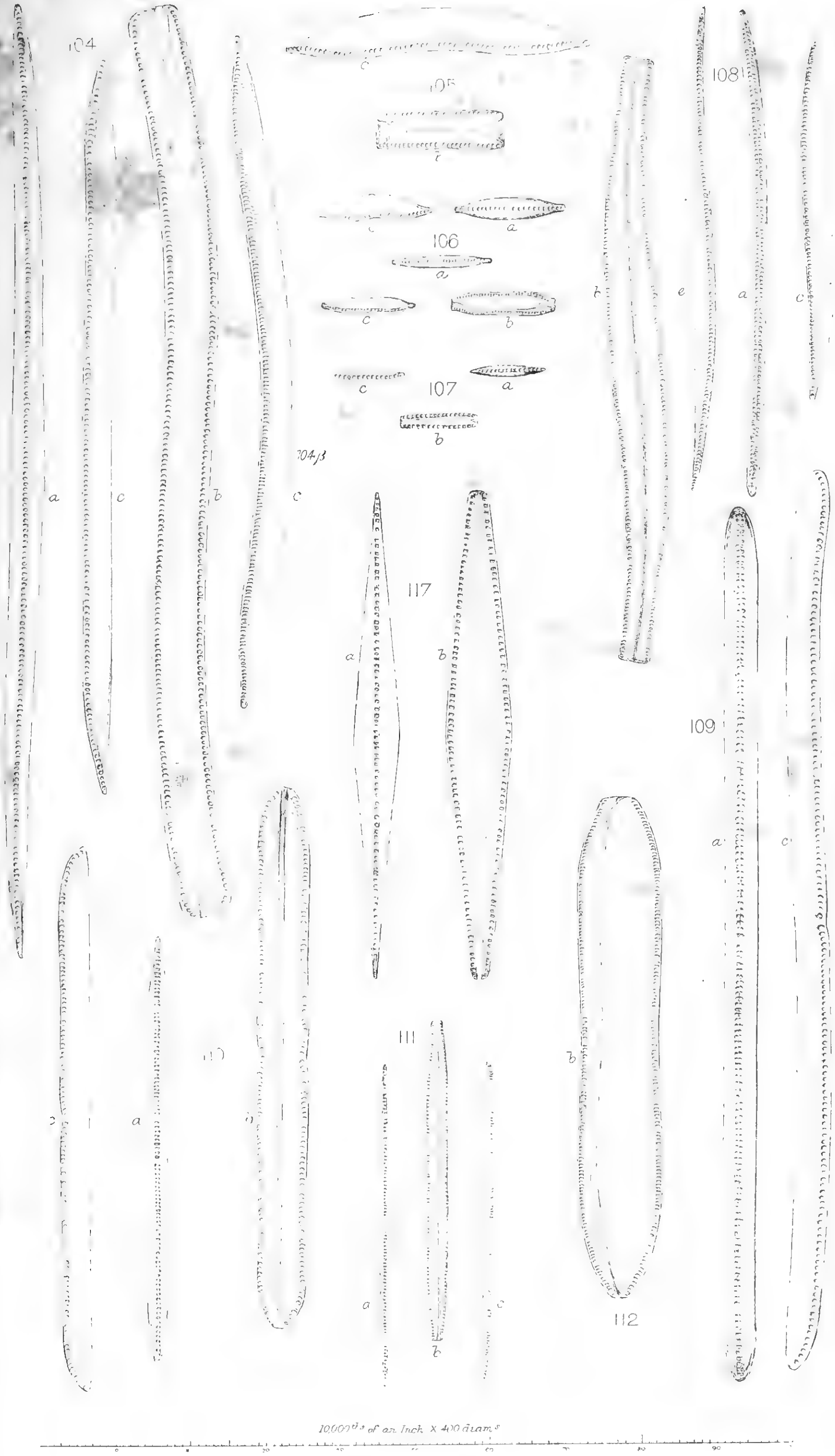
Tuffen West, sculp. ad nat.

Ford & West, Lithographers 54, Hatton Garden



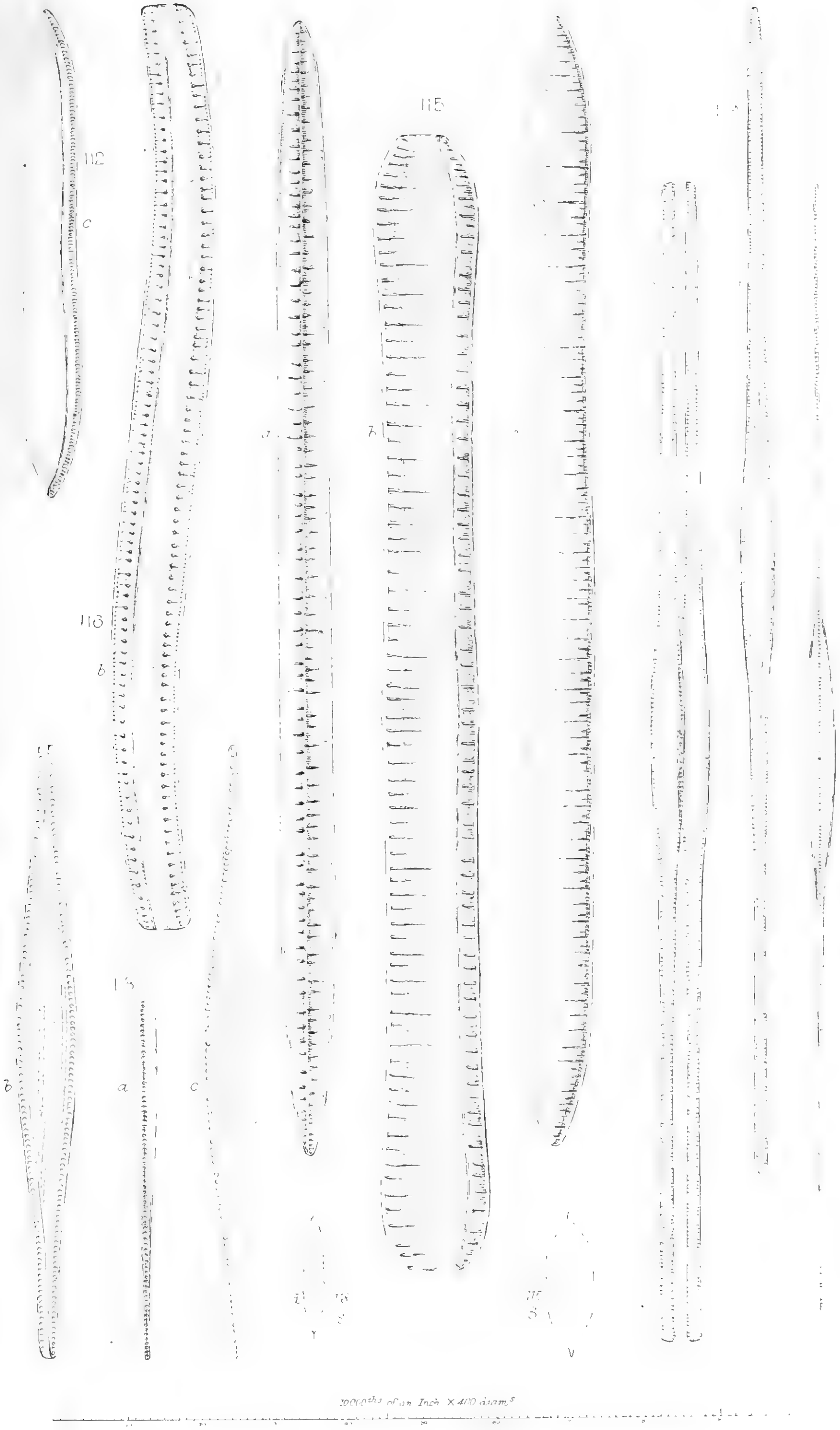
89 S. radians. 93 S. capitata. 94 S. delicatissima. 95 S. longissima.
96 S. tabulata. 97 S. affinis. 98 S. Arcus. 101. S. chrystallina.
102. S. superba. 103. S. fulgens.

Tuffen West, sculp. ad nat. Ford & West, Lithographers, 54 Hatton Gar. Ln.



104. N. sigmoidea. 105 N. amphioxys. 106 N. parvula.
107 N. minutissima. 108 N. Sigma 109. N. obtusata
110. N. linearis 111 N. tenuis 112. N. dubia 117 N. angularis.

Tuffen West, sculp ad nat Ford & West, Lithographers 54 Hatton Garden



112 N. dubia. 115 N. [illegible] 116 N. [illegible]
118 N. lanceolata. 119. N birostrata

Tuffen West, sculp ad nat

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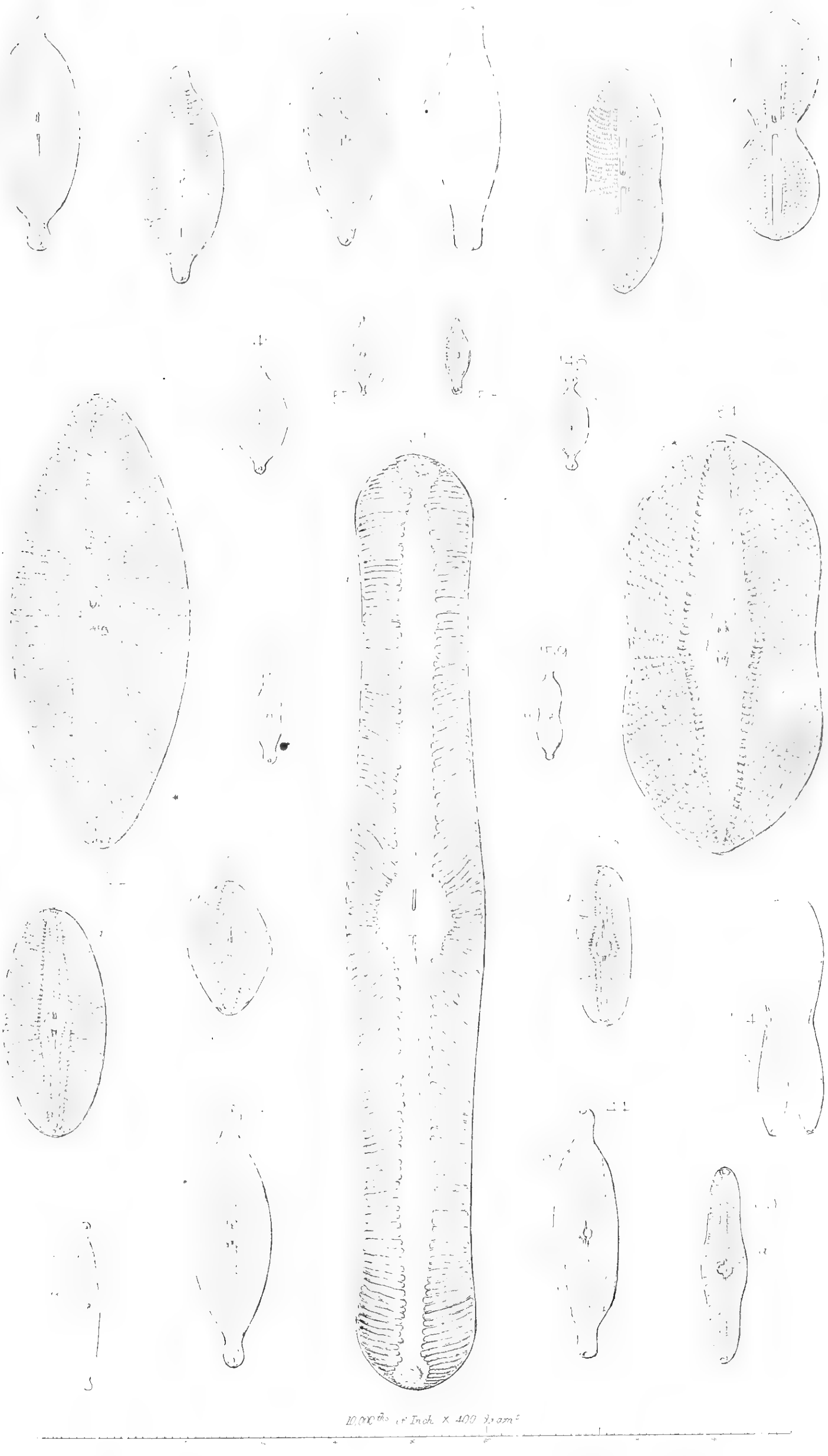
113 N. ... 114 N. ... N. Closterium ... N. ...
N. ... 123 N. Tænia ... alata ... diagma
... 127 Apl. ... 128 Apl. ...

129 N rhomboides. 130. N. serians. 131 N cuspidata. 132. N rhynchocephala.
133. N Liber. 134. N Jennerii. 135 N Westii. 136 N convexa.
137 N elegans. 138. N firma. 139 N patula. 140. N obtusata.
141 N Semen. 142 N. amphirhynchus. 143 N affinis. 149 N ambigua. 151 N punctulata.

Tuffen West sculp ad nat. Ford & West Lithographers 54 Hatton Garden.



10,000ths of Inch × 400 Diam.

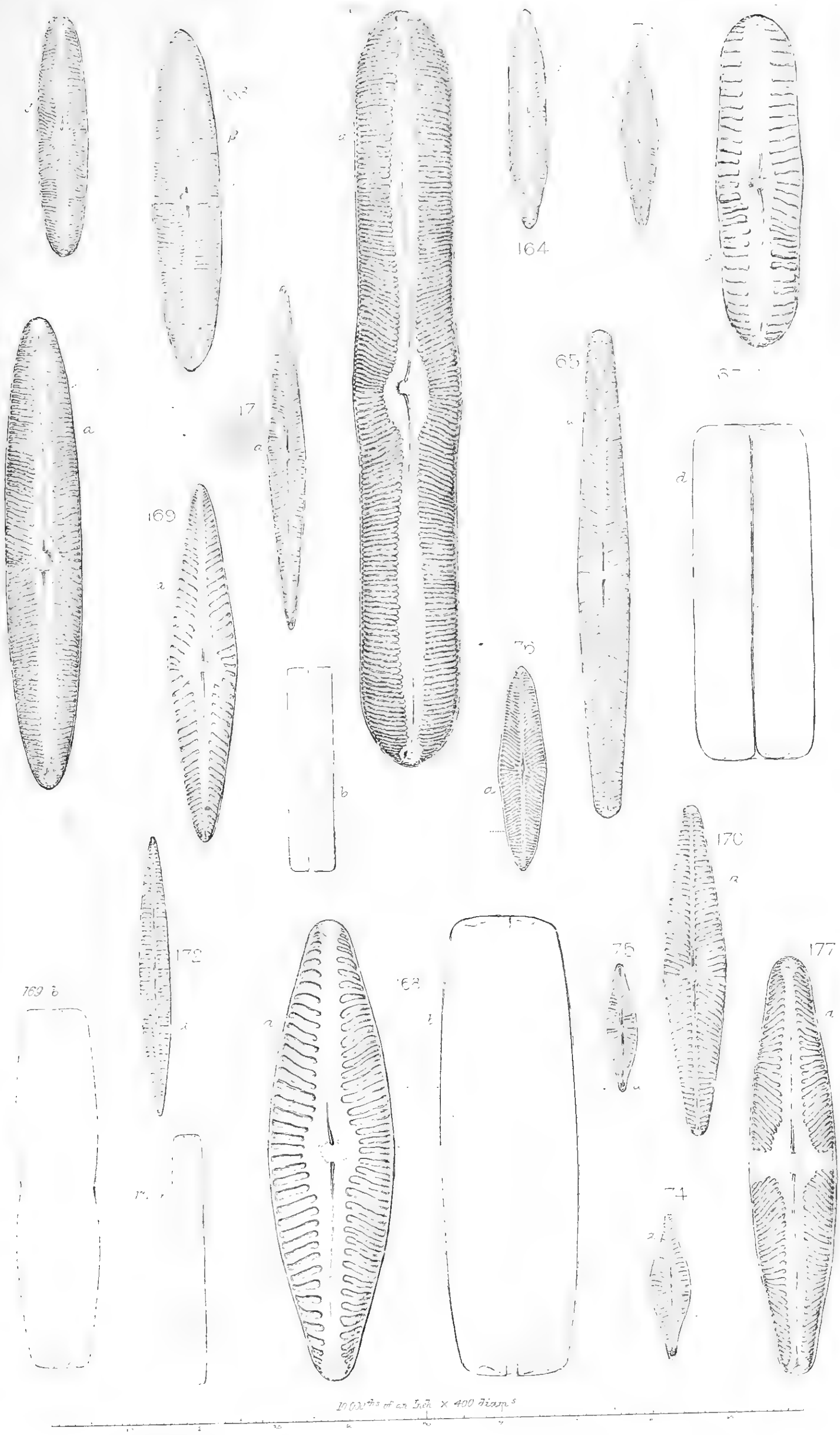
[illegible] N. prod[illegible]ta. 145 N. pusilla. [illegible]46 N. tumid[illegible] 147 N. amphis[illegible]

[illegible] N. sphae[illegible]phora. 150 N. tumi[illegible] 152 N. elliptica. 1[illegible]3 N. ova[illegible]

[illegible] N. didym[illegible] 155 N. cryptoceph[illegible]la. 156 N. [illegible]gristat[illegible] 15[illegible] N. [illegible]

[illegible] N. infl[illegible] 159 N. [illegible] [illegible] N. gibberul[illegible] [illegible] P. [illegible]

Tuffen West sculp. ad nat. — [illegible] Lithographers [illegible]



[illegible] 163.P.viridis 164.P.acuminata 165.P.oblong[illegible]
[illegible]7.P.lata [illegible] P.alp[illegible] [illegible]9.P.distan[illegible] [illegible]0.P.peregrina
171.P.acuta. 172.P.dire[illegible]a [illegible]73.P.rad[illegible] [illegible]74.P.gracilis
175.P.viridula 176.P.C[illegible] 17[illegible] P.[illegible]rgens.

Tuffen West, sculp. ad nat. [illegible]

10,000ths of an Inch × 400 linrs

[illegible] P [illegible] 178 P. stauroneiformis 179 P. Johnsonii 180 P. gibba

[illegible] 182 P. mesolepta 183 P. acrosphæria 184 P. interrupta

[illegible] S. Phœnicenteron [illegible] S. [illegible] 187 S. acuta. 188 S. salina 189 S. punctata

190 S. [illegible] [illegible] S. dilatata 192 S. [illegible] 193 S. linearis 194 S. pulchella.

Tuffen West, sculp. ad nat.

Fnd & West, Lithographers 54, Hatton Garden

195 P. fo[illegible] 197. P. spe[illegible]osum [illegible] [illegible]tum

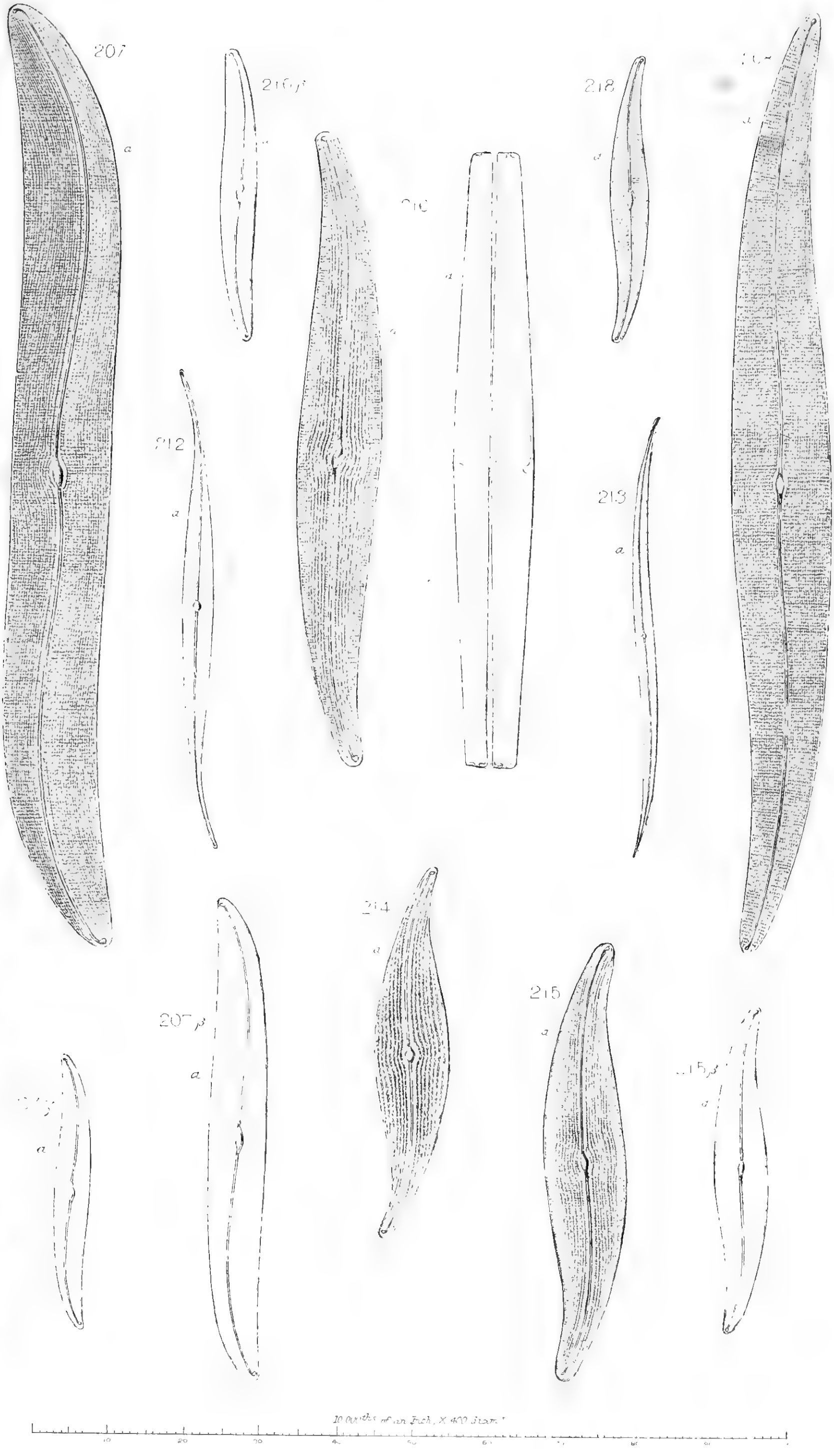
204 P. q[illegible]um 206 P. [illegible]scum[illegible] 21[illegible] P. [illegible]

Tuffen West, sculp. ad nat. [illegible] 54 [illegible]

196 P. decorum. 200 P. intermedium. 201 P. Nubecula. 202 P. delicatulum
203 P. strigosum. 205 P. angulatum. 209 P. acuminatum. 211 P. Fasciola. 217 P. lacustre

Tuffen West, sculp. ad nat.

Ford & West, Lithographers, Hatton Garden.



207 *P. Balticum.* 208 *P. Strigilis.* 212 *P. prolongatum.* 213 *P. tenuissimum.*
214 *P. littorale.* 215 *P. Hippocampus.* 216 *P. attenuatum.* 218 *P. Spencerii.*

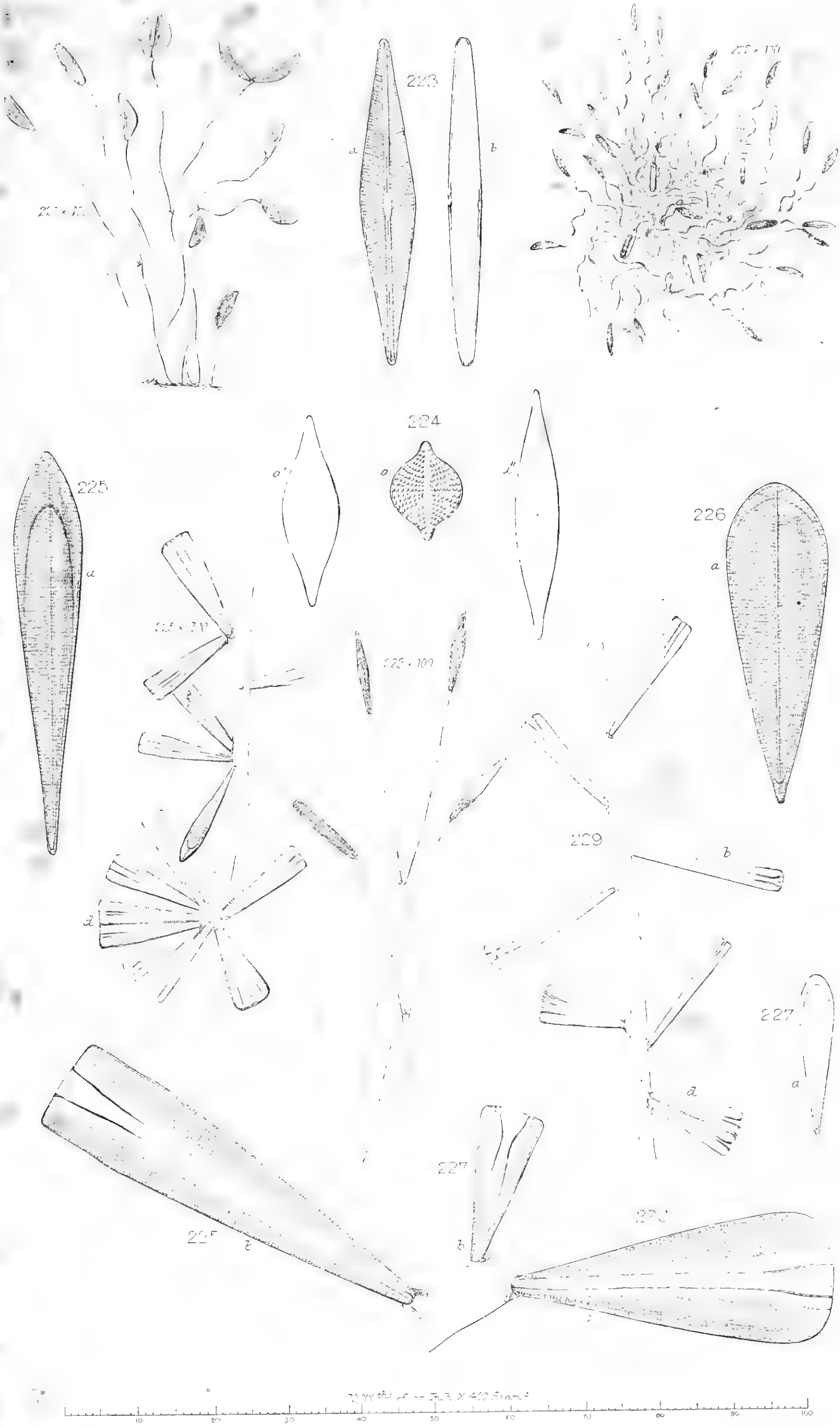
Tuffen West, sculp. ad nat.

Ford & West, Lithographers, 54 Hatton Garden.

203 P. strigosum 207 P. Balticum 219 C. lanceolatum
220 C. cymbiforme 221 C. Cistula 222 C. parvum

Tuffen West, sculp. ad nat.

Printed by W. West Lithographers, Hatton Garden.

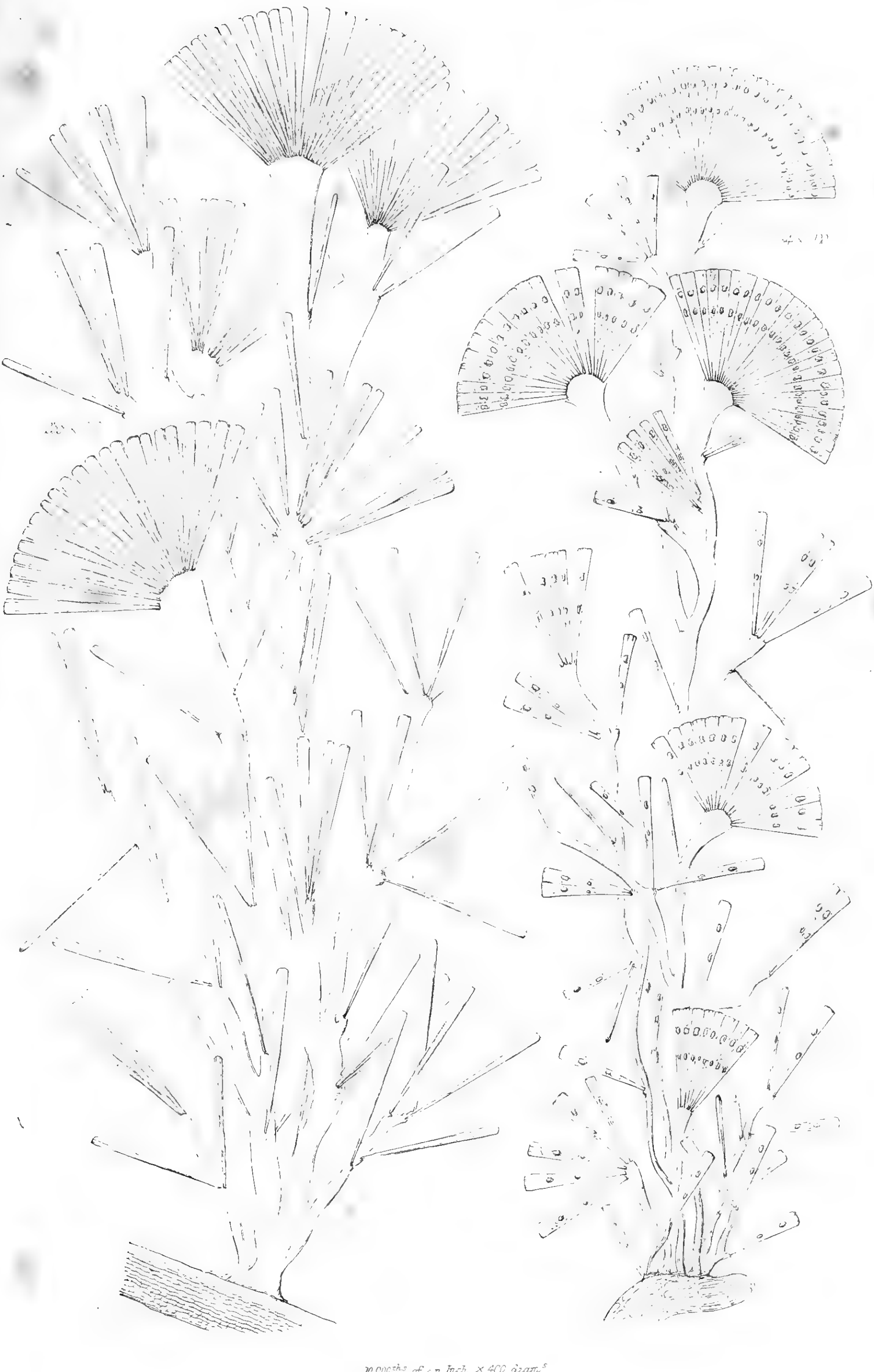


221 C. Cistula. 222 C. parvum. 223 D. Boeckii. 224 D. Amphiceros.
225 P. Ehrenbergii. 226 P. ovata. 227 P. Lyngbyei. 228 P. gracilis.

Tuffen West, sculp. ad nat. Ford & West, Lithographers, 54, Hatton Garden.

228 P. Jurgensii 230. R. Dalmatica
231 R. paradoxa 232 R. elongata

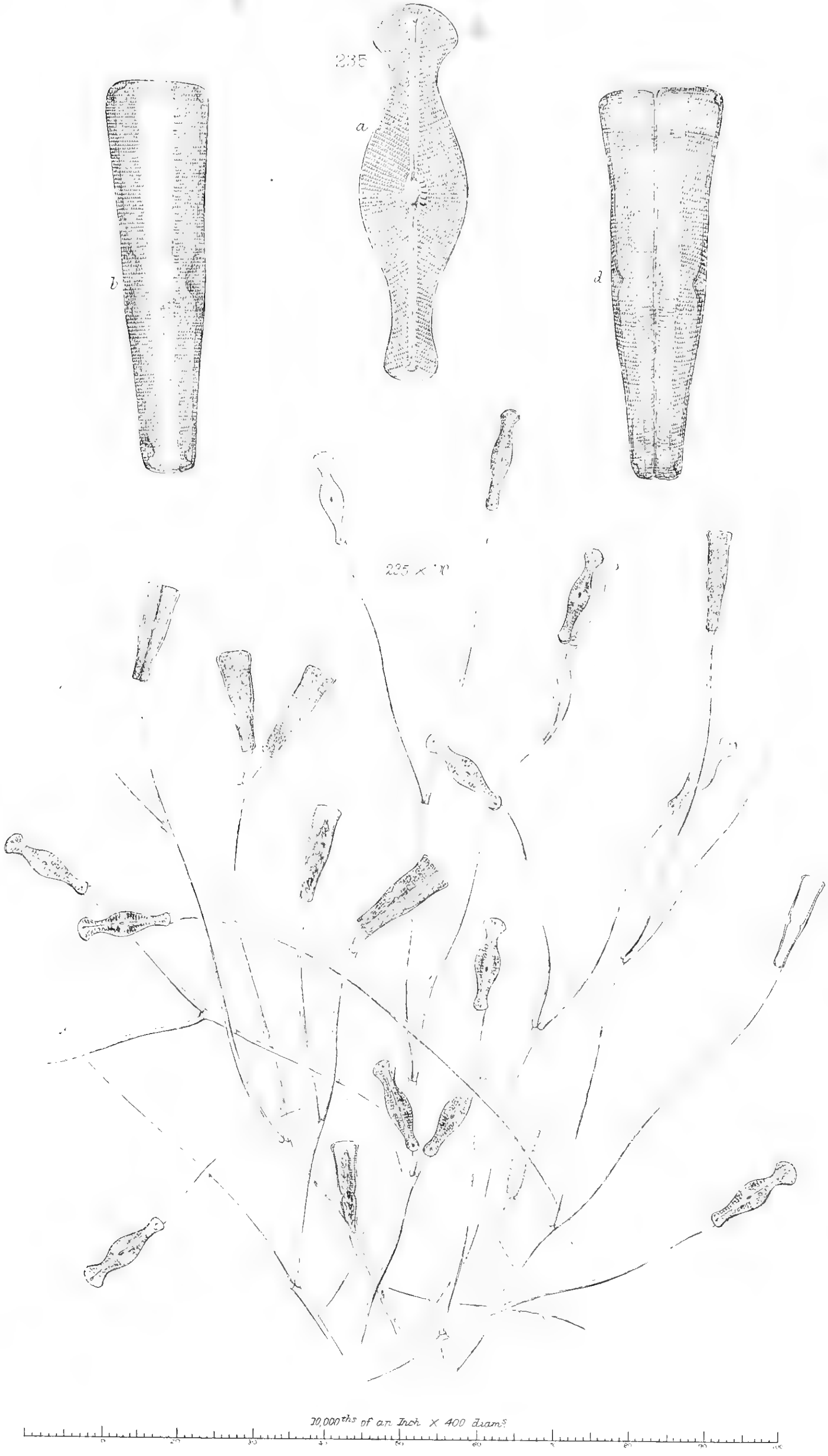
Tuffen West Ford & West, Imp. London



233. L. splendida. 234 L flabellata

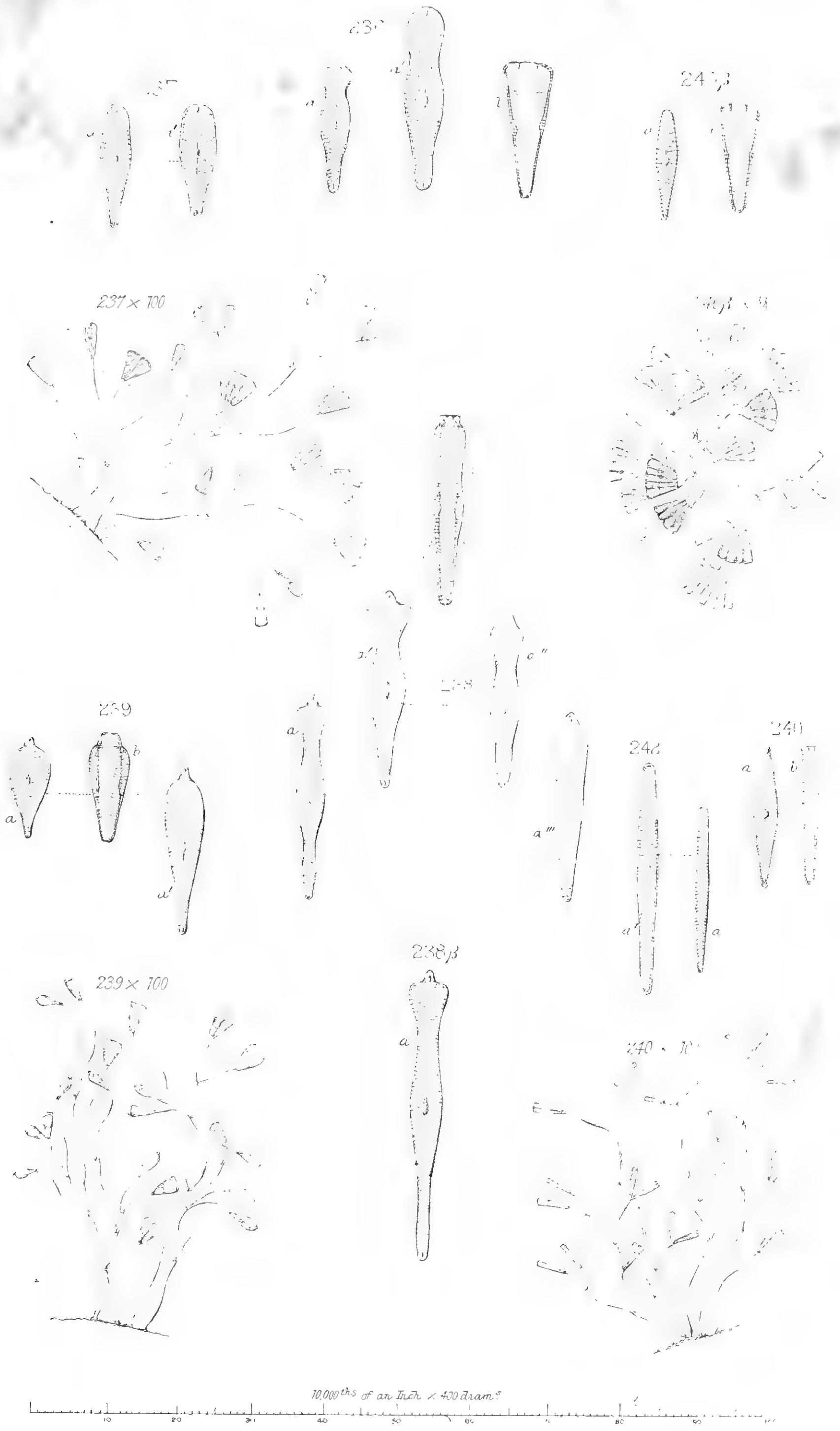
Tuffen West, sculp ad nat

Ford & West, Imp 54 Hatton Garden



235 *G. geminatum*

Tuffen West.
Ford & West. Imp., London



236. G constrictum. 237. G capitatum. 238 G acuminatum
239. G cristatum. 240. G dichotomum. 242. G Vibrio.

Tuffen West, sculp ad nat

Ford & West Imp London

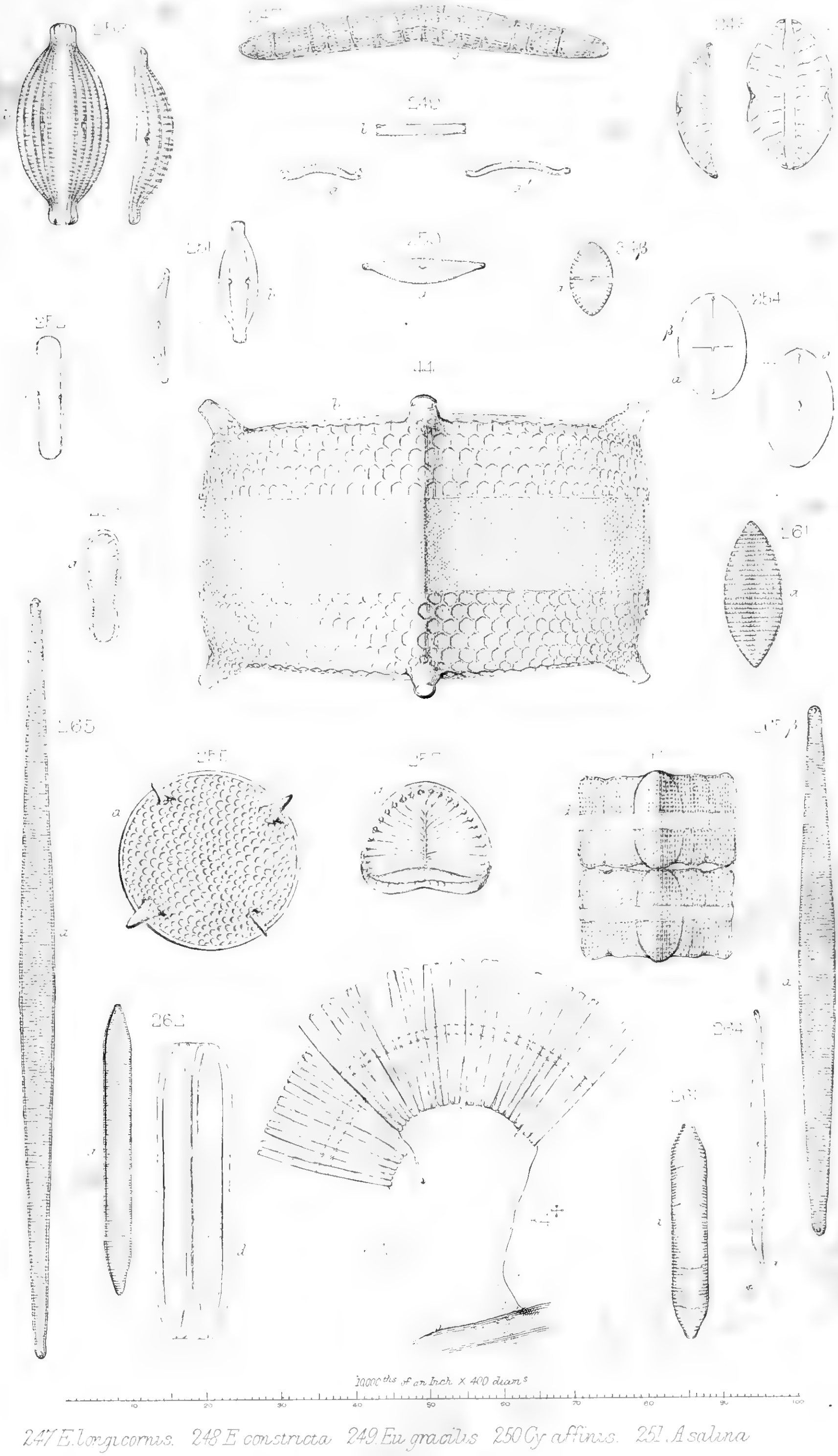
$1/1000^{ths}$ of an Inch x 400 diam.^s

241 G. intricatum. 243 G. tenellum.
244 G. olivaceum. 245 G. curvatum. 246 G. marinum.

Tuffen West sculp. ad nat.   Ford & West Imp. London.

EPITHEMIA. EUNOTIA. CYMBELLA. AMPHORA. COCCONEIS. EUPODISCUS.

TRICERATIUM. CAMPYLODISCUS. SURIRELLA. TRYBLIONELLA. CYMATOPLEURA. SYNEDRA. Supp. Pl. XXX



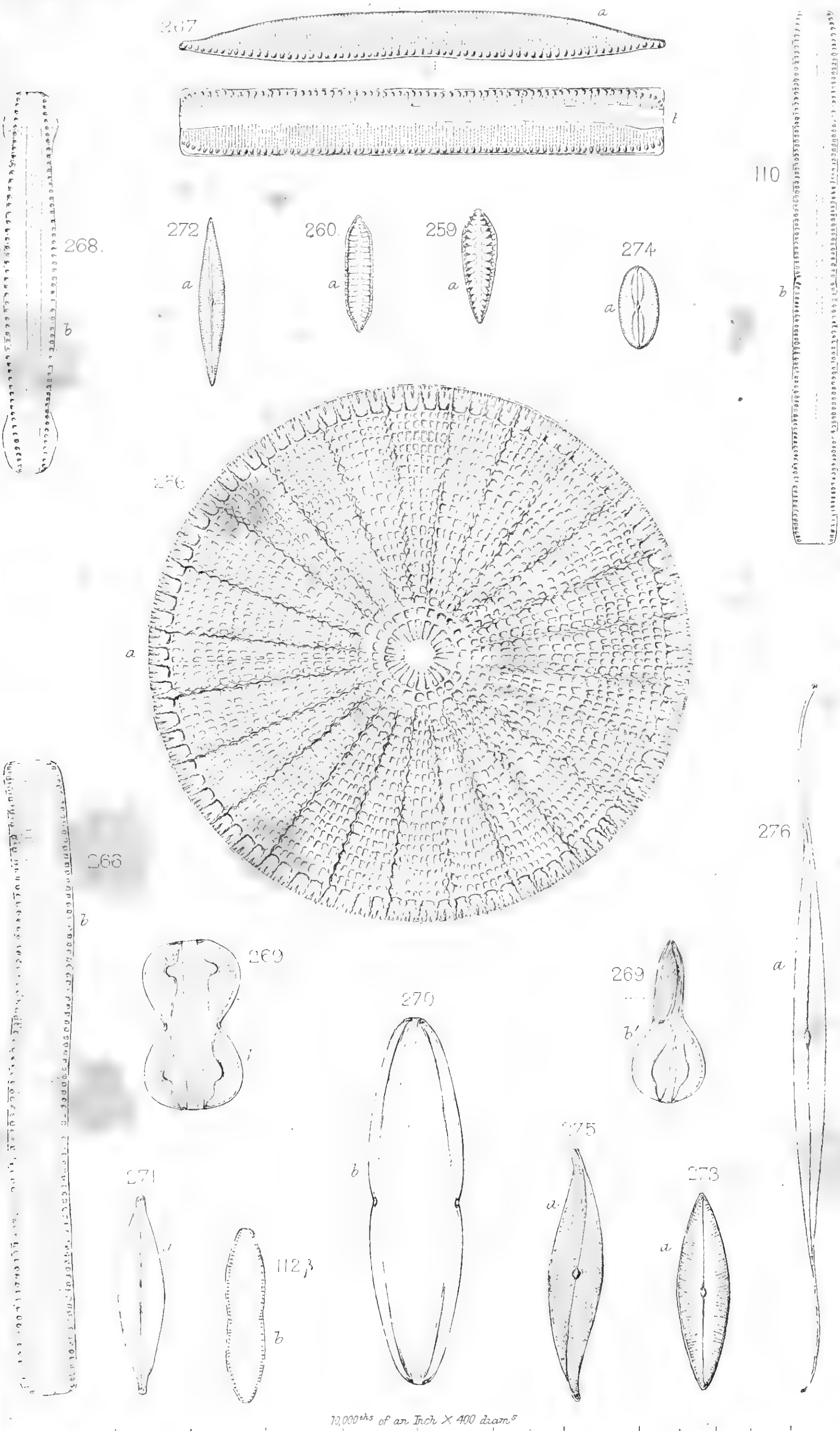
$\frac{1}{10000}$ths of an Inch × 400 diam^s

247 E. longicornis. 248 E. constricta. 249 Eu. gracilis. 250 Cy. affinis. 251 A. salina
252 A. tenera. 253 A. costata. 34 C. Scutellum β. 254 C. diaphana & β. 255 Ed. radiatus
44 T. Favus. 45 T. alternans. 257 Cam. Ralfsii. 258 S. panduriformis. 261 Tbl. punctata.
262 Tbl. angustata. 263 Cpl. parallela. 264 Sy. hamata. 24+ Sy. pulchella. 265 Sy. Gallionii & β.

Tuffen West, sculp. ad nat.

Ford & West, Imp. London

ARACHNOIDISCUS. SURIRELLA. NITZSCHIA. AMPHIPRORA.
NAVICULA. PLEUROSIGMA. Supp Pl. XXXI.



10,000ths of an Inch × 400 diam^s

256. A. Ehrenbergii. 259. S. subsalsa. 260. S. angusta. 110. N. linearis.
266. N. Brebissonii. 112. N. dubia β. 267. N. vivax. 268. N. spathulata.
269. Apr paludosa. 270. Apr vitrea. 271. Nr Crassinervia. 272. Nr lanceolata.
273. Nr palpebralis. 274. Nr minutula. 275. P. Æstuarii. 276. P. macrum.

Tuffen West, sculp ad nat. Ford & West, Imp London

CATALOGUE

OF

ACHROMATIC MICROSCOPES, &c.

MANUFACTURED BY

SMITH AND BECK,

TO WHOM THE COUNCIL MEDAL OF THE GREAT EXHIBITION OF 1851 WAS AWARDED "FOR THE EXCELLENCE OF THEIR MICROSCOPES,"

6, COLEMAN STREET, LONDON,

MARCH 1853.

THEIR improved form of Stand, which is contrived for an easy and most accurate mode of applying every kind of illumination, was shown by them at the Great Exhibition of 1851, and is thus mentioned by the Jury :—

> "The Stand is excellent in principle; the body, stage, and appliances beneath, are all carried on one stout bar, on the recommendation of Mr. G. Jackson, by means of which the centring of the Achromatic illumination is rendered easy and certain; and on any tremor being communicated to the Instrument, it is equally distributed over the whole of the working parts." —(*Reports of the Juries*, pa. 266, Class X. No. 253.)

The increase of the Angle of Aperture, which S. & B. have lately effected in their Object-Glasses, is more especially worthy of notice in the lower powers, which, adjusting through considerable thickness of glass, or some depth into water, will, with a large aperture, exhibit those objects which are the most frequent observation of the naturalist, with a definition that a smaller angle of aperture cannot give. One of these Object-Glasses, a $\frac{4}{10}$ths (erroneously called "half-inch"), is thus alluded to in the "Reports of the Juries of the Great Exhibition" (pa. 266, Class X. No. 253):—

> "The half-inch focus of 70° aperture is a wonderfully fine combination, easily showing objects considered difficult for a one-eighth inch focal length a little more than a year since, and bearing the application of the higher eye-pieces in an unprecedented manner."

LONDON: PRINTED BY TAYLOR AND FRANCIS,
RED LION COURT, FLEET STREET.

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PRICES OF STANDS

FOR

ACHROMATIC MICROSCOPES,

Exclusive of Object-Glasses, Apparatus and Cases,

EXCEPT WHERE MENTIONED.

[*The construction of all these Microscopes is now so arranged, that* SMITH AND BECK *can supply any apparatus without requiring the Instrument for fitting.*]

	£	s.	d.
No. 1. **Improved large Microscope,** the limb continued under the stage, and with cylindrical fitting and rackwork, for applying all illuminating apparatus with ease and accuracy, mounted on two pillars and cones, with revolving base to tripod; body with quick and slow motions, graduated sliding tube, and two eye-pieces; stage half inch thick, with vertical and horizontal actions (given by rackwork and screw, or lever), sliding and revolving planes, and spring clamping piece; diaphragm with revolving and removeable fittings; large plane and concave mirrors, with lengthening arm, and sliding on a triangular bar; pliers, joint and forceps, and two glass plates	22	0	0
No. 1. **Improved large Microscope,** on exactly the same construction, but made very portable	25	0	0
No. 2. **Improved smaller Microscope,** on the same principle, and with the same actions as No. 1, but with single pillar, on tripod stand	18	0	0
No. 2. **Improved smaller Microscope,** made portable	21	0	0
No. 3. **Best Student's Microscope,** with uprights and joints, quick and slow motions to body, graduated sliding tube, and two eye-pieces; thin stage, with vertical and horizontal actions by rackwork, sliding and revolving planes, and spring clamping piece; diaphragm with revolving and removeable fittings; double mirror, with lengthening arm; pliers, forceps, and two glass plates	12	12	0
No. 4. **Best Student's Microscope,** the same as No. 3, but with plain stage, consisting of sliding piece and clamping spring, one eye-piece, and single concave mirror	8	8	0

	£	s.	d.
No. 5. **Smaller Student's Microscope,** with quick and slow motions to body, one eye-piece, sliding tube, stage the same as No. 4, revolving and removeable diaphragm, single concave mirror, pliers, forceps, one glass plate, and mahogany case	5	10	0
No. 6. **Hospital Microscope,** without joint, body with rack-work motion, or sliding tube and slow motion, one eye-piece, diaphragm, single mirror, and mahogany case	3	10	0
No. 7. **Travelling Microscope,** quick and slow motions to body, two eye-pieces, sliding tube, stage the same principle as No. 4, revolving and removeable diaphragm, double mirror, and packed in a mahogany case 10 inches by 4¼ inches and 3¼ inches deep ...	7	7	0
No. 8. **Dissecting Achromatic Microscope,** with quick motion and graduated sliding tube to body, stage the same as No. 4, revolving and removeable diaphragm, single concave mirror, ⅔rds object-glass, one eye-piece, erecting glasses and case; power from 5 to 100 linear........................	12	12	0
No. 9. **Darwin's Improved Single Microscope,** with one doublet, three single, and three Coddington lenses, dissecting apparatus complete, and packed in a case	10	0	0

MICROSCOPE CASES,

FOR NO. 1 INSTRUMENT.

Best Upright Case in Spanish mahogany, with box for apparatus........................	3	15	0
Best Upright Case, with two boxes	4	10	0
Upright Case in Honduras mahogany, with box for apparatus........................	2	10	0
Upright Case, with two boxes	3	3	0
Strong Flat Case in Spanish mahogany, with covered dovetails for the instrument when made portable	2	10	0

NO. 2.

Best Upright Case in Spanish mahogany, with box for apparatus........................	3	3	0
Upright Case in Honduras mahogany, with box for apparatus........................	2	2	0
Strong Flat Case in Spanish mahogany, with covered dovetails for the instrument when made portable	1	15	0

NOS. 3 & 4.

Best Upright Case in Spanish mahogany, with box for apparatus........................	2	10	0
Upright Case in Honduras mahogany, with box for apparatus........................	2	0	0
Strong Flat Case in Spanish mahogany, dovetailed...........	1	5	0

Achromatic Object-Glasses for the Microscope.

Focal length.	Linear Magnifying Power nearly*.	With Eye-Pieces N°. 1	N°. 2	N°. 3	Angle of aperture about	Price. £ s. d.	Lieber-kuhn additional.
$1\frac{1}{2}$ inch	Draw-tube closed	20	45	80	13 degrees	3 0 0	15*s.*
	Add for each inch of tube drawn out	4	6	8			
$\frac{2}{3}$ inch	Tube closed	60	105	180	27 degrees	3 3 0	11*s.*
	Add for each inch of tube...........	7	12	20			
$\frac{4}{10}$ inch	Tube closed	120	210	350	55 degrees	5 5 0	10*s.*
	Add for each inch of tube...........	12	20	35			
Ditto	Ditto	do.	do.	do.	65 degrees	6 6 0	10*s.*
$\frac{1}{5}$ inch	Tube closed	240	430	720	85 degrees	6 6 0	
	Add for each inch of tube...........	30	45	80			
Ditto	Ditto	do.	do.	do.	100 degrees	7 7 0	
$\frac{1}{8}$ inch	Tube closed	450	760	1300	100 degrees	8 8 0	
	Add for each inch of tube	40	60	115			
Ditto	Ditto	do.	do.	do.	120 degrees	10 10 0	

* With the $\frac{2}{3}$ inch object-glass and the erecting glasses, employing eye-pieces Nos. 1 and 2, the magnifying power will range from 5 to 150.

APPARATUS

which applies to the cylindrical fitting under the stage of

No. 1 or No. 2 Microscope.

	£	s.	d.
Achromatic Condenser on an improved construction of two powers, and revolving diaphragm, to give various illuminating pencils from 80° to 25°, also stops for the central rays, complete with adjustments	5	0	0
Achromatic Condenser without diaphragm, apertures 60° and 20°, brass work with adjustments	2	10	0
Achromatic Condenser, Brasswork of, with adjustments......	1	0	0
Wenham's Parabolic Reflector, giving a dark field with an object-glass of 100° of aperture, with adjusting stop and fittings	1	15	0
Amici's Prism for oblique light, mounted on an improved plan, with the reflecting surface uncovered for the convenience of wiping	2	2	0

	£	s.	d.
Nachet's Prism for oblique light, with accurate revolving fitting	1	1	0
Right angle Prism for reflecting the light more perfectly than the mirror, with adjustments and fittings to the triangular mirror stem complete, and the reflecting surface uncovered for the convenience of wiping...	2	10	0
Polarizing Apparatus, of two Nicol's prisms and one selenite film, with revolving fittings to all	2	10	0
Darker's Series of Selenites, which give 13 different colours and their complementary tints, mounted on an improved plan for their more accurate and easy appliance	3	10	0
Darker's Series of Selenites, adapted to the Selenite fitting mentioned in "Polarizing Apparatus"......	1	7	6
Bundle of Thin Glass for polarizing by reflection or transmission......	1	1	0
Black Glass for polarizing	0	15	0
Dark Wells of three sizes, and holder	0	12	6

APPARATUS

AS APPLIED TO No. 3, No. 4 and No. 5 MICROSCOPES.

Achromatic Condenser of two powers, 60° and 20° of aperture, rackwork and complete adjustments to brasswork..	3	0	0
Achromatic Condenser as above, with sliding fitting, and no adjustments to brasswork	2	5	0
Achromatic Condenser, Lenses of......	1	10	0
Wenham's Parabolic Reflector, with sliding stop, rackwork, and complete adjustments to brasswork	3	17	6
Wenham's Parabolic Reflector, with plain sliding fittings ...	2	10	0
Nachet's Prism for oblique light	0	18	0
Polarizing Apparatus, of two Nicol's prisms with revolving fittings, and one selenite film......	2	10	0
Dark Wells of three sizes, and holder	0	12	6

APPARATUS

FOR MICROSCOPES IN GENERAL.

Extra Eye-piece for No. 1 Microscope	0	17	6
Extra Eye-piece for No. 2, 3, 4, or 5 Microscope	0	15	0
Extra Eye-piece for Hospital Microscope	0	13	0
Indicator to Eye-piece	0	5	0
Micrometer, with Jackson's adjusting screw and fittings to Eye-piece......	1	0	0
Micrometer for Stage, divided into 100ths and 1000ths of an inch, and mounted in brass	0	10	0
Micrometer for Stage, divided into 100ths and 1000ths of an inch, unmounted......	0	5	0

	£	s.	d.
Wollaston's Camera Lucida, with large field and fittings to Eye-piece	1	0	0
Erecting Glasses, with which, employing the two-thirds inch Object-glass and Eye-pieces No. 1 and 2, the magnifying power will range from 5 to 150 linear	1	0	0
Large Bull's-eye Lens on stand	1	1	0
Smaller Condensing Lens, with ball and socket fitting, to apply to No. 1 or No. 2 Microscope	0	18	0
Smaller Condensing Lens, on stand, and complete movements	0	12	0
Side Silver Reflector, with fittings to limb, or on a separate stand	1	1	0
Amici's Prism for oblique light, mounted on a stand	2	2	0
Polarizing Apparatus, of two Nicol's prisms with revolving fittings, and one selenite film	2	10	0
Darker's Series of Selenites, with stage and revolving fittings	2	2	0
Two Double Image Prisms and Selenite Film, with fittings to Eye-piece and brass plate with holes	2	2	0
Crystals to show rings round the optic axis and fitted to Eye-piece ...... each from	0	10	6
Tourmalines ...... from	1	0	0
Brooke's Double Nose-piece	1	10	0
Compressorium	1	0	0
Wenham's Compressorium for Parabolic Reflector	0	7	6
Screw Live Box	0	14	6
Large plain Live Box	0	8	6
Small plain Live Box	0	6	6
Large Glass Trough, with wedge and spring complete	0	8	6
Small Glass Troughs ...... from	0	5	0
Set of three Glass Tubes	0	2	6
Glass Plates, with hollows and ledges ...... from	0	1	6
Three-pronged Forceps and Joint	0	8	6
Large Brass Pliers and smaller ditto ...... 0 5 0 and	0	2	6

MICROSCOPE TABLES.

	£	s.	d.
Handsome Walnut-wood Table, to revolve on carved pillar and claw, with plate-glass top, and apparatus packed in the drawers, as shown at the Exhibition	25	0	0
Walnut-wood Table, with improved revolving fitting, on handsome pillar and claw, with leather top	8	8	0
Iron Table with revolving top	5	5	0

MICROSCOPE LAMPS.

	£	s.	d.
Improved small Camphine Lamp, with glass cap, to prevent evaporation of the spirit when not in use	2	2	0
Best Argand Lamp, with blue chimney, for burning oil	1	5	0

Gas Lamps made to order.

MICROSCOPIC OBJECTS.

[*Persons living in the country can have series of Objects sent for selection, on giving a satisfactory town-reference and paying carriage both ways. One week will be allowed for examination.*]

	£	s.	d.
Vegetable Preparations :—			
Recent: Cells, Cuticles, Ducts, Fibre, Membrane, Spores, Sporules, Tissues, Spiral and other Vessels, Hairs, Leaves, Petals, Fungi, Sections of Woods, &c. ....each specimen	0	1	6
Fossil: Sections of various exogenous and endogenous Woods ....each section	0	1	6
Slides, with two and three sections........ 0 3 0 and	0	4	6
Desmidieæ and Algæ ....each slide	0	1	6
Diatomaceæ :—*Recent* : Several hundred varieties, including species of Campylodiscus, Cocconema, Epithemia, Navicula, Surirella, Synedra, &c.—*Fossil:* Specimens from various localities in the British Islands, Germany, Italy, North America, the East and West Indies, New Zealand, &c.	0	1	6
Spicules and Gemmules of Sponges and Gorgonias	0	1	6
Zoophytes, many species	0	1	6
Shells, sections of various species	0	1	6
Echinus Spines, sections in great variety	0	1	6
Entomological Preparations:			
Antennæ, Eyes, Feet, Hairs, Scales, Skins, Spiracles, Stings, Stomachs, Tongues, Tracheæ, Wings, &c. Specimens of numerous Acari and Parasites........	0	1	6
Hairs, Whiskers of various Animals mounted whole or in section, Quills, Feathers of Birds, &c.	0	1	6
Objects from Human and other Bodies	0	1	6
Anatomical Preparations :—			
Blood-Discs, Pigment-Cells, Skin, Muscular Fibre, Tissues, &c. ....from	0	1	6
Bones :—			
Transverse and Vertical Sections of 60 or 70 Recent and Fossil Mammals, Birds, Reptiles, and Fishes each slide	0	1	6
Teeth :—			
Transverse and Vertical Sections of about 30 varieties, Recent and Fossil ....each	0	2	0
Injected Preparations ....from	0	2	6
Polariscope Objects, about 100, selected from Animal, Vegetable, and Mineral Substances ....each	0	1	6
Mineralogical :—			
Sections of Limestones, Oolites, Flints, Agates, &c. each from	0	1	6

CABINETS FOR OBJECTS,

in which the Specimens lie flat, and with Porcelain Labels to the Drawers.

	£	s.	d.
Best Spanish Mahogany Cabinet, with glass panel, and to hold 1000 objects	7	0	0
Honduras ditto, without glass panel........	6	6	0

	£	s.	d.
Best Spanish Mahogany Cabinet, with glass panel, and to hold 750 objects	5	15	0
Honduras ditto, without glass panel	5	0	0
Best Spanish Mahogany Cabinet, with glass panel, and to hold 500 objects	4	4	0
Honduras ditto, without glass panel	3	10	0
Cabinets made to any size, and of every description.			

Cardboard Boxes, to hold two dozen objects ... each	0	1	0
Ditto ditto one dozen ditto ... ,,	0	0	9
Ditto ditto half dozen ditto ... ,,	0	0	6
Single Mahogany Racks, for objects ... per foot	0	0	6
Double ditto ditto ... ,,	0	1	0

INSTRUMENTS USED IN PREPARING OBJECTS.

Wood-cutting Machine with knife	1	1	0
Instrument for Cutting Circles of thin Glass	1	5	0
Diamond for Writing or Cutting thin Glass	0	7	6
Ditto for plate and window Glass	0	12	0
Instrument for making Cells of gold-size or other fluids ...	0	7	6
Page's Wooden Forceps, for holding the glass slides when warmed	0	2	6
Small Brass Tables and Lamps for heating objects in mounting ... from	0	10	6
Quekett's Forceps for deep jars	0	7	6
Ironwork of Dredge, for deep-water fishing	1	5	0
Small Collecting Bottles ... per doz. 1s. 6d. to	0	3	0
Valentine's Knife, for making sections of soft substances ...	0	15	0
Small Dissecting Knives of various shapes ... each	0	3	0
Spring Scissors, 7s. 6d.; Curved ditto, 5s.; Straight ditto, 3s.			
Needle Holders, 5s.; Hooks, 2s. 6d.; Points, 2s. 6d.			
Cutting Forceps, 5s. 6d.; Spring ditto, 3s.			
Combination of three Lenses, mounted in Tortoiseshell, for pocket hand magnifiers	0	10	6
Ditto, with small brass stand	0	18	0
Coddington Lenses, in various mountings ... from	0	6	6

MATERIALS USED IN MOUNTING OBJECTS.

Canada Balsam, Asphalt, Gold Size, Glycerine, &c., 1s. and 2s. bottles.
Thin Glass, in circles, 6s. per oz.; in squares, 4s. per oz.; ditto, mixed, 5s.
Plate-glass Slips, 3 inches by 1 inch, with ground edges, 1s. per dozen.
Glass Cells, square, round, oblong, oval, and with solid bottoms, 2s. 6d. and 3s. per dozen.
Labels for covering objects, 3s. per hundred.

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