XXXI.—On New Forms of Marine Diatomaceæ, found in the Firth of Clyde and in Loch Fine. By William Gregory, M.D., F.R.S.E., Professor of Chemistry. Illustrated by numerous Figures, drawn by R. K. Greville, LL.D., F.R.S.E.

(Read 19th January 1857.)

In two papers read before this Society, I have very fully described the Diatomaceæ of the Glenshira Sand, which is very remarkable both for the large number of species found in it, which is certainly more than 320, and for the circumstances in which it must have been deposited. There can be no doubt, from the nature of the locality, which I have lately visited, that this bed was formed in the bottom of the Dhu Loch, a shallow fresh-water lake, at that time extending about two miles farther up the valley than it now does, and being at a higher level. In consequence of a rise in the level of the land, or a fall in that of the sea (from which—that is, from Loch Fine, the lower end of the lake is separated by a narrow and low barrier, through which the waters of the lake pass to Loch Fine), the lake has long ago been drained, till its upper end is nearly two miles from the point it must have reached when the bed of sand was formed. The present level of the lake is considerably lower than it was then; the precise difference I had no means of ascertaining, but I believe it is about 30 feet. Now, the most interesting fact about this lake is, that its actual level is that of half-tide, so that at low water the lake is discharged into the sea, while at high water the tide flows upward into the lake. Hence marine plants and animals are found in the Dhu Loch; herring, for example, are often caught in it, and were taken while I was in the neighbourhood. Hence also the present deposit in the lake exhibits a mixture of fresh-water and marine Diatomaceous forms. Now, the older sand, the subject of my paper, deposited at a considerably higher level, also contains both marine and fresh-water Diatoms; and while the individuals of the two classes are both abundant, the marine species are at least twice, perhaps thrice, as numerous as those of fresh water.

The natural, and, I have no doubt, the true explanation of the occurrence of so many marine forms in an inland deposit, formed in a fresh-water lake, is this: that at the period when the sand was formed the relative levels of the Dhu Loch and of Loch Fine were the same as now, when similar results ensue.

But as the lake was then at a higher level than now, so also must the sea have been at a level as much above its present one. This conclusion is in accordance with those derived from the observations made on raised beaches on the

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banks of the Firth of Clyde, the level of which must always have regulated that of Loch Fine since the present form of the coast has existed.

There was, however, a circumstance which at first tended to throw some doubt on this conclusion, according to which the marine forms of the Glenshira sand must have come from Loch Fine. For although the known and described marine Diatoms found in the sand occur on our coasts, yet I was struck with the fact that out of upwards of fifty new or undescribed forms, there seemed to be no trace in deposits from the Firth of Clyde, examined by more than one naturalist during the progress of my investigation. The fact of these forms being undescribed was prima facie evidence that they had not yet occurred on the British coasts.

Yet it was evident that the formation of the Glenshira sand was, geologically speaking, very recent; so recent, indeed, that we could not suppose any number of species to have since become extinct. I came, accordingly, to the conclusion, that these undescribed forms must still exist in the waters of Loch Fine, or, what is the same thing, of the Firth of Clyde. I was therefore desirous to examine with care deposits from these waters, and this, during the past six months, I have been enabled fully to do.

The materials which I have examined are the following:-

- 1. A small quantity of dirt or sand washed from some nests of *Lima hidns*, dredged in Lamlash Bay on the 19th of July last, in 4 fathoms, by Professor Allman. This material, though, when cleaned, very scanty, proved the richest of all.
- 2. Four dredgings, made by myself, with the kind assistance of the Duke of Argyll, in Loch Fine, at different points within two or three miles of Inveraray. These were all different, and three of them were interesting. They were taken at depths of from 14 to 18 fathoms, early in October last.
- 3. Three dredgings made at the same time by the Rev. Dr Barclay, in Loch Fine, off Strachur, at depths of 15, 20, and 60 fathoms, also in October last.
- 4. Three materials forwarded to me in October by the Rev. Mr Miles of Glasgow, who was for some time on the Holy Island, in Lamlash Bay.

One of these was washed from the nests of *Lima hians*, as I had reported the richness of the former. These last were from 7 fathoms in Lamlash Bay, This material, dredged, I think, in June, was not so rich in Diatoms as Professor Allman's, but yet contained many interesting forms.

The second was a coarse red sand, dredged off Invercloy, Arran, which was rather poor.

The third was a mass of *Corallina officinalis*, taken with the hand, in rocky pools, at Corregills, Arran, when the tide was low. The Corallina proved to have been a good Diatom trap, and yielded a material, not remarkable for the number

of species, but rich in individuals, and these nearly all of interesting, rare, or new species.

I had thus eleven different materials, no two of which were exactly alike, although in all certain prevalent forms occurred. In each, on the other hand, some forms, few or many, were peculiar, and their presence gave a distinct character. A careful study of the whole has yielded interesting results; and these it is the object of the present paper to state as briefly as may be consistent with accuracy.

The first observation is, that these waters contain a very large proportion of all the known and described marine forms belonging to Britain, including a good many which have hitherto been very rare; so scarce, indeed, in some instances, that few observers have seen them. I may specify the following as being by no means rare, several, indeed, being abundant in these materials:—

Coscinodiscus concinuus.
Eupodiscus crassus.
... Ralfsii.
... sculptus.
Campylodiscus Ralfsii.
... Horologium.
Navicula Hennedyi.
... granulata, Préb.
... Lyra, Ehr.
Pleurosigma rigidum.
... obscurum.

Pleurosigma delicatulum.
... transversale.
Surirella lata.
Hunantidium (?) Williamsoni.
Amphiprora elegans.
Podosira Montagnei.
Orthosira marina.
Grammatophora macilenta.
Biddulphia Baileyi.
... turgida.

The second observation which I made was, that, as I had anticipated, nearly the whole of the new forms figured by me from the Glenshira sand are found living, and generally abundant, in these waters. The following list contains the names of such of the marine species, figured in my former papers, as I have found in the new materials:—

Cocconeis distans. Eupodiscus Ralfsii; also var. β, sparsus. Campylodiscus simulans. Surirella fastuosa, very large. Amphiprora recta. lepidoptera. Navicula rhombica. maxima. ... angulosa, and var. B. humerosa. latissima. clavata. splendida. incurvata. didyma, var. y, costate

Navicula didyma \(\delta\). crassa.

Pinnularia Pandura.

longa.
inflexa.

Amphora Arcus.
crassa.
elegans.
plicata.
obtusa.
Grevilliana.
rectangularis.
lineata.
Synedra undulata.
Tryblionella constricta.
apiculata.

I think we can hardly doubt that all the new Glenshira marine forms will ultimately be found in the neighbouring waters.

Before going farther, I have to remark, that two of the forms in the first list above given, namely, Campylodiscus Horologium and Himantidium Williamsoni. which had only been found by Professor Williamson, who detected them both in a dredging made by Mr Barlee on the coast of Skye, in which they were very scarce indeed, have occurred abundantly, the former in one of the Loch Fine dredgings, and sparingly in some of the others, the latter in another of them, and, though less abundantly, yet frequent in nearly all the Clyde materials. We shall see that Himantidium Williamsoni, which Professor Smith had referred doubtfully to that genus, not having been able to see more than the front view of it, is really no Himantidium; the side view, which is very abundant in one of my dredgings, having characters quite incompatible with the genus Himantidium. On this account. I shall refer to it among the new forms which I have to mention. I have found it a matter of very great difficulty, if not impossible, to refer it to any of the genera in Smith's Synopsis. I may here add, that Synedra undulata, which I had recognised in the Glenshira sand, but which had never occurred entire in that deposit, is frequent in the first material from Lamlash Bay (Professor Allman's), where it occurs quite entire in more than half of those I have seen, and, as I had concluded, from the imperfect specimens I had seen, attains a length of from 0.015 to about 0.02, which, for a Diatom, is gigantic. I had previously noticed a fragment of it in a recent gathering made by Professor Smith, and he had himself subsequently found it frequent in Cork harbour. The first observer, however, was Professor Bailey, of West Point, New York, who had found it still larger on the American coast, which I was not aware of till long after my observations on the Glenshira sand were made.

The third observation I shall here record is, that in these dredgings I found, in sufficient abundance, several very curious forms which had occurred in the Glenshira sand; but the description and figuring of which I had postponed, because either they were so scarce that I could not obtain good specimens, or, being only found in a fragmentary, detached, or imperfect state, I was quite at a loss to determine their true nature and position. I think I may say that in every such case I have been enabled, by the study of the new materials, to understand the nature and structure of these obscure or doubtful forms, and to establish them as new and distinct species. I have also been enabled to understand better several of the forms which were figured in my former papers, and to correct some errors which had crept into these.

I need not here give a list of the forms just alluded to, as they will be included in that of the new forms to be described. In that list, I shall mark them with a G, to indicate that they were first noticed in the Glenshira sand.

Lastly, in the new materials I have found a large number of entirely new and undescribed species, which I shall now proceed to enumerate. I may here mention, that although a good many fresh-water forms do occur in these dredgings,

as must, indeed, be the case, since the Clyde and all its tributaries bring down such forms, yet the new forms in question appear to be all of marine origin. They are, in general, much too abundant to have been derived from any other quarter, whereas the fresh-water forms among them are much scattered. It is proper also to state, that although all these forms are, to the best of my belief, new to Britain, yet a few of them have been described by Ehrenberg in some of his numerous works, and also by De Brebisson. The great majority, however, have not anywhere been figured; not, at least, in any works accessible to me.

As the new forms belong to a very few genera, it will be convenient to arrange them in groups. Those I shall adopt are as follow:—

- I. Naviculoid Forms.
- II. Cocconeides.
- III. Filamentous Forms.
- IV. Discs, including Campylodisci.
- V. Amphiproræ.
- VI. Amphoræ. {A. Simple. B. Complex.
- VII. Miscellaneous.

GROUP I.

NAVICULOID FORMS.

These, as is usual in all gatherings, are numerous. Including two or three varieties of species already known, those which I have recognised as new are the following:—

1. 1	Navicu	la minor, n. sp.	10. 1	Navicu	la spectabilis, n. sp.
2.		Cluthensis, n. sp.	11.		prætexta, Ehr.
3.		inconspicua, n. sp.	12.		Bombus, Ehr.
4.		brevis, n. sp.	13.		Lyra, Ehr.
5.		Claviculus, n. sp.	14.		Lyra, Ehr. var. β, abrupta.
6.		Musca, n. sp.	15.		Smithii, var. B, fusca.
7.		rectangulata, n. sp.	16.		Smithii, var. y, nitescens.
8.		nebulosa, n. sp.	17.		Smithii, var. δ, suborbicularis.
9.	-111	Barclayana, n. sp.	18.		maxima, Greg.

1. Navicula minor, n. sp. Pl. IX., fig. 1. Form rectangular in the middle, acuminate at the ends, which are acute. Length from 0.0012'' to 0.0025''; breadth 0.0004'' to 0.0008''. Striæ fine, inclined near the ends, not reaching the median line, 36 to 40 in 0.001''. The whole form has a delicate aspect.

This little form, represented in fig. 1, occurs in two or three of the Loch Fine dredgings, in one of which it is sufficiently frequent.

2. Navicula Cluthensis,* n. sp. Pl. IX., fig. 2. Form oval, rather broad. Median line broader at the centre, narrower at the apices. Central nodule definite, large; terminal nodules smaller. Length 0 0013" to 0 0016"; breadth about 0 001". Striæ conspicuous, clear, and sharp, inclined slightly in the middle, strongly near the ends; about 20 in 0 001".

Fig. 2 represents this form, which occurs in Professor Allman's dredging from Lamlash Bay, and though not abundant, is yet frequent enough for all practical purposes. It is very uniform in its characters, and though the description above given may not appear very characteristic, yet I know of no form with which this one can be confounded. Its aspect is so peculiar that it is instantly recognised.

3. Navicula (?) inconspicua, n. sp. Pl. IX., fig. 3. Form linear, rather narrow, with rounded ends. Median line strong, complex, interrupted in the middle. Nodule definite. Aspect of valve hyaline. Striation so fine that it has not yet been resolved; and at all events it cannot be visible under a power of 400. Length 0.002" to 0.0032; breadth about 0.00035."

This little form occurs both in Lamlash Bay and in Loch Fine. I do not feel quite sure that it is a Navicula, as it may possibly belong to a filamentous species; it may be, for example, a Diadesmis; or it may prove to be a Schizonema. This can only be ascertained by observations on examples in the living state.

4. Navicula brevis, n. sp. Pl. IX., fig. 4. Form nearly elliptical in the middle; broad, short; contracted to short, produced, obtuse extremities. Length about 0·0023"; greatest breadth 0·0013". Striæ fine, about 35 in 0·001"; very slightly inclined, not reaching the median line, and at the centre leaving a large, round, blank spot, within which the two halves of the median line end in small rounded expansions. Central nodule indefinite; terminal nodules definite.

This form is easily recognised by its short, squat shape, and is distinguished from *N. semen*, which it resembles in form, by its much finer striation. It occurs in Lamlash Bay, and is not very scarce in Professor Allman's dredging from that locality.

5. Navicula Claviculus, n. sp. Pl. IX., figs. 5, 5 b, and 5 c. Form of valve linear, narrow, with one central and two terminal expansions, separated only by two constrictions. The terminal expansions are much elongated, oval at the extremities, and rather broader than the central expansion. Central nodule definite. Length 0.0015'' to 0.002''; greatest breadth 0.0002'' to 0.0003''. On the S.V., figs. 5 and 5 b, the central expansion is unstriated. Striæ on the rest of the valve transverse, sharp, not quite reaching the median line; about 32 in 0.001''. The F.V., fig. 5 c, is rectangular, with slightly expanded and bevelled angles, and exhibits the same absence of striæ from the middle part.† The striæ are seen to a

certain extent on the F.V., but most towards the extremities, indicating that the S.V. is more convex near the ends than in the middle. I have named this form from its resemblance to a small two-headed club.

It occurs only in one of the Loch Fine dredgings, in which, though far from frequent, I have been able to examine many more specimens than are required to ascertain the characters of the dead form. I observe that it often occurs in pairs, as well as solitary, so that it may perhaps belong to a filamentous genus, such as Diadesmis. But as I cannot be sure of this, without seeing the living or growing form, I refer it, for the present, to Navicula.

6. Navicula Musca, n. sp. Pl. IX., fig. 6. Form of valve deeply constricted in the middle, broadest at a point near the middle on each side of it, and almost triangular thence to the acute apices. Length 0.002° ; greatest breadth 0.0011° ; breadth at middle 0.00075° . Striation confined to a marginal band, which is rather broad, and nearly of uniform width, except at the apices. Median line sharp; central nodule definite. Striæ coarse, 18 in 0.001° ; distant, moniliform. Aspect of the valve transparent.

The form of this very pretty species is allied to that of N. didyma and the other panduriform Naviculæ, which are so frequent in marine gatherings. Even its form, however, is peculiar, and it is at once distinguished from all the others by its marginal striation. It so much resembles in shape the body of a bee or wasp, that I should have named it Apis or Vespa, had not these names been already appropriated to other species by Ehrenberg. I have chosen, therefore, the specific name Musca, as the form is also that of various large flies. It occurs in the same Loch Fine gathering, as Nos. 1, 3, and 5; a gathering which, though very scanty and very stony, has proved singularly rich in undescribed forms, especially of Amphorae, as we shall see farther on. This dredging was a very coarse sand, which, after boiling with acid, I was on the point of rejecting as useless, when I observed a very trifling cloud of finer matter. This, though full of mica, supplied a remarkable proportion of new species; so much so, that I believe it contained as many of these as of known species; and of the undescribed forms found in it, a majority have occurred in it alone. I mention these facts, in order to show that every dredging, however unpromising, in such localities as Loch Fine and the Clyde, ought to be closely examined. This one was most unpromising; yet it turned out not only rich in new species, but very different from the other dredgings made in the same waters.

7. Navicula rectangulata, n. sp. Pl. IX., fig. 7. Form of S.V. rectangular, the extremities being rounded; rather narrow. Length from 0.003" to 0.004"; breadth about 0.0006" to 0.0008". Striation highly radiate, there being three centres of radiation on each side—one in the middle, and one at each end. Strike soft, not very fine, subdistant; about 22 in 0.001", not quite reaching the median

^{*} From Clutha, the Clyde.

[†] Figs. 5 b and 5 c are magnified 800 diameters, to bring out the details. Fig. 5 is magnified only 400 times, and is below the average size.

line, and leaving a very small, round, blank space in the centre. Central nodule indefinite. The F.V. has not yet been recognised.

This form is remarkable for the shape of the S.V., which is that usually found in the F.V. It occurs rather sparingly in Professor Allman's dredging from Lamlash Bay, which, of all the dredgings, is the richest in species, whether known or undescribed.

8. Navicula nebulosa, n. sp. Pl. IX., fig. 8. Form oval, broad; generally with a slight tendency to angularity in the middle, and also a tendency to acumination at the apices. Length from 0.0025'' to 0.0035''; breadth 0.0013'' to 0.0016''. Median line sharp, ending in two elongated expansions at the centre, which do not meet. Nodlue indefinite. On each side of, and close to, the median line, is a narrow rectangular band of striation, interrupted at the nodule. At the margin is a somewhat broader, but still narrow, striated band, almost exactly of uniform width throughout. Striæ 34 to 36 in 0.001". Aspect of valve hazy and indistinct. Striated portions pale blue under the half-inch objective. This form is allied to N. Hennedyi, figured in my second paper on the Glenshira sand (see Trans. Mic. Soc., vol. iv., pl. v., fig. 3.) But I have found it necessary to separate it from that species, in consequence of its very different aspect. N. nebulosa is a smaller form than N. Hennedyi, the one here figured being an unusually large one. It is also much more finely striated; and, above all, it has invariably that peculiar indistinctness of aspect from which I have named it; whereas N. Hennedyi, even when of a smaller size, as we sometimes find it, is always remarkable for the sharpness of its markings. The tendency to angularity generally seen in N. nebulosa is never found in N. Hennedyi. Lastly, the striation of the former is so much finer, that the striated parts, seen under a low power, have a very pale bluish tinge never seen in the latter. When the two forms are seen in the same field of view, as often happens in Professor Allman's dredging from Lamlash Bay, and even when N. Hennedyi is the smaller, though it is generally much larger, the difference between them is very striking. I might have considered N. nebulosa as a variety of N. Hennedyi, but that I have found both forms exceedingly uniform in their characters, and have not been able to observe any tendency to transition from one to the other. $N.\ nebulosa$ is frequent in the Lamlash Bay dredging just mentioned, in which N.Hennedyi also occurs; but elsewhere I have hardly ever seen the present species.

9. Navicula Barclayana, n. sp. Pl.IX., fig. 9. Form an elongated oval, somewhat suddenly contracted to acute extremities, terminated by small round apiculi. Median line narrow, ending at the middle in two small expansions. Nodule indefinite. Length 0·004" to 0·0045"; breadth 0·001" to 0·0012". Strike about 38 in 0·001", somewhat inclined, sharp, minutely moniliform, confined to a marginal band, which is rather narrow, and of uniform width except near the apices, where it becomes narrower.

This is a fine conspicuous form, and occurs not unfrequently in the same Loch

Fine dredging, with *N. Claviculus*, *N. Musca*, &c. I have also seen it, though much more sparingly, in some of the other dredgings, both from Loch Fine and Lamlash Bay.

10. Navicula spectabilis, n. sp. Pl. IX., fig. 10. Form elliptic-lanceolate, very broad; ends subacute or acute. Length from 0.003" to 0.005"; breadth from 0.0023" to 0.0032". Median line sharp, having close to it on each side a narrow striated band, interrupted at the middle. Central nodule large, indefinite. There is a marginal band of striation, which is very broad in the middle, where it projects inwards to an obtuse point, and very narrow at the apices. Striæ coarse, moniliform, about 22 in 0.001". The blank spaces between the marginal and central bands are very broad; and this part of the valve is so thick and strong, that in fractured specimens we never find it broken across, but we often see the entire blanks, united by the central nodule, which is elongated laterally, separated from all the striated parts, forming a singular object.

This form is allied to N. Lyra, Ehr., and also to N. Hennedyi. I consider it, however, quite distinct from either. It occurs frequently in Lamlash Bay; but I have not yet seen it elsewhere. The form and width of the marginal band distinguish it from N. Hennedyi, while the broad blank spaces distinguish it from N. Lyra, in which, as we shall see, these spaces are linear. Besides this, N. Lyra very often occurs with produced ends, and never has the peculiar form of N. spectabilis. The latter never occurs with produced ends. Moreover, under a low power, N. spectabilis has a bright brown colour, in the striated parts, not observed in N. Lyra. Lastly, I find this form remarkably uniform and constant in its characters. It is very conspicuous, and generally larger than N. Lyra.

11. Navicula pratexta=Pinnularia pratexta, Ehr. Pl. IX., fig. 11. Form a pure and broad oval. Length from 0.004" to 0.005"; breadth 0.0025" to 0.003". Median line sharp, the central extremities ending in large, rounded expansions, which are bent to the same side. Central nodule indefinite, extending transversely. On each side of, and close to the median line, a narrow linear band of very coarse and coarsely moniliform striæ. At the margin of the valve is a rather broad band of striæ, exactly like those of the central bands. This marginal band is of uniform width till near the apices, where it gradually becomes narrow. Striæ 8 to 10 in 0.001". The broad intermediate space between the marginal and central bands is not blank, as in $N.\ Hennedyi$, but is irregularly dotted or stippled with round granules, precisely the same as those of the striæ Towards the centre, and near the ends, the median striated bands pass gradually into the sparsely dotted space. Between these points the median bands end more abruptly. The scattered granules are consequently most thickly set round the nodule and near the apices. The granules are so large, that there are not more than five in each of the longest of the marginal striæ.

This conspicuous and beautiful species has been figured by Ehrenberg, as you, XXI, PART IV.

occurring in the Clay Marl of Ægina, a bed belonging either to the Chalk formation or to the oldest Eocene strata. It seems to be very scarce there, for Ehrenberg has figured an imperfect specimen. I found it first rather sparingly in Professor Allman's Lamlash Bay dredging; and, since then, still more sparingly in Mr Miles's, from the same locality, as well as in several of my Loch Fine dredgings. It is obviously a member of the same group as N. Hennedyi, N. nebulosa, and others, with marginal and central striated bands. It is distinguished by its size, by the remarkable coarseness of its striation, and by the peculiarity that granules, such as form the striæ, are scattered over the unstriated space, without regularity. I have been informed that a form of N. Hennedyi occurs, with a similar character, but this I have not seen. I presume it will be easily known by its much finer striation, and its smaller size. Though this species is hitherto scarce, I have been able to examine a large number of examples, and also to supply various correspondents with specimens.

I avail myself of this opportunity to point out, that we have here an excellent example of the occurrence, in the recent state, in our seas, of a species hitherto known only as a fossil one. But as the Clay Marl of Ægina is the oldest deposit in which Diatoms have been detected with certainty, we have evidence that a species which is among the oldest of known Diatoms still exists. Nor is this by any means an unusual occurrence. In Ehrenberg's plate of the microscopic forms of this Eocene clay marl (Eocene at least, if not Cretaceous), he figures many other forms, all of marine origin; and all, or nearly all, of which are still living species. Indeed, I have seen upwards of three-fourths of these Diatoms in the dredgings described in this paper. Among these are Actinocyclus undulatus, Coscinodiscus radiatus, Pyxidicula cruciata, Navicula prætexta, N. Bombus, and many other frequent forms. I feel assured that every form of Diatom found in that Clay Marl, still lives in the present seas. And if this be the case with the oldest Diatomaceous deposit, it is no less likely to hold good of such as are of later date. In the great bed of Richmond, Virginia, which is marine, and said to be of the Miocene period, perhaps the most frequent form is Orthosira marina, Sm. (olim Melosira sulcata, Kütz.); a form which I find, as already mentioned, very abundant in Lamlash Bay. In the same deposit occurs Coscinodiscus centralis, Ehr., a splendid disc, to be described farther on, as occurring in the Clyde; and I might multiply similar examples almost ad infinitum.

Here the question naturally presents itself, Are there any extinct species of Diatoms? Strange as it may seem, when compared with what is found to occur in organisms of other and higher classes, I believe that this question ought to be answered in the negative.

In the earlier works of Ehrenberg, we frequently meet with species, and even with large groups of species, or almost genera, which are stated to be "fossil only," and which were believed to be extinct. Such forms are Campylodiscus

clypeus, found in the polishing slates of Bohemia, and the whole series of dentate Eunotiæ, found so abundantly in the Lapland Bergmehls.

But the progress of observation has shown that these forms are still in existence. *C. clypeus* has recently been found in British waters; and in America, and elsewhere, the *dentate Eunotiw*, such as *E. Diadema*, *E. heptodon*, *E. octodon*, *E. Serra*, and others, have been found recent. I have myself often found, during the last two years, *E. triodon*, a form long regarded as extinct, in many of our streams, although scattered. But last summer I detected it as the predominant form in a gathering made by Professor Balfour, in a small stream on a hill in Arran, not far from Lamlash.

I conclude, therefore, that our knowledge of the existing species of Diatoms is yet far too limited to allow us to say that any fossil species no longer exists. In this very paper, I make known the actual existence of several species, hitherto supposed to be exclusively fossil, and every day adds to the number of existing forms, while it diminishes that of those conjectured to be extinct, few of which are now left. Surely, when one or two localities yield so many undescribed forms as I have here the honour to lay before the Society, we are not entitled to conclude that any form is extinct, because hitherto it has only been met with in the fossil state. In the present state of our knowledge, it is far more probable, that we shall ultimately find, as I have done in the case of N. prætexta, that the supposed extinct species are all still in existence.

But, it may be asked, How is it that you suppose no species of Diatoms to have become extinct, when, in almost every other class, the extinct species far outnumber the existing ones? In answer, I would observe, first, that we have no undoubted evidence of the existence of Diatoms earlier than the Clay Marl above named, which is either Eocene, or a member of the latest Chalk deposits. Now, if it be Eocene, then we know that that formation contains, even among fishes, a certain proportion of existing species. This proves that the condition of the Eocene period did not differ nearly so much from the present conditions as those of earlier deposits must have done; those, for example of the Carboniferous series, of the Old Red Sandstone, or of the Silurian strata.

Secondly, the size of Diatoms is so very minute, and their structure so exceedingly simple, that they must be little, if at all, affected, even by very considerable climatic variations. Of this, indeed, we have ample evidence, so far at least as concerns existing differences of climate. If we consult the plates of Ehrenberg's Microgeology, we shall see that the existing species of Diatoms found in the most distant and different parts of the world, in the Arctic and Antarctic Seas, in the tropical zone, and in our own temperate regions, are, for the most part, absolutely identical. There are, no doubt, local differences; but these, as is shown in this paper, may be very great in almost contiguous localities. On the other hand, having examined the diatoms in a large number of American and other exotic

soils, I have always found a very great majority of common British species. As an example, I may specify two soils particularly rich in Diatoms; one from the Sandwich Islands, the other from Lebanon. The former was quite like an ordinary fresh-water gathering, the latter resembled a poorer material. In both, I have great doubts whether all the numerous species are not identical with our own. Some few of the species, indeed, are not to be found in Smith's Synopsis; but most of these have been described by others, or by myself, as British forms, since that work appeared.

So far, therefore, as the greatest actual differences of climate are concerned, Diatoms are apparently not affected; as in the cases just mentioned, it is impossible to distinguish the exotic specimens from British ones.

If, therefore, Diatoms did not exist earlier than the Eocene period, it is quite conceivable that none of them may have become extinct.

I have already stated that the Clay Marl of Ægina is supposed by some to belong to the formation next below the Eocene, that is, to the latest Cretaceous beds; but that there is no satisfactory evidence of Diatoms in any earlier formation. If we admit the Xanthidia to be Diatoms, these forms are known to occur in chalk flints. But the Xanthidia are not usually regarded as Diatoms, and I have not seen, either in flint or in chalk, any admitted or recognised Diatoms.

EHRENBERG figures many microscopic forms from the Chalk and older strata, some even from the Silurian Greensand. But these older forms, at least so far as are shown in the Microgeology, are not Diatoms, but either the siliceous Polycystineæ, or the calcareous Polythalamia, or, finally, sponge spicules.

I admit that Diatoms may have existed in the Chalk or earlier, and that, by a slow chemical change, they may have been destroyed, so that their form is lost, the siliceous material alone remaining, whether alone or in combination. We may even suppose that flint has been formed in part from the shells of Diatoms which lived along with the Foraminifera or Polythalamia of that period. But these are mere conjectures, and till Diatoms are found in the older strata, it must remain doubtful whether they existed previous to the Eocene period.

The Chalk or Marl of Meudon, near Paris, and that of Caltanisetta, in Sicily, exhibit a mixture of microscopic forms, calcareous and siliceous, including Diatoms. Here Diatomaceous shells, in contact with excess of calcareous matter, have remained unaltered; and if the Chalk of the true Cretaceous period had originally contained Diatoms, it seems probable that they would have been found as little altered as those of the newer beds just alluded to.

On the whole, then, it is probable that the continued existence of all, or nearly all, the known fossil species of Diatoms is the result, first, of their comparatively late introduction, and secondly, of their small susceptibility to climatic changes, arising from their minute size and very simple structure.

12. Navicula Bombus, Ehr. Pl. IX., fig. 12. Form much constricted in the

middle, the two halves broad and rounded, with subacute extremities. Median line broad; central nodule square, definite. Length about 0.0045"; greatest breadth 0.0018". Striation coarse, strongly moniliform, not reaching the median line, but leaving a narrow blank space on each side of it. Striæ about 18 in 0.001, much inclined near the apices.

This form, which I had found frequent in the Glenshira sand, is also frequent in the new dredgings. It is regarded by many as a variety of N. didyma, and by others as a variety of N. Crabro. I am disposed to consider it a distinct species, on account of its peculiar and very constant form, and also because it has a decided light-brown colour in balsam, under a low power, which N. didyma has not. It is much larger than N. didyma. As to N. Crabro, the moniliform structure in it is always obscure, and the form is also different. I cannot perceive that N. Bombus passes into either of these species by intermediate forms. But whatever be the ultimate decision on this point, I give it here as the form called by Ehrenberg N. Bombus; which, be it species or variety, is at all events conspicuous, and very constant in its characters.

In my last paper on the Glenshira sand, I have figured several Naviculæ and Pinnulariæ of the panduriform group, and I have pointed out that this remarkable group requires thorough investigation. In order to contribute towards this end, I have figured the present form, as well as *N. Musca*, a new member of the same group; and I shall describe, farther on, another, namely a remarkable form of *Pinnularia Pandura*, Bréb.

13. Navicula Lyra, Ehr. Pl. IX., fig. 13 and 13 b. Form oblong-elliptic, broad; often contracted to short produced extremities. Length from 0·002" to 0·0045"; breadth 0·0007" to 0·0018". Median line fine, interrupted by a large indefinite nodule, extending transversely. On each side of, and in contact with, the median line, is a linear, somewhat broad, striated band, and this is separated from the very broad, marginal, striated band by a narrow linear blank space. These linear blank spaces are, in each half, united by their base to the extremities of the nodular blank. They bend outwards from this point, then inwards, and finally again outwards at their extremities, thus forming, in the entire valve, two lyrate shapes united by their bases. Hence the name. The lyrate character is often much more decided than in the specimens figured. The extremities of these lyrate blanks generally reach the margin of the valve near its apices, but sometimes fall short of this, as in the figure. Striæ about 22 or 24 in 0·001", somewhat inclined near the apices.

This species, which occurs in the Glenshira sand, and is scattered through all the dredgings here mentioned, has been described, though not as I have described it above, in the 2d volume of Professor Smith's Synopsis. Professor Smith seems to have seen only a variety, to be presently mentioned, which does not possess the lyrate character, and has therefore omitted that character. He refers to a figure

in vol. i. (fig. 152 a^*) given as N. elliptica, which is not lyrate; but the name given by Ehrenberg proves that he regarded the lyrate character as a principal one. I have therefore figured it, in order to show that it occurs in Britain as Ehrenberg described it.

14. Navicula Lyra, Ehr., var. β , abrupta. Pl. IX., figs. 14 and 14 b. Form usually oval, more or less elongated; sometimes linear in the middle, broad, with parallel sides, and obtusely acuminate at the extremities. I have hardly ever seen it with contracted and produced ends, as is so often observed in N. Lyra. Size and striation as in N. Lyra, but the blank spaces, which are linear, as in that species, instead of being recurved at the ends, or lyrate, bend inwards at the ends, so as to form two narrow ellipses meeting in the central nodule. These linear blanks in this variety stop abruptly at some distance from the terminal margin of the valve, which, in N. Lyra, they often, though not always, reach.

This form, which is frequent in the Glenshira sand, as well as in the dredgings, is that already referred to as having been figured in vol. i. of the Synopsis (fig. 152 a^*), as N. elliptica, and since referred to as N. Lyra, in vol. ii.

I figure it here, both that it may be compared with the N. Lyra of Ehrenberg, and that it may be contrasted with N. spectabilis (fig. 10), which is supposed by some to be a form of N. Lyra. The form of the latter, and the fact that the blank spaces in it are not linear, but broad, and reach the margin, all which characters are very constant; to which may be added the rich brown colour of N. spectabilis in balsam, under a low power, seem to me to be sufficient to distinguish it from N. Lyra. The reader is requested to compare fig. 10 with figs. 13, 13 b, 14, and 14 b. The latter forms are colourless in balsam.

15. Navicula Smithii, var. β , fusca. Pl. IX., fig. 15. Form an elongated oval, broad, with rounded ends. Length from 0.003" to 0.0063", and even more; greatest breadth from 0.0014" to 0.0028". Median line narrow at the terminal nodules, which are a little within the apiees; broad, and formed of three parts, all ending in expansions, on each side of the central nodule. Nodule large, broad, indefinite. Striation very coarse, and coarsely moniliform, not reaching the median line, but leaving on each side of it a narrow blank line, terminating in the angles of the nodular blank. The whole spaces, taken together, form two very acute long triangles, base to base Striæ about 10 in 0.001". At about one-third of the distance from the median blank lines to the margin, the striæ are traversed by a strong, dark line, which is often, as in the figure, nearly rhombic, but is generally curved, though very slightly. This line is caused by a ridge or elevation of the valve, and is very conspicuous. Valve thick, and highly convex, of a strong brown colour, in balsam, under the $\frac{1}{2}$ or $\frac{2}{3}$ of an inch objectives.

This form, which is very conspicuous, occurs, like the two preceding, both in the Glenshira sand and in the dredgings; and in that of Professor Allman from Lamlash Bay and one from Loch Fine, it is frequent. I give it as a variety of N.

Smithii (olim N. elliptica Sm.), because I have always understood the typical N. Smithii to be a form which is very frequent in the Glenshira sand, and occurs also in the new materials. It is of a short, broad, inelegant, oval shape, flat, colourless, and much less coarsely striated. Neither does it exhibit the longitudinal ridge so distinctly. It may be, that the present form, N. fusca, is the typical one, and the other a variety of it; but in my experience I have only seen N. fusca in the gatherings above named, while I observe N. Smithii in every marine gathering.

16. Navicula Smithii, var. γ , nitescens. Pl. I., fig. 16. Form lanceolate, tending to rhombic, with obtuse ends. Median line straight, nodule definite. Length from 0.002'' to 0.0035''; breadth from 0.0009'' to 0.0014''. Striæ about 16 in 0.001'', considerably inclined, obscurely moniliform, and of a shining aspect. They are traversed by a ridge, which is about half-way from the margin to the median line, and has an outline more rhombic than that of the valve.

This form occurs both in Lamlash Bay and in Loch Fine, and is not at all rare in some of the dredgings. It is conspicuous, from its elegant form and shining aspect. It is quite colourless under a low power. I have given it as a variety of N. Smithii, from a desire to avoid unnecessary multiplication of species. But I am inclined to regard it as distinct from that species, from its peculiar form, its smaller size, the character of the nodule and median line, and its bright white aspect; all of which characters are very constant.

17. Navicula Smithii, var. 3, suborbicularis. Pl. IX., fig. 17. Form a short, broad oval, or suborbicular. Length 0·002" to 0·0026"; breadth 0·0013" to 0·0018". Median line bounded by white lines, curving inwards both to the apices and to the indefinite nodule. Striation conspicuous, much inclined. Striæ 16 or 18 in 0·001", moniliform. There is a ridge, as in the two preceding forms, traversing the striæ, and when the striæ near the margin are in focus, those between the ridge and the median line are very faint.

This form occurs in Lamlash Bay, and is also tolerably frequent in one Loch Fine gathering, in which the preceding form is not found. Its small size, nearly round form, and peculiar median line, with the slightly-marked ridge, compared to that in the two preceding forms, seem to point it out as distinct; especially as it is very constant in its characters. But, for the reasons already stated, I give it as a variety. It is at least a form to be noticed, and to be considered with the others with a view to a more accurate determination of species than has yet been possible, but which, in the progress of observation, we may hope to attain.

18. Navicula maxima, Greg. Pl. IX., figs. 18, and 18 b. Form of S.V. linear, rather narrow, with obtuse ends. Length from 0002" to 0.008"; breadth of S.V. from 00.0025" to 0.00011"; of F.V. in the larger specimens, 0.0009" in the middle, 0.00115" at the ends. Striæ fine, but distinct, about 52 in 0.091", parallel, not quite reaching the median line, from which, at the centre, they retire, leaving a pretty large round space. F.V. rectangular but narrowest at the middle, and

slightly expanded at the ends, the angles being be velled. From the opposite ends the margin inclines very slightly, but visibly, to the middle. No dules very conspicuous on the F.V., in which the striation also extends, on each side, to rather more than $\frac{1}{4}$ th of the width of the frustule, which arises from the convexity of the S.V.

I first described this species in my first paper on the Glenshira sand, in which the figure was not characteristic. I figured it again in the second paper; giving, however, a shorter, broader, and constricted form as the type, and the present one as a variety. I have since found it frequent in all the dredgings, but especially abundant in one from Loch Fine, and am now satisfied that the linear form is typical and the broad constricted form a variety. I give the peculiar and characteristic F.V. for the first time. The S.V. in fig. 18 b, is that of a broad individual of the linear type. It is generally narrower, and often even no more than half this width. The shortest specimens are often still narrower. The broad, incurved form, at first regarded as the type, is very scarce in the dredgings, compared to the linear form.

This form has been supposed to be identical with N. firma , Kütz, var. β ; but its marine habitat at once negatives this supposition; and, besides, its aspect and colour are quite different. N. firma is brown, while N. maxima is of a pale straw-colour. The striation in N. firma is coarser and more conspicuous; and, lastly, N. firma is broader, has acute extremities, and yields several marked varieties, such as Ehrenberg's N. $\mathit{dilatata}$ and N. $\mathit{Amphigomplus}$; while the only observable variety of N. maxima is the shorter, broader, incurved one, represented in fig. 2 of my second paper on the Glenshira sand.

19. Pinnularia (?) subtilis, n. sp. Pl. IX., fig. 19. Form linear rhombic, very narrow, with elongated apices. Length about 0.0035''; greatest breadth about 0.00025''. Nodule definite. Costa about 28 or 30 in 0.001''; transverse, slightly inclined towards the apices.

This form occurs in Lamlash Bay. I do not feel quite sure about its genus. It may be a Navicula. The whole form is delicate and translucent, and it is far from conspicuous.

20. Pinnularia rostellata, n. sp. Pl. IX., fig. 20. Form linear, broad, with acuminate ends, terminating in short, acute apiculi. Length from 0.002'' to 0.0027''; breadth about 0.0007''. Central nodule definite. Costæ strong, subdistant, inclined near the ends, reaching the median line, about 14 in 0.001''.

This pretty form occurs both in Lamlash Bay and in Loch Fine. It is not frequent, but I have been able to examine a considerable number of specimens, which are quite constant in their character.

21. Pinnularia Allmaniana. Pl. IX., fig. 21. Form elliptic-lanceolate, broad, extremities subacute. Valve highly convex on one side, concave on the other. Length from 0.0016" to 0.0026"; breadth from 0.001" to 0.0014". Costæ appa-

rently marginal, strong, about 20 in 0.001", giving the appearance of a narrow marginal band of very strong costæ. Within this band, however, the valve, on close inspection, is found to be marked with similar but much fainter costæ nearly to the median line. The valve appears to be thicker near the margin than in the middle, and this perhaps is the reason why the costæ are so strong and conspicuous there.

This form is frequent in Professor Allman's dredging from Lamlash Bay, and it occurs also in Loch Fine. I have named it after Professor Allman, to whom I am indebted for this dredging, the richest of all those here described.

22. Pinnularia Pandura=Navicula Pandura, Bréb., var. β , elongata. Pl. IX, fig. 22. Form deeply constricted in the middle, with elongated sub-triangular ends, and obtuse apices. Length 0·0075" or more; greatest breadth 0·002", breadth at constriction 0·0014". Median line sharply defined, broader at the centre than at the ends; nodule square, definite. On each side of the median line, and a little way from it, there is on each side a line or ridge, apparently formed of large granules, but probably only apparently so, from the sudden and sharp elevation of the ends of the costæ. Costæ, from this point to the margin, perfectly entire and glassy, like those of P. alpina. Valve thick, costæ 10 or 11 in 0·001", somewhat inclined near the apices.

This seems to be a variety of De Bredisson's Navicula Pandura, which I have represented in the second paper on the Glenshira sand, in figs. 11, 12, and 12*. But as De Bredisson himself describes the costæ as being entire, and represents them distinctly so in his figure of the species, I have changed the generic name to Pinnularia. I consider it as quite distinct from N. Crabro, Ehr., as described by Professor Smith, in vol. ii., of the Synopsis; for the latter has obscurely moniliform striæ, as is shown in Dr Greville's figure of it from Trinidad, in the Microscopical Journal for January 1857.

The forms represented in figs. 11, 12, and 12* of my second paper on Glenshira (Micr. Trans. iv., pl. v.), and that here figured (fig. 22), are abundant in several of the dredgings; but of all the numerous examples I have examined, not one exhibits the slightest trace of moniliform structure; and I have had the satisfaction of having this observation confirmed by Dr Greville, who is acquainted with the form in which that structure exists obscurely. Unless, therefore, we are prepared to abolish the distinction between entire and moniliform striation, on which Professor Smith founds the distinction between his genera Navicula and Pinnularia, we cannot regard this form as a Navicula.

GROUP II.

COCCONEIDES.

The new forms belonging to this group are not numerous, but they are, in every case, interesting. In addition to one species, already figured, though imperfectly, as occurring in the Glenshira sand, I have detected in the new materials six additional species, all of them beautiful and well-marked forms. These constitute a largeaddition to a genus, which, in Britain at least, has hitherto been a very small one. The species to be described are:—

23. (Coccon	eis distans, Greg.	27. 0	occone	is pseudomarginata, n. sp.
24.		ornata, n. sp.	28.		major, n. sp.
25.		dirupta, n. sp. G.	29.		splendida, n. sp.
26.		nitida, n. sp.	Chine said a		

23. Cocconeis distans, Greg. Pl. IX., fig. 23. Form oval, broad; ends subacute. Length from 0.0014" to 0.0026"; breadth from 0.001" to 0.002". Median line delicate. The valve is marked by distant lines, much inclined near the apices, not reaching the median line. These lines are about 10 in 0.001", and consist of white hyaline faint bars, on which are set small and distant granules. The number of granules is only 4 or 5 in the longest of these lines, so that the granules are very distant. They are, as nearly as possible, of equal size, and from their distance, give to the valve a spotted rather than a striated aspect. In the figure, the granules appear larger than they really are; but this, as I have since ascertained, depends on the focus, and is an effect of shadow. By careful focussing, the real size of the granules is easily seen. The valve is hyaline; but it is always easy, by focussing, to see the faint bars on which the granules are set, a character which at once distinguishes this form from C. Scutellum, to which some are disposed to refer it. Another character, besides that of its having much fewer lines and much fewer granules than the coarsest varieties of C. Scutellum, is, that in C. distans the granules are of equal size, while in C. Scutellum they diminish in size as they approach the median line. In C. distans, if there be any difference, it is that the marginal granules are somewhat smaller than the others. I may here also allude to the fact, that while C. Scutellum is a most variable form, C. distans, so far as I have seen, exhibits only one variety, and that quite different from any variety of C. Scutellum. This form, C. distans, var. β , promorsa, is considerably larger than the type, having a length of 0.003" to 0.0038", and being a little narrower in proportion than the type. There is always, at one point of the margin, a notch or solution of continuity, as if a portion had been cut out, and then smoothed over. The only other difference is, that the granules are somewhat smaller, but the faint bars are exactly as in the type.

I figured this species, both in my first and in my third paper on the Glenshira

sand. But in the former, a variety of *C. Scutellum* was figured by mistake: and the latter figure was imperfect, because I had not then seen the faint white bars. This species, along with *C. costata*, also figured in the third paper alluded to, is so frequent in Lamlash Bay, that I have had ample means of studying it, and am quite satisfied of its being a good species. I may say the same of *C. costata*, with the remark, that I cannot ascertain from Ehrenberg's figures, whether his *Raphoneis fasciolata* may not be the same form. Ehrenberg's form seems to be much larger, and the markings much coarser and more conspicuous. I must leave this point undecided till I can compare the two forms.

24. Coccone ornata, n. sp. Pl. IX., fig. 24. Form a pure and elegant oval. Length about 0.0022"; breadth about 0.0014". There is a broad marginal band, marked by strong distant costæ, the ends of which are rounded. Within this band the surface appears concave to the median line, which is delicate, with a large, definite, central nodule. The middle part is marked by fainter costæ, corresponding to those on the marginal band, and, like them, so much inclined near the apices, as to be nearly vertical. There is a narrow blank line between the marginal and central costæ, and the latter do not reach the median line, leaving a long lanceolate blank space in the middle. The whole valve has a rich ornate aspect.

This beautiful species occurs in Lamlash Bay; and although scarce as yet, I have been able to examine a sufficient number of specimens to ascertain its characters. I have also observed a few in Loch Fine.

25. Coccone dirupta, n. sp. Pl. IX., fig. 25. Form a broad, short oval, sometimes all but orbicular. Length from 0·001" to 0·0024"; breadth from 0·0007" to 0·0021". Valve thick, and under the half-inch objective of a strong brown colour. Median line irregular, like a slit or tear down the middle of the external surface. The whole valve is marked, except the slit, with coarse, wavy, longitudinal striae; but, when carefully focussed, fine transverse striae are seen over the whole surface to the median line. Under the half-inch, there is an appearance of a long stauros, which, under a higher power, disappears as such, and can only be seen as a transverse gleam of light from below. The striated surface seems to be an outer one, torn asunder in the middle, and from this I have named it. Vertical striae about 26, transverse striae about 60 in 0·001".

I had observed this form in the Glenshira sand, where, however, it was very scarce, and hardly ever entire, so that I postponed its investigation. It occurs very abundantly in Mr Miles's Corallina gathering, and less frequently in several of the dredgings. There is but one known form which is in any degree allied to it. This is C. diaphana, Sm., which I find to occur along with it. After many comparisons, I am disposed to conclude, although these two forms are not the same thing, since C. dirupta is by no means diaphanous, while its strice are conspicuous and its colour brown, the strice of C. diaphana being very obscure, and the valve colourless, that C. diaphana may perhaps be an imperfect form of

C. dirupta, possibly the surface which lies under the one here figured, or possibly also the lower valve, which in Cocconeis is often different from the upper. It is, however, at least equally probable that these two forms belong to different species. In the Corallina gathering, C. dirupta is infinitely more frequent than C. diaphana.

26. Cocconeis nitida, n. sp. Pl. IX., fig. 26. Form a very broad oval, suddenly contracted, above and below, to very short, subacute, produced apices. Length from 0.001" to 0.0038"; breadth from 0.0008" to 0.0035". Valve very thick, aspect glassy. It is marked by lines of very large nitid granules, these lines forming, longitudinally, concentric striæ, the two inner ones of which bend slightly outwards from the median line, leaving a narrow lanceolate blank space; the others becoming more and more curved as they approach the margin. In large specimens, there are five such lines on each side, or from 3 to 4 in 0.001". But the granules also form transverse lines, much inclined near the apices, of which there are, in large specimens, 28 or 30 in the length of the valve, or from 6 to 8 in 0.001". The margin is marked by a series of finer striæ. Median line obscure. In the middle of the valve, the transverse lines contain on each side five granules, corresponding to the five vertical lines. The granules are generally of equal size or nearly so, except a few near the apices, which are smaller. The whole form is very conspicuous, from its glassy aspect, and the size and brilliancy of the granules.

This striking form occurs not unfrequently in Lamlash Bay, and sparingly in the Loch Fine dredgings. It is very uniform in its characters.

27. Cocconeis pseudomarginata, n. sp. Pl. IX., fig. 27. Form a very broad elliptic, or elliptic-lanceolate. Length 0·0016" to 0·0033". Breadth 0·0011" to 0·003". Valve thin and transparent. Within the margin is a line or shade parallel to it; and within this, half-way from the margin to the centre, is a very strong line, forming a broad lanceolate figure. At first sight it seems as if the latter were the inner boundary of a marginal striated band; but on close inspection the strice, which are very fine, are seen to extend from the margin almost to the median line, where they leave a very narrow rhombic blank space, extending, in the median line, only to the inner of the two marginal lines. The third, or interior line, counting from the margin, is a very strong and raised ridge, the ends of which are almost in contact with the second line. Median line delicate, central nodule definite; terminal nodules placed within the ends of the third line. Striæ very delicate, but sharp, about 62 in 0·001", transverse in the middle, nearly vertical at the ends. The first or outer margin is formed of two lines very close to each other.

This remarkable form occurs in Professor Allman's dredging from Lamlash Bay, where it is rather scarce, and also in that of Mr Miles from the same locality. It requires a very good glass to resolve the markings perfectly.

28. Cocconeis major, n. sp. Pl. IX., fig. 28. Form a very broad oval. Length to 0.0015'' to 0.0038''; breadth from 0.001'' to 0.00315''. Median line distinct;

central nodule indefinite. Terminal nodules considerably within the margin, small. The two parts of the median line terminate in the middle in small rounded expansions, but do not meet. Striæ delicate, but sharp, transverse in the middle, and gradually more and more curved towards the apices, where they become nearly vertical. They are not so close together as in some forms in which they are equally delicate, and there are about 54 in 0.001". Valve thin, flat, hyaline.

This remarkable form occurs in Professor Allman's Lamlash Bay dredging, where, however, it is rather scarce; also in that of Mr Miles.

29. Coccone splendida, n. sp. Pl. IX., fig. 29. Form, a pure broad oval. Length about 0·0044"; breadth about 0·0039". Valve strong, and very richly marked with striæ, which are highly inclined and curved near the apices. These striæ are coarse, about 14 in 0·001", and are formed of granules, which gradually diminish in size towards the median line. The four or five outer granules of each of the striæ are set as closely together as possible, while the rest are separate. This gives the appearance of a broad marginal band. There is a small, nearly square blank at the centre, which is no doubt the indefinite central nodule. The two halves of the median line are strong, somewhat bent at the terminal ends, where they form elongated expansions, lying just within the dense marginal band. The central ends terminate in small expansions, which lie at the upper and under edges of the central blank.

This beautiful form occurs in Lamlash Bay, but it is hitherto scarce. No doubt it will some day be found more abundantly. It is, with the two preceding forms, remarkable for the size it attains, being the largest Coccone yet described, while C. major and C. pseudomarginata are but little below it in this respect, and even C. nitida is unusually large for this genus.

GROUP III.

FILAMENTOUS FORMS.

Of this class of forms, the number is considerable. It is worthy of remark, that most of them belong, so far as I am able to judge, to the genus Denticula, which hitherto has yielded only fresh-water species. But there are six of which the genus is doubtful; partly because the F.V. alone is as yet known, which is the case in four of them; partly because, if not Denticulæ, they cannot well be referred to any of the genera in SMITH'S Synopsis. One remarkable species, the genus of which is still uncertain, I have been compelled to remove from Himantidium, in which genus Professor SMITH had provisionally arranged it. The forms of this group are 14; viz.:—

30 T	Denticula	(?) interrupta, n. sp.	34. I	Denticul	a nana, n. sp.
31.		(?) capitata, n. sp.	35.		minor, n. sp.
32.		(?) ornata, n. sp.	36.		distans, n. sp.
33.		(?) lævis, n. sp.	37.		staurophora, n. sp.

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NEW FORMS OF MARINE DIATOMACEÆ.

- 38. Denticula fulva, n. sp.
- 39. ... marina, n. sp. 40. Diadesmis (?) Williamsoni = Himanti-
- dium Williamsoni, Sm.
- 41. Meridion (?) marinum, n. sp. (or Gomphonema lineare ?).42. Pyxidicula (Dictyopyxis) cruciata, Ehr.

43. Orthosira angulata, n. sp.

30. Denticula (?) interrupta. Pl. X., fig. 30. Form of F.V. nearly rectangular, the middle part very slightly convex, and the ends a little expanded. There is an apparent interruption of the margin at the middle point on each side, and on each side of this opening is a round punctum. Length about 0·0015"; breadth about 0·0004". It occurs in chains of 2, and the two dots of each margin form a square with those of the margin of the adjacent frustule. The S.V. is not yet known, and the species is only provisionally referred to Denticula.

This species occurs in Lamlash Bay, but is scarce.

31. Denticula (?) capitata, n. sp. Pl. X., fig. 31. Form of F.V. generally rectangular, but with the middle part considerably convex, and the apices expanded and rounded. Length about 0.0018"; breadth about 0.0005". Occurs, like the last species, in chains of two. S.V. as yet unknown; and it is only doubtfully and provisionally referred to Denticula.

This species occurs only in one of the Loch Fine dredgings, and it is as scarce as the preceding.

32. Denticula (?) ornata, n. sp. Pl. X., fig. 32. Form of F.V. rectangular, but somewhat expanded in the middle, and also, after a slight contraction, at the apices, which are finally truncate. The margin, at the expansions, is beautifully moulded, having a moulding or notch on each side of the middle point.—Occurs in chains of two. Length 0.0015'' to 0.0017''; breadth, in the middle, 0.0005''. S.V. not yet known, so that the species is only provisionally referred to Denticula.

This very pretty species occurs both in Lamlash Bay and in Loch Fine, and is much less scarce than the two preceding ones. Notwithstanding this, however, I have not been able to find the S.V.

33. Denticula (?) levis, n. sp. Pl. X., Figs. 33, 33 b, and 33 c. Form of F.V. linear, rectangular, with a small sharp prominence in the middle of each margin, and the apices slightly, but sharply, expanded. Occurs in chains of two or three, and also solitary. Length from 0.0016'' to 0.0027''; breadth 0.0006''. It is striated on each side to one-third of the width, indicating that the S.V. is convex. Striædelicate, but distinct under a high power, about 48 in 0.001''. The general aspect is smooth, and the striation is only seen on very careful adjustment. There are two terminal nodules visible on the F.V. at each end, which are joined by lines bounding the striæ. The middle prominence of the margin of the F.V. seems to indicate a central nodule on the S.V., which view has not yet been observed.

This species is by no means rare in Lamlash Bay, and it occurs also in Loch Fine; but I have hitherto been unable to detect the S.V. I have referred it provisionally to Denticula, but with many doubts. It is probable that if we had the

S.V. we might find it to be a Diadesmis, that is, a catenated species, having naviculoid frustules. But I do not venture to name it on conjecture, and I only refer it, with the three preceding forms, to Denticula provisionally, in order that some name may be used in speaking of them. Indeed it is probable that the three preceding species may also prove to belong to Diadesmis. My present object is, not to determine their genus, for which I do not possess the necessary data, but only to point them out as well-marked species, for the researches of other naturalists.

34. Denticula nana, n. sp. Pl. X., fig. 34. Form of the F.V., which occurs in chains of two, three, four, and occasionally more, rectangular, expanding a little in the middle, and also at the apices, which are truncate. Length from 0.0005'' to 0.001''; breadth, in the shorter examples, 0.0003'' to 0.0004'', and less in the longer ones. Margin of F.V. faintly denticulate, from the ends of the striæ, S.V. obtusely rhombic, broad, with a raphe in the median line. Striæ rather fine, inclined.

This little form is tolerably frequent, both in Lamlash Bay and in Loch Fine. I think it is properly referred to *Denticula*, although it has some resemblance to some of the forms figured by foreign authors under the name of *Zygoceros*.

35. Denticula minor, n. sp. Pl. X., figs. 35, 35 b, 35 c, and 35 d. Form of F.V., which occurs in chains of from two to seven or eight, on the whole rectangular; sometimes exactly so, more frequently with an angular expansion at the apices, which become capitate and subtruncate, while the margin is convex in the middle. Length from 0.0005'' to 0.002''; breadth from 0.0002'' to 0.0006''. Margins of F.V. strongly denticulate. S.V. rhombic or rhombic-lanceolate, very narrow, with srong marginal costae. Costae 18 or 20 in 0.001''.

This form, which is very frequent in the Lamlash Bay dredgings, and also in one of those from Loch Fine, varies much both in size and shape, the F.V. being sometimes as short as the shortest *D. nana*, and very broad in proportion, bulging in the middle, and capitate, sometimes longer, rectangular, and broad; and most frequently longer, much narrower, and capitate. The S.V. is so narrow, that the frustule seldom lies on that side, so as to present it to the eye. It appears to belong distinctly to Denticula.

36. Denticula distans, n. sp. Pl. X., figs. 36 and 36 b. Form of F.V., which occurs in chains of from two to five or six, and also solitary, rectangular, rather broad; often convex on the sides, and with the ends a little expanded. Margin strongly denticulate. Length 0.0017'' to 0.0026''; breadth 0.0006'' to 0.0008''. S.V. rhombic or rhombic-lanceolate, broad; marked with very strong, distant, sharp, and marginal costse. Terminal nodules large and conspicuous. No central nodule. Costse about 10 in 0.001''. Valve thick and glassy.

This fine species is tolerably frequent, both in Lamlash Bay and in Loch Fine. There is a considerable resemblance between this and the preceding species, so

that *D. minor* almost looks like a miniature of *D. distans*; but on a close comparison, they are found to be totally distinct. *D. distans* often occurs shorter than the average length of *D. minor*, but it never loses its own characters, the strong, distant, glassy coste, and the broad S.V. But the two forms are evidently allied species, and both seem to be true *Denticulæ*.

37. Denticula staurophora, n. sp. Pl. X., figs. 37, 37 b, and 37 c. Form of F.V., which occurs in chains of two, three, and sometimes more, rectangular, with coarse marginal striæ, which in the middle on each side, are interrupted by a blank space, bounded by diverging lines. Length from 0·001" to 0·0038"; breadth 0·0005" to 0·0008", the shorter examples being the broadest. S.V. lanceolate, rather narrow, marked with coarse moniliform striæ, except in the middle, where there is a broad stauros, on each side of which is a line, curved and concave towards the extremities. Striæ 14 to 16 in 0·001".

This striking form is not unfrequent either in Lamlash Bay or in Loch Fine. I have referred it to Denticula, but perhaps it ought to be referred to *Diadesmis*, or, if the stauros be considered an objection, to a new genus allied to *Diadesmis* as *Stauroneis* is to Navicula. But this point must be left for farther investigation.

38. Denticula fulva, n. sp. Pl. X., figs. 38 and 38 b. Form of F.V., which occurs in chains of two, three, and sometimes four, linear, rectangular, and slightly expanded at the apices, the margin marked with the ends of somewhat coarse strize. Length from 0·0018" to 0·004"; breadth 0·0005". S.V. linear, narrow, broadest in the middle, and gradually contracting to long, narrow extremities, which are ultimately subcapitate and rounded. Strize moniliform, somewhat coarse, leaving a raphe in the middle, and the two terminal knobs unstriated. No central nodule in the S.V.; but the two nodules seen at each end of the F.V. appear to form the unstriated knobs at each end of the S.V.

This well-marked species occurs with the three last, and is even more frequent than they are. The genus cannot be considered as determined with certainty.

39. Denticula marina, n. sp. Pl. X., figs. 39 and 39 b. Form of F.V. linear, rectangular, with the angles very slightly expanded, and the margin strongly denticulate. It occurs in chains of from 2 to 18 or 20, so that the filament seems to be tenacious. Length from 0.002", to 0.008" or 0.009"; breadth from 0.003" to 0.0005". S.V. linear, expanded at the middle, and obtusely acuminate at the ends. Striæ very coarse, and very coarsely moniliform, about 10 in 0.001". On each side of the median line each of the striæ is formed of only two granules, which are distant, and half of a third, which seems to be on the margin. The two or three central striæ on each side, having only one and a half granules, the inner granule of each being absent, there is a blank space round the centre; and there is a smaller blank at each apex. The F.V. here figured is of about the usual

length, the S.V. is one of the longest. The whole form has a pale, whitish aspect on the S.V., and the single valves are hyaline.

This very fine and conspicuous form is frequent in Lamlash Bay, and even abundant in one of the Loch Fine dredgings. It occurs scattered in all the dredgings without exception. It seems to be a true *Denticula*.

40. Diadesmis (?) Williamsoni, n. sp. Pl. X., figs. 40 and 40 b. Form of F.V. rectangular, narrow, with three angular expansions, one in the middle, and one at each end; so that there are two long, narrow elliptical spaces between the adjacent frustules, which occur, as in the last species, in chains of from two to twenty, and upwards. Margin of F.V. strongly denticulate. Length from 0.0016" to 0.008"; breadth from 0.0004" to 0.0005". S.V. linear, narrow, straight, very slightly incurved in the middle, and acuminate at the ends. Striæ coarse, coarsely moniliform, but closely set, giving to the valve a black aspect; about 16 or 18 in 0.001". Central and terminal nodules large, white, conspicuous.

This remarkable and conspicuous form occurs with the last, and is even more abundant, especially in two of the Loch Fine dredgings. It is found in all the materials. The F.V. has been described and figured by Professor Smith, as having occurred sparingly in a dredging made by Mr G. Barlee, off the coast of Skve. and detected by Professor Williamson. It was referred by Professor Smith, but doubtfully, from the absence of the S.V., to Himantidium. The S.V. is particularly frequent in one of my Loch Fine dredgings, and certainly cannot belong to Himantidium. The nearest genus is Diadesmis; but I do not feel at all sure that it is the true one. The conspicuous nodules agree with it; but the aspect of the species is unlike that of any known Diadesmis. I therefore give it as such with a doubt, and am satisfied with having, in the meantime, ascertained that it is not a Himantidium. I would indicate one curious character, that the striæ, on the F.V. seem to pass across the intervals between the adjacent frustules. This seems also to have been observed by Professor Smith, as it is represented in his figures of the F.V., which are accurate. I have also observed, that the shortest examples, which are sometimes so short as to be nearly square on the F.V. are not only broader on both views than the larger ones, but also devoid of the central expansion or undulation, seen on the F.V. In this state, they approach in form to the rectangular F.V. of D. distans, but are at once recognised by the closeness of the striæ, as well as by their moniliform character. In one dredging I find many long filaments, especially of the shorter frustules; while in another, treated precisely in the same way, the detached frustules, generally exhibiting the S.V., and much longer, are much more common than the chains.

41. Meridion (?) marinum (or Gomphonema lineare (?)), n. sp. Pl. X., figs. 41 and 41 b. Form of F.V., which occurs in chains of two, three, or four, both in entire apposition, or attached only by an angle at the broader end, cuneate and truncate at both ends, and narrow. It is marked with coarse marginal denticu-

lations. S.V. linear, narrow, broadest at a point above the middle, from which it becomes narrower both ways; the shorter half being rather broader than the other, and rounded at the apex. The longer and narrower half is also rounded, and very slightly expanded at the end. Striæ coarse, not reaching the median line, but leaving a somewhat broad raphe in the middle. Striæ about 16 in 0·001"; Length about 0·0015"; breadth of F.V., at larger end, 0·0004", at smaller end, 0·0003". Breadth of S.V. 0·0002" at the broadest point.

This form resembles both a *Meridion* and a *Gomphonema*. The absence of a central nodule prevents me from referring it to the latter genus; and with reference to the former, the mode of attachment, as well as the form of the frustules, agree pretty well with it. But I have not seen more than four attached; so that it is still doubtful whether it forms a spiral filament, as the slightly cuneate frustules must tend to do. It occurs, by no means sparingly, both in Lamlash Bay and in Loch Fine. Future observations on the living form will decide the question of its generic position, but in the meantime it is a well-marked species.

42. Pyxidicula cruciata, Ehr. Pl. X., fig. 42. Form of V. cup-shaped, hemispherical, with hexagonal cells over the whole surface, and in one direction, a crest composed of square or irregular cells running round the hemisphere in a plane at right angles to that of the junction of the two valves. Cells large, and of uniform size. Diameter 0.0019".

The form here figured is only a detached valve, the entire trustule not having yet occurred in these dredgings. But it agrees precisely with Ehrenberg's figure of the valve. The specific name is given on account of the arrangement of some of the cells, as seen in a view obtained by looking down on the frustule, at right angles to the junction, in the form of a broad rectangular cross. This cannot be seen in the view here figured. The species is very scarce as yet, having occurred very sparingly in Lamlash Bay. But it is interesting, as being one of the forms which Ehrenberg has figured from the Ægina Clay Marl already mentioned at p. 482, and from the deposit of Richmond, Virginia. I have placed it in this group, because I have reason to think that Pyxidicula is a catenate form, though we cannot expect to see this in fossil deposits. I would here refer to the beautiful new form, detected by Professor Walker Arnott, and figured in the Appendix to this paper, which, in the frustules, is so closely allied to the present species, that it may prove to be actually P. appendiculate of Ehrenberg, a form which occurs along with P. cruciata. Professor W. Arnott's form is decidedly catenate.

43. Orthosira angulata, n. sp. Pl. X., figs. 43 and 43 b. Form of F.V., which occurs solitary, and in chains of from two to six, rectangular in the middle, acuminate and truncate at the ends. On the margin, which is often slightly incurved, are seen denticulations arising from the cells of the disc or S.V. Length from 0.0005" to 0.0015"; breadth of F.V. from 0.0003" to 0.00045". Diameter of disc,

0.0005" to 0.0015". Disc cellulate; cells largest in the centre, becoming regularly smaller towards the margin, arranged in quincunx, but, from the diminishing size of the cells, in curve lines. It often happens that the cells in the two inner thirds of the disc are conspicuously seen, inclosed within an equilateral triangle, formed by three slightly curved lines of cells, beyond which the cells and lines of cells are so small and hyaline, as to become obscure. Such discs are convex, and seen on the convex side. Others, especially the largest, are much flatter, d, when properly focussed, exhibit the whole cellular structure plainly.

This species is very frequent, even abundant, in Professor Allman's dredging from Lamlash Bay; and it is found more or less frequently in all the others. Possibly the disc is identical with the *Coscinodiscus minor* of Ehrenberg or Kützing; that of Professor Smith being a fresh-water form. But the present species is unquestionably an *Orthosira*, notwithstanding the resemblance of the disc to *Coscinodiscus*.

GROUP IV.

DISCS, INCLUDING CAMPYLODISCI.

The new forms belonging to this group are not, in the materials examined, very numerous, but they are very interesting, and most of them are very fine species.

		r Coscinodiscus (?) n. sp.			subtilis, Ralfs, n. sp. cus centralis, n. sp.
46.		punctulatus, n. sp., G.	52.		Ralfsii (?) Sm.
47.		concavus, Ehr., G.	53.		angularis, n. sp.
48.	1/0	umbonatus, n. sp.	54.	14 11 W	eximius, n. sp.
49.	44 Y	centralis, Ehr., G.	55.		limbatus, Bréb.

44. Melosira or Coscinodiscus (?) (?), n. sp. Pl. X., fig. 44. Diameter of disc 0·003". It is marked by fine, sharp, radiate lines, which are very numerous. These lines are strongest near the margin, which has the form of a broad, thick, raised rim, within which the valve seems to sink and then to rise, the middle part being apparently somewhat convex.

This disc occurs not very unfrequently in one of the Loch Fine dredgings, and more sparingly in one from Lamlash Bay. As no view of it is to be seen except the disc, or S.V., I have not been able to determine its genus, although the disc looks more like that of a filamentous form than a Coscinodiscus.

45. Coscinodiscus nitidus, n. sp. Pl. X., fig. 45. Diameter of disc 0·0012" to 0·0025". Margin entire, transversely striated. Striæ of margin about 16 in 0·001", traceable to some small distance beyond the marginal band towards the centre. Surface of disc marked with distant and irregularly radiate lines of rather large, round, distant cells or granules. The rays are distinctly marked to-

wards the margin, but somewhat confused towards the centre. Puncta or granules larger towards the centre than at the margin. Aspect of valve glassy, puncta nitescent, very much as in *Cocconeis nitida* (fig. 26).

This pretty disc was figured without a name, from an imperfect specimen, in my last paper on the Glenshira Sand (*Trans. Mic. Soc.*, vol. v., pl. i., fig. 50). Having found it tolerably frequent in Lamlash Bay, I now figure a perfect example, which, provisionally, I refer to Coscinodiscus.

46. Coscinodiscus punctulatus, n. sp. Pl. X., fig. 46. Diameter of disc 0·003′ to 0·0036″. It is marked by very fine and obscure lines, which, near the margin, are traceable as rays, but which soon become fainter, and apparently wavy at the same time, as they proceed towards the centre. Over the whole surface are scattered, sparsely, small puncta, which, in a certain focus, appear as points of light.

This disc was also figured, but not named, in my last paper on the Glenshira Sand (*Trans. Mic. Soc.*, vol. v., pl. i., fig. 48); but the specimen here figured is a better one, and shows more of the very obscure structure. It is impossible, in the present state of our knowledge of it, to refer it with certainty to any genus; but it may be a Coscinodiscus. It occurs in Lamlash Bay and in Loch Fine, but is not very frequent. It may possibly prove to be the end view, or the dissepiment, of a Melosira or an Orthosira.

47. Coscinodiscus concavus, Ehr. Pl. X., fig. 47. Diameter of disc 0 0025" to 0 0043". Margin entire, transversely striated. Striæ about 10 in 0 001". Surface concave, covered with large, equal, hexagonal cells, arranged as in a honeycomb.

This beautiful disc occurs rather sparingly both in Lamlash Bay and in Loch Fine. It agrees exactly with one of Ehrenberg's figures of *C. concavus*. But in my last paper on the Glenshira Sand, I have figured another disc (*Trans. Mic. Soc.*, vol. v., pl. i., fig. 52), which differs from the present form in having a punctum in the centre of each cell, and in the margin being formed of very large cells, divided by strong bars, which appear to project from the plane of the valve, and which also extend beyond the outer margin. This disc I at first suspected to belong to some of the Polycystineæ; but I afterwards found it figured by Ehrenberg as *C. concavus*. I confess that I cannot believe these two discs to be of one species; but that represented in fig. 47 seems to be a true Coscinodiscus; and as it is identical with one of Ehrenberg's examples, we may consider it as the true *C. concavus*, leaving the other for farther investigation. (I have recently found, in some of the Clyde dredgings the other disc, just alluded to as having been figured in my paper on the Glenshira Sand, and as being also named by Ehrenberg, *C. concavus*.)

48. Coscinodiscus umbonatus, n. sp. Pl. X., fig. 48. Diameter of disc about 0.0045". Surface densely cellulate, having a broad, nearly flat, marginal zone,

the central portion being almost or quite hemispherical. It is so convex, that, when the marginal zone is in focus, the middle part appears as if full of air. Cells in lines, generally radiate, rather small, irregular in outline, and unequal in size to some extent. As the rays diverge from each other towards the margin, the space is often filled up by a bifurcation of the rays, which gives an aspect of irregularity to the markings.

This fine disc occurs in one of the Lamlash Bay dredgings, in which, however, it is very scarce indeed. We must hope that it will be found in greater abundance. The broad marginal zone or brim, and the very convex middle part, give to it a great resemblance in shape to a "wide awake" hat; but I have named it from its resemblance to a shield with a large boss in the centre.

49. Coscinodiscus centralis, Ehr. Pl. XI., fig. 49. Diameter of disc 0·004" to 0·009", or even 0·01". Surface regularly cellulate. Cells rather small, hexagonal, equal, except at the centre, where there are three large oblong cells, meeting in a point; and between these, a little farther from the centre, three more cells, a little smaller. The valve is remarkably transparent, and from this, and the small size of the cells, it is apt to be overlooked, although, when accurately focussed, the cells are very distinct. It has frequently a yellow or straw colour, in balsam, under the ½-inch objective.

This very beautiful disc is by no means rare in the Glenshira Sand; but when I described that deposit, I was not well acquainted with the discs figured by Ehrenberg, and supposed it to be a form of *C. radiatus*, or else *C. concinnus*. It agrees exactly with Ehrenberg's figure of *C. centralis*. It occurs not unfrequently, both in Lamlash Bay and in Loch Fine, and it reaches occasionally a diameter exceeding that above mentioned.

50. Eupodiscus subtilis, n. sp. (Ralfs.) Pl. XI., fig. 50. Diameter of disc 0·0033°. Surface apparently convex, very hyaline, and very densely marked with fine lines, and indications of minute cells, of which the lines are probably composed. In the centre is a rather large circular spot, and the usual pseudo-nodule of the genus is placed close to the margin.

This disc was first noticed by Mr Ralfs in the early part of this winter (1856–57). He distributed specimens as probably Coscinodiscus concinnus; but when Dr Greville and myself came to examine it with object-glasses of high power and of superior quality, it was soon recognised as an Eupodiscus. This, so far as I know, was first done by Dr Greville. I had frequently observed a disc like it, with very delicate and obscure markings, in some of my dredgings; but it was Dr Greville also who first ascertained that these discs, which I had taken for granted were Coscinodiscus concinnus, were really identical with the disc of Mr Ralfs. As the form occurs in these dredgings, therefore, though less abundantly than in Mr Ralfs' gathering, I figure it here as an Eupodiscus.

51. Campylodiscus centralis, n. sp. Pl. XI., fig. 51. Form orbicular, or nearly so. vol. XXI. PART IV. 6 T

Surface marked with strong canaliculi, which are broad near the margin, narrower towards the centre, near which they terminate in a portion of the middle of the median line; in length about two-fifths of the diameter. At about one-third of the radius, or a little more, from the margin, is a strong shade, probably a ridge or elevation, of a nearly square outline, placed diagonally to the median line, which passes through two of its angles. Half-way from this ridge to the centre is a second ridge of a circular form, inclosing the elongated centre, from which the canaliculi arise. The radiating canaliculi are fainter within the square ridge, stronger outside of it; they diverge as they approach the margin, near which their ends are joined by semicircular loops, forming a scalloped inner margin, beyond which is an entire outer margin. Diameter about 0·0021". Canaliculi about 40 in a disc of that size.

This species occurs very sparingly in one of the Loch Fine dredgings, and none of those I have seen are larger than the one figured. It is probable, however, that it may occur of greater dimensions, as the next species does.

52. Campylodiscus Ralfsii, Sm. (?). Pl. XI., fig. 52. Diameter 0·003" to 0·0045". From orbicular in many instances, but with all the modifications of the genus. From two points in the median line, near its extremities, arise two lines, diverging in the middle, so as to leave a long, narrow, vacant space, the width of which varies from 0·0003" to 0·0005", according to the size of the valve. To these lines the canaliculi reach. These canaliculi are narrow, very short near the ends of the median line, longest in the middle, where they reach a length of from 0·0013" to 0·0017". Near the margin each expands into a small round head, and beyond the line of these heads, the margin is entire. Canaliculi in a disc such as is here figured, 64, curved as they approach the ends, having their concavity turned from the centre. The valve is much undulated.

This fine and conspicuous form first occurred to me in the Glenshira Sand, where it is scarce. I afterwards found it, still scarce, in Professor Allman's Lamlash Bay dredging; and still more recently, I found it frequent in three of the Loch Fine dredgings. I have referred it to *C. Ralfsii*, Sm., although it is so much larger than the form figured by him, and although there are other differences. Thus in *C. Ralfsii*, Sm., the canaliculi reach the median line, and the row of heads or expansions lie some distance from the margin. But these differences cannot be regarded as specific. The smaller variety figured by Smith occurs also in some of the dredgings and in the Glenshira Sand. But the larger form seems to be the typical one, and for that reason, chiefly, I have here figured it.

53. Campylodiscus angularis, n. sp. Pl. XI., fig. 53. Valve orbicular, with the usual modifications. Diameter of disc from 0.0025'' to 0.0039'', the smaller sizes being the most frequent. The canaliculi from 160 to 180 in large examples, such as the one here figured. They are very short at the ends of the median line, and inclose a broad blank space, which, in the median line, occupies the whole

diameter, but in the middle, in a line at right angles to this, extends to less than half the diameter. Hence the canaliculi form a broad marginal band, except near the ends of the median line, where it is narrow; and the vacant space is elliptical, suddenly contracted at the ends to narrow processes, which traverse the band of canaliculi at its narrowest part to the very margin. At the roots of these processes, the canaliculi suddenly recede from the median line. They are much inclined at the extremities; and the longest are from 0.0008° to 0.015° in length. The true median line is visible, and is very delicate; but there are no other markings visible on the vacant middle space.

The surface of the valve, both above and below, that is, near both ends of the median line, is suddenly bent back, so as to form an angle with the rest of the valve. On the surface thus bent, short lines appear, apparently between the canaliculi, which lines terminate abruptly. The greater part of the valve, and especially that part on which are the canaliculi, is convex, which causes the canaliculi to appear curved.

This species is frequent in one of the Loch Fine dredgings, and occurs more sparingly in two others. I have named it from the angular bending back of the valve.

54. Campylodiscus eximius, n. sp. Pl. XI., figs. 54 and 54 b. Form nearly orbicular, and sometimes nearly square, with the usual modifications. I have seen one specimen spiral, like C. spiralis. Diameter of disc from 0·004" to 0·007" or even 0·008". Canaliculi strong, very numerous, about 150 in average specimens; confined to a marginal band, the width of which is generally about 0·0007" or 0·0008". The middle space is pale and hyaline, and at first appears blank; but on close inspection is seen to be covered with pretty large, very transparent, round granules, which are not arranged in any order, but indiscriminately scattered, like the points in shagreen. The median line is marked by a raphe, the ends of which, as of the middle space, do not, as in the preceding species, traverse the band of canaliculi. There is, at each end, a small point of the middle space which indents the marginal band, that being a very little narrower there than it is elsewhere.

This very fine and conspicuous form is very frequent in one Loch Fine dredging, and less so in two others. At first I thought it might be identical with C. Hodgsonii, Sm., of which one example is figured as large as this form. But in his description, Professor Smith describes the middle space as marked by strong radiate lines, formed of large granules; and although I have not seen any of C. Hodgsonii of this large size, yet I find the small ones to agree exactly with this description. Now in C. eximius, not only is the valve in the middle not marked with strong radiate lines, but under a low power it appears at first sight blank; and the very transparent granules are in general quite irregularly disposed, and only in some instances show faint traces of a linear arrangement close to the marginal band. As far as I have been able to judge, I am satisfied that the small

C. Hodgsonii is not of the same species as C. eximius. And with regard to the large C. Hodgsonii of the Synopsis, not having seen it, I am unable to decide. But if it be, as the figure indicates, as strongly marked as the small one, it cannot be C. eximius. If, on the other hand, it should prove to be like C. eximius, then it is probable that it will be found to differ specifically from C. Hogdsonii.

55. Campylodiscus limbatus, Bréb. Pl. XI., fig. 55. Form orbicular. Diameter from 0·005" to 0·008". Canaliculi marginal, short, broad, transversely sulcate, so as to appear, on close inspection, almost moniliform. Within this marginal band is another fainter band (the outer one being strong and black), which looks almost like the reflection in a mirror of the first, except that the bars in it are more decidedly moniliform, or formed of more distinct granules, which, near the median line, extend from both ends towards the centre, in a broad band, which becomes gradually narrower and fainter as it proceeds, and is lost on both sides before reaching the centre. In De Breeisson's figure these projecting bands reach the centre, but I have not been able to trace them so far, and have only done so with difficulty, so far as I have traced them.

This very fine and striking form is not unfrequent in two of the Loch Fine dredgings. About four years ago, I observed a fragment of a large Campylodiscus in a marine gathering from Oban, which was not known to Professor Smith; but I did not describe it, having waited for an entire specimen, which I did not meet with till this last October, when it proved to have been a fragment of *C. limbatus*, which De Brebisson had shortly before figured as occurring at Cherbourg.

GROUP V.

AMPHIPRORÆ.

Of the genus *Amphiprora*, the new species in these dredgings, though not very numerous, are very interesting. One form is very doubtfully referred to this genus.

56. A	Amphipr	ora pusilla, n. sp.	60. A	mphipre	ora obtusa, n. sp.
57.		plicata, n. sp.	61.		maxima, n. sp., G.
58.		elegans, Sm.	62.		(?) complexa, n. sp., G.
59.		lepidoptera n. sp. G.			

56. Amphiprora pusilla, n. sp. Pl. XII., figs. 56 and 56 b. Form of the F.V. nearly rectangular, a little incurved in the middle, and expanded at the extremities. Above each valve lies a plate, in shape like a narrow arc of a very large circle, the convex edge outwards, the middle of it slightly overlapping the central constriction, while the ends coincide with the inner terminal angles of the valve. Length about 0.0027°; breadth, including plates, at the middle, 0.0008°. S.V. lanceolate,

narrow, and, but for the absence of apiculi, a miniature of that of Apr. lepidoptera. (See farther on, fig. 59 b.) Both views, and also the plates, are marked with very fine transverse and parallel strize, which, however, on the F.V. do not extend to the rectangular space between the valves. Strize about 60 in 0.001".

This pretty little species has occurred only in one of the Loch Fine dredgings, where it is rather scarce. It is remarkable for the occurrence of the lateral plates, which we shall find in several other species, and which perhaps ought to constitute a new genus. But the resemblance to Amphiprora is so great in other points, that I do not think it advisable to separate these species from that genus.

57. Amphiprora plicata, n. sp. Pl. XII., fig. 57. F.V. deeply constricted, with rounded extremities, which are very broad. Inner margin of valves straight. On each valve lies a plate extending from the inner margin of the valve to the nodule; its outer or convex margin being a little incurved in the middle, and bent forward at the ends, to join the inner angles of the valve. The rectangular space joining the two valves is marked with faint vertical lines or folds; and the valves and lateral plates, as well as the rectangular space, are all marked by fine transverse striæ, about 50 in 0·001". Length 0·0037"; breadth from nodule to nodule 0·00075", at broadest part 0·0016". Outer margin double. S.V. not yet certainly known.

This species occurs with the preceding, and is equally scarce. It approaches nearest to *Apr. alata*, but differs from it in the folds of the middle space, and in the presence of the lateral plates.

58. Amphiprora elegans, Sm. Pl. XII., figs. 58 and 58 b. Form of S.V. linear-lanceolate, ends obtuse. Valve traversed by two longitudinal lines, and marked by fine but distinct transverse strice. Length from 0.0085" to 0.012"; breadth of S.V. about 0.0011". F.V. rectangular, with two longitudinal lines. Strice 44 in 0.001", parallel.

I have figured the S.V. of this fine form, first noticed by Mr BLEAKLEY, because, although described in vol. ii. of the Synopsis, no figure of it has yet appeared. It occurs both in the Glenshira Sand, and in more than one of the dredgings; but more frequently in one of those from Loch Fine than in any of the others. The valves are, in these deposits, generally detached, so that I have not met with the entire F.V. I am indebted to Mr ROPER for an entire specimen, fig. 58 b.

59. Amphiprora lepidoptera, n. sp. Pl. XII., figs. 59, 59 b, and 59 c. Form of FV. linear, constricted in the middle, expanded at the apices, which are flatly rounded. Length from 0.0055'' to 0.008''; breadth of F.V. in the middle 0.0009'', near the ends 0.0015''. SV. lanceolate, with acute ends, terminating in small apiculi. Central nodule strongly marked; median lines somewhat curved, meeting in the nodule. Striation fine, parallel, about 48 in 0.001''; on the F.V. the strise are absent from the middle space. The form of the F.V. with its long slender alæ, is very elegant.

(Since this paper was read, I have ascertained that the peculiar plates above mentioned in Apr. pusilla, and in Apr. plicata, occur also in this species. I had overlooked them, from their being very narrow. They rise from the inner margin of the valves, as seen on the F.V., from two points a short distance from the extremities. Their convex margin extends in the middle just beyond the constriction. They are so narrow as to be readily overlooked, but are quite distinct, and appear to be thicker at the outer or convex margin than at the inner or plane one. There is even some appearance of a second plate in each valve, rising from the same line, as that just mentioned, but apparently extending in a plane at right angles to the surface of the valve, so that, in the F.V., it is seen foreshortened. and appears as a dark line. But I am not yet satisfied about this second plate.

The plates first named constitute a very peculiar feature, both in this species, and in the two previously described. We shall see the same structure still more developed in another species, a very remarkable one, namely, *Apr. maxima*.)

The form represented in fig. 59 c, I am satisfied belongs to this species; but I do not quite understand its relations. It is of an elegant rhombic-lanceolate form, with two curve-lines on each side, which at the middle bend inwards, to join a strong stauros, interrupting the median line, and at the ends coalesce with the margin. The whole valve is marked with fine parallel striæ, except the stauros. This form, as will be seen, differs considerably from the usual S.V., (fig. $59 \ b$), which latter often occurs with the longitudinal lines in it much more curved than in the example figured. Can the lateral lines in fig. $59 \ c$ be the outer margins of the two plates, above described, or perhaps of those suspected to lie in a different plane?

This species first occurred to me in the Glenshira Sand, and I figured the S.V. as $Apr.\ vitrea,\ \beta$? in my first plate of that deposit ($Mic.\ Jour.,\ vol.\ iii.,\ pl.\ iv.,\ fig.\ 14,$ the larger of the two figures, which shows the curved lines above alluded to, with a third line to the side); and the F.V. in my third plate ($Trans.\ Mic.\ Soc.,\ vol.\ v.,\ pl.\ i.,\ fig.\ 39$). But the former had not the striee, and the latter was from a very inferior specimen, and, besides, did not show the peculiar plates. I have therefore figured both views here from good specimens, which are frequent in Mr Miles's Corallina gathering from Corriegills, near Lamlash Bay. It is at once distinguished from $Apr.\ didyma$ by its much more elegant form, and by being twice as long. The S.V., also, is quite different. I am informed by Dr Greville that he finds this form abundantly, even predominating, in a dredging or gathering from nearly the same locality, which he made early last summer.

60. Amphiprora obtusa, n. sp. Pl. XII., fig. 60. Form of F.V. linear, broad, with rounded ends, slightly incurved in the middle. The termination of the middle space projects a little beyond the general curve of the apices. The inner margin of the striated part of the valve is gently and gracefully curved, forming two concave lines towards the middle, which meet in a point of the inner margin

of the valve, in a narrow, elongated nodule, which is in a line with the terminal nodules, also long and narrow. But close to the outer margin, at the constriction, is another large round nodule. The narrow portions, which lie between the curve-lines just mentioned and the inner margin of the valve, appear, like the middle space, to be unstriated; but perhaps this is because they lie in a different plane from the outer compartments. And even in the last, the strike are too fine to be resolved under a power of 400.

This remarkable form occurs in one of the Loch Fine dredgings, where, however, it is very scarce. I have not yet recognised with certainty the S.V., but there are some forms which may prove to belong to it.

61. Amphiprora maxima, n. sp. Plate XII., figs. 61 and 61 b. Form of F.V. rectangular, very broad, but deeply constricted in the middle, and rounded on the ends. Length 0.0068"; greatest breadth 0.0028" to 0.003", breadth of frustule at constriction 0.0017". Central nodules large, situated close to the constriction in the outer margin. Terminal nodules on the inner margin of valves, conspicuous. Over each valve lies a strong, broad plate, arcuate outwards, straight on its inner margin, which coincides with that of the valve. Outer margin of plate prominent in the middle, and on each side of this prominence slightly incurved; thick, overlapping the valve at the constriction. Breadth from the margin of one plate at this point to that of the other 0.0023". Valves and plates transversely striated. Striæ distinct, parallel, about 36 in 0.001", thicker and apparently coarser at the margin of the plate. S.V. lanceolate, ends acute, with a trace of a constriction just before the apices. Greatest breadth 0.00125". Two strong lines, as in Apr. lepidoptera, proceed from the apices, on one side, and curve inwards to join a large nodule at one-third of the width. Round this nodule the striæ are curved, as if pushed outwards. Between the nodule and the nearest margin the striæ are very short, and they leave a large blank space, extending to the margin. Valve thick and very convex on the S.V. Query, Are the curve-lines on the S.V., the outer margin of the plates, seen on the F.V? From the convexity of the S.V. its striation is more conspicuous than that of the F.V.

This, which is one of the finest and most interesting forms described in this paper, first attracted my attention in the Glenshira Sand. But I could only find there halves of the F.V; and I postponed the description of it. In Professor Allman's Lamlash Bay dredging I again saw these halves occasionally; but it was not till I examined, in October last, the Loch Fine dredgings, that I found, in one of them, besides a number of the same halves, some entire frustules; and finally, the S.V. which, from its comparative narrowness, is seldom presented; the frustule or detached valve lying on its broadest side. There is something very beautiful in the entire form; and in its structure it is peculiarly interesting, as presenting the peculiar lateral plates, already noticed in Apr. pusilla, Apr. plicata, and Apr. lepidoptera, and that in a high degree of development. The occurrence of

these plates in four species, all of which have the general aspect of Amphiproræ, naturally leads to the inquiry, whether this remarkable structure may not be found in all the species of the genus, or whether the forms in which it occurs ought not to form a new genus. I understand from Mr Roper, that he has found this species in a marine gathering from the coast of Wales, or of the south of England.

62. Amphiprora (?) complexa, n. sp. Pl. XII., figs. 62; 62, b; 62, c; 62, d; and 62, e. Form elliptical, broad, with a constriction in the middle, and broadly rounded ends. The frustule is composed of two arcuate and constricted segments, which are broad, thick at the outer margin, thin at the inner margin, and placed opposite each other, with a narrow interval between them. Over the middle of these two lateral segments is placed a complex mass, formed of five or six segments, converging inwards and on the ends, like the segments of an orange or melon. The thick backs of these central segments, marked with transverse striae, are alone seen in the entire frustule, and those of the outer segments approach near to the outer margins of the lateral or flat lying segments, leaving only part of the surface of the latter exposed. A convex line joins the convergent ends of the central segments

When the frustule, as often happens, falls asunder, a number of segments are found lying near each other. Some of these have no constriction, and no nodule; these I take to be the segments of the central mass. Those with nodules at the middle of their outer margin, at the constriction, seem to be the lateral segments.

Length of frustule 0.0035'' to 0.004''; breadth 0.0028''. Segments arcuate, broad; some with a nodule and constriction on the thick convex or outer margin, others without. Surface of segments finely striated; striæ about 45 in 0.01, delicate, radiating from the thin or inner margin, and curved near the ends of the segment. At the margin, there is a row of conspicuous puncta, about 1 for every 2 striæ. The backs of the central segments, when $in\ situ$, are striated, but exhibit neither nodule nor puncta.

It is with much doubt that I refer this very curious form to Amphiprora; which I should not do, were it not that the lateral plates in four species already described may be regarded as the rudiments of the complex central mass in this species. One of the three alluded to, $Ap.\ plicata$, has even longitudinal folds in the middle part.

It is, however probable, that the remarkable structure of this species may render necessary the establishment of a new genus, a step which I do not venture to take without farther inquiry.

This form, like the preceding one, first caught my eye in the Glenshira Sand, where I could find, however, only detached segments, and one half frustule. Not being able, from these, to understand the structure, and not, indeed, perceiving the

connection between the segments and the half frustule, which only showed the backs of the segments, I postponed it with other forms, all of which I have now been able to establish as species. I found the present species tolerably frequent in Mr Milles's Corallina gathering, in which detached segments are much commoner than the entire frustules.

We shall see, farther on, that a similar structure prevails in a numerous section of Amphorae, a few of which were described in my last paper on the Glenshira Sand.

GROUP VI.

AMPHORÆ.

The new forms of this genus in these materials are very numerous, since, in addition to almost all those (ten in number) which I had described in the Glenshira Sand, they have yielded about 32 additional undescribed species. And as I have again to describe and figure four of the Glenshira species, which are now better known, there are in all, 36 species of Amphoræ to be described and figured. As the whole of the British species figured in the Synopsis of Professor Smith amounted only to eight, it appears that the Glenshira Sand, and the Clyde and Loch Fine dredgings, or the latter alone, without the sand, have yielded a five-fold addition to the British forms of this genus. This may serve to show what stores of undescribed forms are yet to be found in our estuaries; for all these have been obtained from two localities, namely, Lamlash Bay and the upper part of Loch Fine, just below Inveraray.

The remarkable group of complex Amphoræ, to which I have lately directed attention, and of which the first known example was A. costata, Sm., though the peculiarity of its structure seems to have been overlooked, has now become so large (one-half of the species here described belonging to it) that it is necessary to subdivide the genus. I shall, therefore describe the Amphoræ in two sub-groups, viz., A. Simple, and B. Complex Amphoræ.

(Since this paper was read, I have ascertained that two of the Amphoræ in the following list of simple species, namely, A. monilifera, and A. spectabilis, belong to the complex division. The latter is indeed one of the most curious of the complex Amphoræ.)

A. Simple Amphoræ.

		*	*		
63. A	mpho	ra turgida, n. sp.			, pellucida, n. sp.
64.		nana, n. sp.	74		lævis, n. sp.
65.		macilenta, n. sp.	78	i	exigua, n. sp.
66.	Chille	angusta, n. sp.	76	3	dubia, n. sp.
67.		binodis, n. sp.	77		truncata, n. sp.
68.	H	ventricosa, n. sp.	78		oblonga, n. sp.
69.		monilifera, n. sp., G	79		robusta, n. sp.
70.		lineata, n. sp.	80		spectabilis, n. sp.
71.		Ergadensis, n. sp.	81		Proteus, n. sp.
72.		lævissima, n. sp.			

6 x

NEW FORMS OF MARINE DIATOMACEÆ.

63. Amphora turgida, n. sp. Pl. XII., fig. 63. Form nearly orbicular, with short, square, produced apices. Detached valves, nearly semicircular, with the vertical margin straight and the extremities capitate. Nodule conspicuous. Length from 0.001" to 000.2"; breadth 0.008" to 0.0015". Valve marked with somewhat coarse radiate striæ. Striæ 24 in 0.001".

This little form occurs in Lamlash Bay, but it is more frequent in one of the Loch Fine dredgings, which, though stony and unpromising in aspect, is yet singularly rich in undescribed species, and especially in Amphoræ. The detached valves or halves of this species, which are like small and very convex Cumbellae. are much more frequent than the entire frustule.

64. Amphora nana, n. sp. Pl. XII., fig. 64. Form a narrow, linear-elliptic. Inner lines lying very near the ventral margin of valves, and nearly straight. Nodules small; near the ventral margin. Rectangular middle space very narrow. Length 0.001" to 0.0016"; breadth 0.0004" to 0.0005". Striæ about 50 in 0.001".

This small species occurs with the last, and is tolerably frequent.

65. Amphora macilenta, n. sp. Pl. XII., fig. 65. Form elliptic, long and narrow, contracting towards the ends, which are again slightly expanded, and terminate so that it has very short, square, produced ends. Valves very slender, arcuate on dorsal margin, straight on ventral. Middle space narrow, with a strong median line. Length 0.0018" to 0.0022"; breadth of entire frustule 0.0005" to 0.00086". Striæ parallel, rather coarse, about 30 in 0.001".

This species occurs with the two preceding, and is not at all unfrequent.

66. Amphora angusta, n. sp. Pl. XII., fig. 66. Form nearly rectangular, or rather linear-elliptic, narrow, truncate at the ends, so as to form a slender and somewhat elegant barrel shape. The inner curve-lines arise in each half or valve from the outer angle, and meet in a nodule situated half-way across the valve. Both valves are transversely striated across, up to the narrow rectangular space in the middle. Length 0.0015"; breadth of entire frustule 0.0004". Strice fine, about 44 in 0.001".

This species occurs with the preceding ones, chiefly in the Loch Fine dredging above specified, where it is not very rare.

67. Amphora binodis, n. sp. Pl. XII., fig. 67. Form linear, with rounded apices, and two expansions half-way between the middle and the ends, between which it is deeply constricted. Length from 0.00175" to 0.002"; greatest breadth about 0.0005''; breadth of narrow parts 0.0003''. Rectangular middle space narrow. The detached halves or valves, having the ventral margin straight, and two large rounded expansions, while the ends are linear, much resemble the frustules of Eunotia Camelus, as described by Professor Smith in vol. ii. of his Synopsis, and figured by Dr Greville in the Annals of Natural History; but the expansions are smaller and more rounded than in E. Camelus. The inner lines

run nearly parallel to the outer margin of the valve, but are less curved, and generally obscure. Striæ transverse, obscure, about 30 in 0.001".

This very curious little form occurs by no means unfrequently in Professor All-MAN's dredging from Lamlash Bay, and more sparingly in the Loch Fine dredging alluded to under A. turqida. The resemblance of the detached valves to Eunotia Camelus has been mentioned. The entire frustule also resembles amini ature of A. angularis, Greg., figured by me in my first paper on the Glenshira Sand. (See Micr. Jour., vol. iii., pl. iv., fig. 6.) But besides the much smaller size of A. binodis, the expansions in A. angularis are more angular; indeed, the figure represents them less so than they are; and the striation of A. angularis is not only distinct, but very much coarser, so that the whole aspect of the two forms is different.

68. Amphora ventricosa, n. sp. Pl. XII., fig. 68 and 68 b. Form linear-lanceolate, with obtuse apices, more or less expanded in the middle. Valves long. very slender, arcuate, with acute ends, marked with somewhat coarse transverse striæ. Length from 0.0023" to 0.0035"; greatest breadth at the expansion in the middle 0.005" to 0.008". Inner lines generally obscure, but in some cases well seen. They arise from the inner angle of the valve, pass rapidly across, and, as shown in fig. 68 b, sometimes extend beyond the outer margin; then suddenly bend inwards to meet the obscure nodule near the inner margin. Rectangular middle space narrow. Striæ strong, about 22 in 0.001"; conspicuous.

This pretty and interesting species occurs not unfrequently both in Professor ALLMAN'S dredging from Lamlash Bay, and in the Loch Fine one so often alluded to above. The detached valves resemble a very long and slender Cymbella, as may be seen in fig. 68, in which the form of the valve is plainly seen on each side of the frustule. By focussing, a transverse bar, or elongated nodule, may be seen in the middle of the valve; but it is obscured by the striæ, when they are in focus.

69. Amphora monilifera, n. sp. Pl. XII., fig. 69. Form elliptic, slightly recurved at the apices, which form very short produced extremities. The recurved ends of the valves do not meet, and the space between them is filled up by a transverse curve-line. Valves arcuate, very convex on dorsal margin, with recurved ends. Nodules on the ventral margin. Between the valves the frustule is marked by three to five longitudinal rows of distant round granules, giving to it a dotted aspect. If there be transverse striæ, they are very obscure. Length from 0.0017" to 0.0026"; breadth from 0.0008" to 0.0011".

This pretty and well-marked species is tolerably frequent in the two dredgings mentioned under the last form, but chiefly in that from Lamlash Bay. It occurs also very sparingly in the Glenshira Sand, as may be seen by referring to my last plate (Trans. Mic. Soc., vol. v., pl. i., fig. 53). I had figured, from that deposit, an imperfect specimen, which at first I took for an Amphora, but subsequently supposed to be possibly not Diatomaceous. The Lamlash Bay dredging soon cleared up this point, and established it as a distinct species of *Amphora*.

(Since the preceding description was written, I have ascertained that this species belongs to the complex group. Like the other complex species, it is formed of a number of Cymbelloid segments, arranged like the segments of a melon, as will be more particularly described farther on, in some of the other species. The convergent longitudinal lines of dots prove to be the dotted backs of the central segments. I have not been able to find a detached segment, the frustule being usually entire, so that I cannot give a figure of the segment. I can see, however, that it has the form of a Cymbella.)

70. Amphora lineata, n. sp. Pl. XII., fig. 70. Form elliptic or elliptic-lanceolate, with short, produced apices, which are truncate. The valves are slender, arcuate on the dorsal, straight on the ventral margin. The nodules lie in the middle point of two strong lines, slightly curved, within the ventral margin. Outside of the nodule is another curve-line, dividing the valve longitudinally into two parts, the outer one being the broader. This outer portion is marked by fine longitudinal lines, of which there are generally four in each valve. The rectangular middle space is narrow, and has a sharp line down the middle. This line, with the inner margins of the valves, the slightly curved line with the nodule, the line beyond it, and the four exterior lines, give to the whole a lineate aspect, which is very characteristic. In certain views, the frustule appears lineate uniformly from one side to the other. Length from 0.0022° to 0.003"; breadth of frustule 0.0007" to 0.008". The whole frustule is marked with transverse parallel striæ, which are fine, about 42 in 0.001", and obscure, except at the margins, where they may generally be distinctly seen. As the longitudinal lines, however, are much more conspicuous, it is they which characterize the species.

This species is not unfrequent in the dredgings so often mentioned, and occurs also in the Glenshira Sand. In my last paper on that deposit, I described and figured it (Trans. Mic. Soc., vol. v., pl. i., fig. 33). But by some mistake of mine, the form there figured was either not a characteristic specimen, or, more probably, a form of A. salina. I have therefore described it anew, and given, in fig. 70, an accurate representation of a very frequent size and shape of this species.

71. Amphora Ergadensis,* n. sp. Pl. XII., fig. 71. Form elliptic-lanceolate, narrow, with truncate apices, which are very slightly expanded. Valves in apposition, or nearly so, long, slender; the inner lines, on which lie the conspicuous central nodules, forming one gentle curve from one end of each valve to the other. Length about 0.0035"; breadth in the middle 0.00075". The valves are marked by strong and conspicuous transverse striæ, about 24 in 0.001".

This form, like most of the preceding Amphoræ, occurs both in Lamlash Bay and in Loch Fine; but it is not so frequent as most of the others. It is conspicuous from its length.

72. Amphora lævissima, n. sp. Pl. XII., fig. 72. Form elliptic, rather narrow, ends subtruncate. Aspect remarkably hyaline. Length 0·0025" to 0·003"; breadth 0·0009". The inner lines in each valve rise from the inner angles, bend suddenly outwards for a short distance, then gently inward to the nodule, leaving a very narrow inner compartment at each end. The middle of each valve is traversed by a strong bar or elongated nodule. The valves are transversely striated, but the striæ are so fine, and the valves so hyaline, that the striation has not yet been perfectly resolved.

This delicate species is not very rare in the Loch Fine dredging noticed under A. turgida as rich in Amphoræ. But the detached valves are much more frequent than the entire form. These detached valves have a resemblance in form to the valve of A. elegans, figured in my last paper on the Glenshira Sand (Trans. Mic. Soc., vol. v., pl. i., fig. 30). But A. elegans is a considerably larger form, and not particularly hyaline; while its striæ are much less fine, and thus easily seen.

73. Amphora pellucida, n. sp. Pl. XII., figs. 73 and 73 b. Form a broad oval. Length from 0.002" to 0.003"; breadth from 0.0012" to 0.0018". Valves arcuate, very convex on the dorsal, slightly concave on the ventral surface. There is something very peculiar in the aspect of the terminal parts of the inner margins of the valves, as these coincide with the terminal nodules, which, from the delicacy and transparency of every other part of the inner margin of the valve, appear to project like horns, as the nodules not only coincide with the ends of the inner margin, but are narrow and much elongated. The inner lines follow the margin for a little, then bend rapidly outwards, and then as rapidly inwards to the central nodule on the ventral margin. The ventral margin, except at the nodules, is so hyaline as to be seen only on close inspection, as are also the spaces lying between it and the inner curve-lines. The space outside of these latter curve-lines is striated, the striæ rather coarse; but the whole is so hyaline, that the striæ are only seen on very close inspection, when they come out plainly. They are somewhat inclined, thicker and more easily seen at the outer margin, very delicate and nearly invisible towards the inner one, and about 30 in 0.001". There is a narrow, rectangular space between the two valves. Sometimes the form of the frustule becomes nearly rectangular, but all its other characters continue as before.

The form of the valves, as well as of the entire frustule, in this species, is somewhat similar to that of A. ovalis. But, not to dwell on the marine habitat of A. pellucida, its very hyaline aspect, and the singular delicacy of the striæ, which are entire, and, towards the nodule, become so fine as to be hardly visible, effectually

^{*} From Ergadia, Argyll.

distinguish it from that species, in which the strize are conspicuous and moniliform.

This species is not unfrequent in the Loch Fine dredging mentioned under A. turgida. It has some resemblance, in the form of the valves, to A. incurva, Greg. figured in my first paper on the Glenshira Sand (See Mic. Jour., vol. iii., pl. iv. fig. 5). But in A. incurva the striation is conspicuous, not hyaline, and the form of the valve is more elongated, and less projecting at the extremities. I am not yet acquainted with the entire frustule of A. incurva.

74. Amphora lævis, n. sp. Pl. XII., figs. 74, 74 b, and 74 c. Form of frustule rectangular, slightly incurved in the middle, sometimes with the ends rounded, but more commonly with nearly square ends. Length from 0.0017'' to 0.003''; breadth from 0.0007'' to 0.0012''. Aspect very hyaline. In each valve the inner curve line, rising from the inner angle of the valve, and following the margin outwards, bends inwards again in a long graceful curve to the central nodule placed just within the ventral margin. The nodule extends as a strong bar across the middle of the valve. The outer compartments are transversely striated, but the strike are very fine, about 60 in 0.001'', very hyaline, and hardly to be seen with a power of 400.

I have added, in fig. 74 d, the figure of a fine Amphora, which probably belongs to this species. It is remarkable for the fact, that the curve line coincides with the outer margin till very near the middle, where it bends inwards to the nodule. There are also four longitudinal lines at considerable and equal distances. In this specimen, I have not seen the strike as in the others; but believing it to be of the same species, I give the figure under the head A. lævis.

This species occurs with the last, and is more frequent, though by no means abundant. It frequently happens, as in one of the figures, that the valves are in apposition; and as this occurs in long examples, these become proportionally narrow.

75. Amphora exigua, n. sp. Pl. XIII., fig. 75. Form linear-elliptic, narrow, with somewhat obtuse ends. Length from 0·0015" to 0·0022"; greatest breadth about 0·00035". The valves are transversely striated, the strike being strongest at the margin. Strike about 28 in 0·001".

This little form occurs, scattered, both in Lamlash Bay and Loch Fine. In size and form it approaches nearest to A. lineata (Pl. XII. fig. 70); but its markings are totally different. It has no striking characters, but I cannot refer it to the same species with any of the small Amphora I have here described.

76. Amphora dubia, n. sp. Pl. XIII., fig. 76. Form of entire frustule oval, flattened, or even a little incurved, on the sides. The valves are concave in the middle of the ventral margin; so that as they are in apposition, there is a longish rhombic opening in the middle, between them. They also diverge a little at the apices. Within each valve is a faint line, nearly parallel to the outer margin.

but lying nearer to the inner margin. On these lines are faint nodules, while at the middle of the inner margin there are distinct nodules. Length 0.0025"; breadth 0.0011". The whole is marked by transverse striæ, which also traverse the openings between the valves, in which openings a median line is also visible. Striæ fine, subdistant, about 24 in 0.001". The divergent extremities are joined by a convex curve line.

This very peculiar species occurs, but very sparingly, in Lamlash Bay. It has some analogy with A. marina, a form lately figured by Professor Smith, in the Annals of Natural History (January 1857, vol. xix., pl. i., fig. 2.) But besides the coarser striation and distinct nodules of A. dubia, Professor Smith describes A. marina as so much resembling A. affinis, that it has been confounded with that species on our coasts. Now A. dubia has no resemblance whatever to A. affinis, nor indeed to any other known species; so that I have some doubts as to its being really an Amphora. The figures of A. marina given by Professor Smith are not satisfactory, for they do not at all resemble A. affinis.

77. Amphora truncata, n. sp. Pl. XIII., fig. 77. Form of frustule slightly barrel-shaped, broad, with truncate ends. Length about 0·0028"; breadth about 0·0017". Valves arcuate on dorsal, straight on ventral margin. Inner curve lines arise from the terminal margin, and bend gently inwards to a small nodule, rather nearer the inner than the outer margins. Inner margin of valve marked by a longitudinal line of short transverse striæ. In the rectangular space between the two valves, which is broad, are two similar longitudinal lines of short striæ, near to, and parallel to those just mentioned, and between the two last-named lines or bars are traces of others. Valves transversely striated, but the striæ are more conspicuous on a band at the outer margin, than elsewhere. So that the frustule appears, at least in a certain focus, marked with longitudinal striated bands, formed of short striæ.

This species is not very rare, in either of the two gatherings so often named in connection with Amphorae. It frequently happens, that the line joining the ends of the valves appears to be interrupted in the middle. But by careful focussing it may be seen.

The appearance of longitudinal striated bands on the middle part of the frustule seems to indicate a tendency in this species to the complex structure. Indeed, among the complex species there is one, A. quadrata, which has considerable analogy with the present form.

78. Amphora oblonga, n. sp. Pl. XIII., figs. 78, and 78 b. Form linear elliptic, rather broad, the ends obtusely acuminate. Length from 0·0034" to 0·004": breadth from 0·001" to 0·0014". The inner curve lines are strong and much curved, but they keep unusually near the outer margin of the valve, only in the middle projecting rather more than half way across. The central nodules, which are conspicuous, are situated outside of the curve lines, and nearer to the outer

margin. Valves transversely striated. Striæ about 24 in 0.001″, conspicuous. The portion of the valve outside of the curve line seems to be in a plane different from that of the inner portions, and the striæ on the latter are radiate.

This well-marked and conspicuous species, remarkable for the position of the central nodules, is by no means rare in one of the Loch Fine dredgings, in which, except this form, *Campylodiscus angularis*, and *C. Ralfsii*, but few forms are found. It occurs more sparingly in some of the other dredgings.

79. Amphora robusta, n. sp. Pl. XIII., figs. 79, 79 b, and 79 c. Form of frustule a broad oval with subtruncate extremities. Length from 0.0033 to 0.0048, occasionally even as much as 0.006. Breadth from 0.0018" to 0.0024". Valves arcuate, with the ends more or less obtuse; ventral margin straight or slightly concave. Inner curve lines very sharp and strong, rise from the inner angles, pass outwards, without reaching the outer margin, and bend suddenly inwards to the central nodules, which are within the ventral margin, by one-fifth of the width of the valve. In some specimens, or perhaps in a certain focus, the points where the two curve lines meet in the middle is on the inner side of a straight line, apparently forming the inner margin of the valve, so that a small blank triangular space is included between that straight line and the ends of the two curve lines. This produces a very peculiar aspect. Frustule thick, marked with strong striæ, which on the compartments outside the curve lines are transverse, but on the inner terminal compartments are somewhat radiate. Striæ subdistant, moniliform, about 16 in 0.001". Figs. 79 b, and 79 c, represent two valves, in one of which the curve lines are seen, while it is evident that the inner compartments are in a different plane from the outer one. The other shows the entire valve viewed in a different focus. in which the striæ appear all in one plane.

This fine form, conspicuous for its size and the stoutness of its aspect, is not rare in the Loch Fine dredging mentioned under A. turgida, and occurs also in Lamlash Bay.

80. Amphora spectabilis, n. sp. Pl. XIII., figs. 80, 80 b, and 80 c. Form nearly rectangular, broad, with rounded angles; occasionally sub-elliptic. Length from 0·003" to 0·0047"; breadth from 0·002" to 0·0025". The inner curve lines bend inwards from the outer margin very nearly to the inner margin of the valve, dividing the valve into a middle outer compartment, and two terminal inner ones. The detached valve has prominent obtuse rostra or beaks, not seen in the entire form. Outer compartment transversely striated, the striation being very coarse; inner compartments marked with radiate striæ, which are much finer. Aspect of the whole form soft and indistinct, so that in general only the marginal ends of the striæ in the outer compartments are easily seen, these striæ being thicker at that end, and the frustule very convex. Even at the margin they are not sharp but softened. Striæ in the outer compartment 14 to 16 in 0·001": in the inner ones, 26 in 0·001", and very obscure. As in the last species, and indeed in many Am-

phoræ, the inner compartments seem to be in a different plane from the outer ones. This species exhibits two frequent varieties, both smaller than the typical form, which are figured (figs. 80 b, and 80 c). One is long and narrow, its length being 0.0032'', its breadth hardly 0.0008''. The other is short and broad; its length being 0.002'', and its breadth 0.001''. Both have the soft, hazy, indistinct aspect of the larger form, and both, when carefully examined, exhibit the same characters, except that the striation is perhaps somewhat finer.

(Since the above was written, I have found that this species not only belongs to the complex group, but is one of the most interesting forms in that group. As will be seen in the descriptions of various complex Amphora, the complex structure is only seen in one focus, while in another, the frustule exhibits the characters of a simple Amphora. This is peculiarly the case in A. spectabilis. The simple view, shown in fig. 80, is so thoroughly simple, that it never occurred to me that it could possibly conceal a second and more complex structure. But when I happened to examine, under a rather high power, and with oblique light, a frustule well placed for bringing out this structure, I detected the appearance shown in fig. 80 d. In this case, the coarse transverse striæ of the middle part, as seen in fig. 80, were still traceable, at the margin only, on one side, because the frustule did not lie quite flat. In other examples, no such traces are visible on the complex view, although in general the very strong and elongated central nodules shine through. In fig. 80 d, it will be seen that the whole frustule is composed of parallel, longitudinal, very slightly convergent bars, with a narrow sulcus between each two bars. These bars are transversely striated, and the strize, though much finer than even those of the inner and terminal compartments of the valves, are yet quite distinctly seen, even more so than the others, being apparently free from the haziness above alluded to. Striæ of the bars, in this view, about 50 in 0.001".

In this remarkable form we have the unusual occurrence of three distinct systems of striation; 1st, The coarse, soft, and hazy transverse striæ of the outer and middle compartments of each valve, on the simple view, fig. 80; 2dly, On the same view, the finer and radiate striæ of the two terminal inner compartments of each valve, which lie in a plane inclined to that of the middle compartments; and, 3dly, The still finer and parallel striæ crossing the longitudinal bands, in the complex view, fig. 80 d, which lie again in a different plane. The frustule is also remarkable for its convexity, which is probably the cause, or one chief cause, of the indistinctness of the markings on the simple view.)

This beautiful species is tolerably frequent in Professor Allman's dredging from Lamlash Bay, and in one from Loch Fine, less so in the other dredgings. The short variety is even more frequent than the typical form. The species has some resemblance to the preceding one in general form and coarseness of striation. But it is at once recognised by its hazy indistinct aspect, by the finer

striation on the inner compartments, by the beaked form of the detached valves, and finally, by its varieties. (Its complex structure, and its three systems of striæ, are even more decisive characters.)

81. Amphora Proteus, n. sp., Pl. XIII., figs. 81, 81 b; 81 c; 81 d; and 81 e. Form very variable, obtuse lanceolate, elliptical, barrel-shaped, broad and truncate, long and narrow, &c. It has usually the rectangular space between the valves, but sometimes the valves are in apposition, and then resemble twin frustules of Cymbella. Some of these modifications are figured. The size also varies prodigiously. Length from 0.0015" to 0.006"; breadth from 0.0013 to 0.0024". The broadest examples are generally short. Valves acute, sometimes with arcuate, at other times with obtuse apices. Inner curve lines and nodules strongly marked, and inner compartments of the valve in a different plane from the outer ones. There are two peculiarities which are found in all specimens, from the smallest to the largest. When the outer compartment is in focus, and its striæ conspicuous, the striæ of the inner compartments appear in narrow lines or bars, separated by white longitudinal lines or raphes; and the transverse strice, which are finely moniliform, are, especially, in a certain focus, traversed by longitudinal wavy lines or striæ, produced by the circumstance that the granules of contiguous transverse striæ are not placed exactly opposite each other. In figs. 81 and 81 b, the same specimen, a long one, is shown as it is seen in two different foci, one of which brings out the curve lines and nodules, the other the transverse striæ, which extend across the whole valve. These striæ are about 22 in 0.001"; but in regard to the number of striæ there are very great variations in this species, as I have shown, in former papers, to occur in other species. In some of the smaller specimens the strize are at least twice as numerous as in some of the larger, and even in the specimens of equal size they differ in this respect. But in all, the strize exhibit the characters I have mentioned as peculiar and characteristic.

(I must here state, however, that there are some forms which, for the present, I include under A. *Proteus*, respecting which I have great doubts whether they ought not to form a distinct species. These forms have many characters in common with A. robusta, but have uniformly a much finer striation, and consequently a very different aspect.)

This species is very frequent in Lamlash Bay, and also in some of the Loch Fine dredgings. At first I was quite at a loss with the multitude of forms agreeing in striation, but when I had observed the characters above mentioned, I was able to trace all these forms into one another by gradual transition. Those here figured are some of them very different; but intermediate forms occur. One of the figures represents two valves in apposition, which I suspect to belong to this species (fig 80, e); but I am not quite certain about that one.

I may here direct attention to the fact, that such a form as that shown in fig. 81 e, resembles closely a twin frustule of a Cymbella or Cocconema. Yet it is con-

sidered as only a single frustule, while the Cymbella or Cocconema would be called a double one.

I confess I feel disposed to consider both in the same light, as double forms. If that be correct, then what is usually called the valve of an Amphora will be an entire frustule, and what is usually called the entire frustule (as in figs. 63 to 72, for example) will be considered as two frustules in the act of self-division, but still united by the connecting membrane.

One reason why I incline to this view is, that what, on this principle, are to be called single frustules, which are now regarded as halves or single valves, are often much more frequent than the entire, or, as I should say, double frustules. We never see the halves of Naviculæ separated in this way. Secondly, Each single valve, or as I should say frustule, has three nodules; but the entire or double frustules have six. Thirdly, In Amphoræ, the two halves of the double or entire frustule are almost always separated by a rectangular space, apparently homologous with the connecting membrane, which is seen in other genera when in a state of self-division. When this is absent, as in fig. 81 e, or in fig. 76, the form has exactly the appearance of a twin frustule of Cymbella. Lastly, If we regard the so-called valves as entire frustules, they become perfectly analogous, in general form and structure, to Cymbellæ or Cocconemata; and we shall find, in the remarkable group of Complex Amphoræ, next to be described, that the segments in many species, indeed in most, have a still greater resemblance to Cymbellæ or Cocconemata.

Let us now consider that group.

B. Complex Amphoræ.

Of this sub-group, as I have already stated, there are, in these materials, as many as of the simple group just described. These species are as follows:—

	1 0	1 0		on en o cer	, 10110 11 0 1	
82.	Amphora	lyrata, n. sp.	92.	Amphora	sulcata, Breb.	
83.		Milesiana, n. sp.	93.		acuta, n. sp.	
84.		elongata, n. sp.	94.	to the firm to	crassa, Greg.	
		quadrata, n. sp.	95.		pusilla, n. sp.	
86.		excisa, n. sp.	96.		granulata, n. sp.	
87.	11111	nobilis, n. sp., G.	97.			
88.	•••	Arcus, Greg.	98.			
89.		Grevilliana, Greg.	99.		costata, Sm.	
90.		complexa, n. sp.	100.		bacillaris, n. sp.	
91.	MINNE.	fasciata, n. sp.	en connomical de la connomica		ranta più 10 - m	
	83, 84. 85. 86. 87. 88. 89.	82. Amphora 83 84 85 86 87 88 89	82. Amphora lyrata, n. sp. 83 Milesiana, n. sp. 84 elongata, n. sp. 85 quadrata, n. sp. 86 excisa, n. sp. 87 nobilis, n. sp., G. 88 Arcus, Greg. 89 Grevilliana, Greg. 90 complexa, n. sp.	82. Amphora lyrata, n. sp. 92. 83 Milesiana, n. sp. 93. 84 elongata, n. sp. 94. 85 quadrata, n. sp. 95. 86 excisa, n. sp. 96. 87 nobilis, n. sp., G. 97. 88 Arcus, Greg. 98. 89 Grevilliana, Greg. 99. 90 complexa, n. sp. 100.	82. Amphora lyrata, n. sp. 92. Amphora 83 Milesiana, n. sp. 93 84 elongata, n. sp. 94 85 quadrata, n. sp. 95 86 excisa, n. sp. 96 87 nobilis, n. sp., G. 97 88 Arcus, Greg. 98 89 Grevilliana, Greg. 99 90 complexa, n. sp. 100	82. Amphora lyrata, n. sp. 92. Amphora sulcata, Breb. 83

The first species of this group which was figured was A. costata, Sm. But the remarkable peculiarity of its structure was not specially noticed. I subsequently noticed several species in the Glenshira Sand, in which the complex structure had attracted my attention, such as A. Arcus, A. Grevilliana, and A. crassa, which I described and figured. I also pointed out that the same structure occurs in A. costata, Sm. In the new materials, besides acquiring a more accurate knowledge of the three new species just named, all of which I here figure a second

time, I have found a considerable number of new species, exhibiting the same peculiarities of structure.

The general character of all these species is, that the frustule is very convex, and formed, in the first place, of two segments or valves, in shape like Cymbellæ or the halves of simple Amphoræ, placed opposite each other, as in the simple species. The middle space between these is, in the next place, covered, to a greater or less extent, by a complex mass, like that seen in Amphiprora complexa, (fig. 61), and exhibiting, when the two lateral segments lie flat, a series of convergent longitudinal bars, which are the backs of other segments, grouped like those of an orange or a melon. The lateral segments exhibit all the characters of the halves of a simple Amphora; they have the inner curve lines and the nodules, in some cases elongated so as to form a cross bar. The segments forming the central mass appear to have neither curve lines, nor nodules, nor bars. The lateral segments are transversely striated, and the bars of the central mass, or backs of the central segments, are frequently also marked by transverse striæ; but in other cases have much coarser markings, approaching more to the nature of puncta or granules. In some species again, while the margins of the lateral segments are very coarsely marked, the backs of the middle segments are much more finely striated. In general, when the frustule lies so, that the two lateral segments are flat or nearly so, we see in one focus the lateral segments with their curve lines and nodules, while in another focus these become invisible, and the convergent bars alone are seen, which in many cases fill up the whole space between the lateral segments, of which only a part, that nearest the outer margin, can then be seen. This is shown in several of the figures.

This structure is so peculiar, that it seems as if it would be desirable to establish a new genus for the reception of these forms. But the form of the segments is so exactly that of the valves (or frustules) of simple Amphoræ, and even the entire complex forms, in a certain focus, are so like the others, that I think it will be sufficient to make a sub-genus for the complex forms.

I have already mentioned that some of these forms occur in the Glenshira Sand; others, as well as these, are found in the dredgings from Lamlash Bay. But by far the larger part of the complex species here described are to be found in that one Loch Fine dredging spoken of under A. turgida, as being rich in Amphoræ. Of the above list, thirteen species at least, along with A. costata, besides fourteen or fifteen of the simple group, occur in this one dredging, and several of these are found in it alone. It will be unnecessary to repeat this in detail for each species; and I shall briefly refer to Loch Fine as the locality of the species here alluded to as occurring in that particular dredging.

82. Amphora lyrata, n. sp. Pl. XIII., fig. 82. Form doubly lyrate, with truncate ends, and a notch in the middle, on each side, where the two lyrate halves meet base to base. The lateral segments have each a strong bar or elon-

gated nodule in the middle. Bars between the lateral segments four or five. Length 0.0011"; breadth 0.00075". The whole form is transversely striated; strike distinct, about 36 in 0.001".

This pretty little form is not very rare in the Loch Fine dredging above mentioned, as containing most of the complex *Amphoræ*. I have seen it also in Lamlash Bay.

83. Amphora Milesiana, n. sp. Pl. XIII., fig. 83. Form nearly rectangular, with a constriction in the middle, and subtruncate ends. The sides are very slightly convex. There are several longitudinal bars between the lateral segments. Length 0.0023°; breadth 0.001°. The whole is transversely striated; striæ about 28 in 0.001°, conspicuous.

This species occurs with the last, both in Loch Fine and in Lamlash Bay.

84. Amphora elongata, n. sp. Pl. XIII., fig. 84. Form elliptic lanceolate; long, narrow, with truncate extremities. Length 0.0044° ; breadth 0.0011° ; Lateral segments very narrow; curve lines very near the outer margin. There are six bars in the middle, convergent on the ends. Striæ conspicuous, transverse, about 26 in 0.001° .

This species occurs both in Lamlash Bay and in Loch Fine. It is not frequent, nor yet very scarce.

85. Amphora quadrata, n. sp. Pl. XIII., fig. 85. Form nearly rectangular; the sides slightly convex, broad, ends truncated, as in A. truncata. Length about 0·0027°; breadth about 0·0018". Lateral segments arcuate on the dorsal, straight on the ventral margin. Between them are about six broad vertical striated bars, which are not, as in the preceding forms, in apposition, but which are somewhat distant, being separated by narrow raphes. The structure, therefore, differs in some respects from that of the other complex species. The lateral segments and the vertical bars are transversely striated; striæ about 34 in 0·001".

This species occurs both in Lamlash Bay and in Loch Fine, and is not very rare.

86. Amphora excisa, n. sp. Pl. XIII., fig. 86. Form rectangular. The curve line in each lateral segment keeps near the outer margin, except in the middle, where it bends inward to a nodule; but outside of this nodule is another, larger and more conspicuous, situated on the outer margin, which appears deeply notched at this point. Length 0·0025" to 0·004"; breadth 0·0015" to 0·0018". There are a number of longitudinal bars, convergent at the ends. The whole form is hyaline, and marked with very fine transverse striæ, which are best seen, though with difficulty, at the outer margin. Striæ about 52 in 0·001".

This fine species occurs in Lamlash Bay, where it is not unfrequent. It is also found more sparingly in Loch Fine.

87. Amphora nobilis, n. sp. Pl. XIII., fig. 87. Form barrel-shaped, broad, ends truncate. Length from 0.003" to 0.0045"; breadth, 0.0013 to 0.0028". Lavola XXI. PART IV.

teral segments arcuate, ends acute, inner curve-lines strongly curved, nodule elongated into a transverse bar. The converging bars in the middle are numerous, in apposition, and the whole frustule very hyaline. It is marked by fine transverse striæ, easily seen on the lateral segments, and which may also be traced, by careful manipulation, across the whole frustule. Striæ about 40 in 0.001°.

I first observed this fine and conspicuous form in the Glenshira Sand, but postponed the description of it that I might examine it farther. I have found it more frequently in Lamlash Bay and in Loch Fine.

88. Amphora Arcus, Greg. Pl. XIII., fig. 88. Form of entire frustule barrelshaped, ends truncate. Segments arcuate, sub-apiculate, marked by coarse moniliform striæ, which are also seen over the entire form. Length from 0.0035'' to 0.0045''; breadth about 0.002.'' Striæ 16 or 18 in 0.001''. The longitudinal bars in the middle between the lateral segments are about 16 or 17, closely set, and we can see that they are segments seen edgewise.

This fine form was rather frequent in the Glenshira Sand, but was only then known in the shape of detached segments, two of which I figured in my first paper on that deposit (*Mic. Jour.*, vol. iii., pl. iv., fig. 4), without at that time understanding its real structure. Subsequently I recognised the entire frustule in the Glenshira Sand, and also in the dredgings from Lamlash Bay. In my third paper I figured an imperfect specimen (*Trans. Mic. Soc.*, vol. v., pl. i., fig. 37), and I now give a more perfect one, which shows that it really belongs to the complex group. See fig. 88.

89. Amphora Grevilliana, Greg. Pl. XIII., fig. 89. Form of entire frustule nearly oval, broad, slightly truncate at the extremities, which are broad, the line joining the apices of the lateral segments being concave, so that a short process stands out at each side. Length about 0·006"; breadth about 0·002". In the specimen figured (fig. 89) the form of the lateral segments is perfectly seen, probably because the frustule is viewed from the flat side, as we view an orange cut in half from the cut side. These segments are precisely like that figured in my last plate from the Glenshira Sand (Trans. Mic. Soc., vol. v., pl. i., fig. 36*). They are broad, arcuate, with somewhat acute rostra, and three curve-lines on their surface, which are peculiar to this species. They are marked with strong transverse moniliform striae. Striae about 28 in 0·001". Between the lateral segments are five or six convergent bars, which are the backs of other segments, and which are in apposition, except at the ends, where they diverge a little, from their apices becoming suddenly narrower.

This fine species occurs both in the Glenshira Sand and Lamlash Bay. But the entire frustule given under this name in the plate just referred to (at fig. 36) does not belong to this species, as may be seen at once by comparing it with fig. 89, and by the form of its segments, as seen in that figure. The segment in that plate, fig. 36*, is correct, as above stated.

The form figured in my last plate, at fig. 36, as the entire A. Grevilliana, is a new species, to which I now proceed.

90. Amphora fasciata, n. sp. Pl. XIII., fig. 90. Form of entire frustule barrel-shaped, that is, gently convex on the sides, broadly truncate on the ends. The form of the lateral segments, as well as that of the inner curve-lines, is well seen at the sides. Length about 0.005"; greatest breadth about 0.0023". Between the lateral segments are seven or eight converging bars, separated by very narrow raphes; these are the backs of other segments. The detached segments are arcuate on the dorsal margin, nearly straight on the ventral margin, with acute ends. They have only one curve-line, bending forward in the middle to the nodule, which is near the ventral margin. Striæ about 34 in 0.001", conspicuous.

This fine and conspicuous form is not unfrequent in the Glenshira Sand, and occurs also sparingly in Lamlash Bay and in Loch Fine. Unlike the preceding one, it is almost always entire.

91. Amphora complexa, n. sp. Pl. XIII., fig. 91. Form of entire frustule rectangular, with rounded extremities. Length about 0.005''; breadth about 0.0021''. Lateral segments narrow, with the dorsal margin straight, except near the apices, where it bends inwards. Inner line strongly curved to the nodule, which lies close to the ventral margin. Between the lateral segments are seven longitudinal converging bars, the backs of other segments, which meet on the convex ends, entirely filling them up. These bars are separated by raphes, rather broader than in the preceding species. The whole form is marked by transverse striæ, which are strong and conspicuous; about 30 in 0.001''.

This very fine and conspicuous form, which is evidently nearly related to the two which precede it, A. Grevilliana and A. fasciata, while yet all these are distinct, as is seen by the figures, occurs, like the others, both in the Glenshira Sand and in Lamlash Bay, and is not very rare. For some time I confounded all these together in the Glenshira Sand, and it was only a careful examination, especially of the detached segments, which showed me that they were really different species.

92. Amphora sulcata, Bréb., n. sp. Pl. XIII., figs. 92 and 92 b. Form barrel-shaped, rather broad, ends truncate. Length of frustule 0·0041"; breadth 0·002". Lateral segments broad, arcuate; inner lines strongly curved, nodule near ventral margin. Between the lateral segments—when viewed in a focus which brings out these segments clearly, as in one of the figures—are seen four or five converging bars. These bars, and all the lines of the lateral segments, are marked by short, transverse striæ, the rest of the surface being hyaline. In another focus, the lateral segments and their curve-lines disappear, and the whole width is taken up by seven or eight converging bars, which are now separated by very narrow lines of transverse striæ. The whole form is very hyaline and very convex. It

is transversely striated; but the striæ cannot be traced throughout without altering the focus. Striæ about 38 in 0.001''.

This remarkable form was first described by De Brebisson as occurring near Cherbourg. No form is better adapted to show the structure of a complex Amphora, on account of its transparency, and the breadth of the convergent bars. I have found it in Lamlash Bay, where it is not very frequent; and also sparingly in Loch Fine. No detached segments have yet occurred.

93. Amphora acuta, n. sp. Pl. XIV., figs. 93 and 93 b. Form of detached segment arcuate, dorsal margin convex; in some examples with a slight inflection just before the extremities; ventral margin straight, or slightly concave, ends acute. The inner lines are very near the ventral margin, and almost exactly parallel to it, but sometimes a little incurved, except in the middle, where the nodule meets them. Nodule elongated into a strong transverse bar. Length of segment 0·0035" to 0·0055"; breadth of it 0·00075". The segments are marked by transverse striæ, about 36 in 0·001", which are distinctly moniliform.

I have not yet seen the entire frustule; but it is no doubt complex, for I found a good many half-frustules, as it were, formed of segments lying one over the other, to the extent of five or six. Sometimes no cross bar is seen, probably because the cross bar is only found on the lateral segments, which may have become detached, and left the middle ones by themselves. One figure shows a group or pack of segments.

This species occurs in Lamlash Bay, but is more frequent in Loch Fine. It is probable that the entire frustule will somewhat resemble A. nobilis in form, but not in its hyaline aspect. On comparing the segments of A. acuta with those of A. nobilis, as seen in the entire frustule, the curve lines in the latter are seen to be very deeply curved, and to be much farther from the inner margin of the segment, whereas the inner lines in the segments of A. acuta are straight, or very nearly so, and close to the ventral margin. In A. acuta, the striæ, though not coarse, are strongly moniliform, while the striæ of A. nobilis are much finer. Yet it is probable that these two species are related.

(I have very recently observed two specimens, apparently of A. acuta, in which two segments are placed opposite, and close to each other. I suppose this view to represent the flat side of the frustule, or the half frustule, like a cut orange, as in the figure of A. Grevilliana, fig. 89. But in these specimens of Grevilliana, the two lateral segments are in apposition.)

94. Amphora crassa, Greg. Pl. XIV., figs. 94, 94 b, 94 c, 94 d. Form of frustule rectangular, broad, with rounded ends. Length from 0.0025" to 0.004"; breadth from 0.0008" to 0.0013". Lateral segments linear, from 0.0005" to 0.00075" in breadth, straight, or very slightly incurved on the dorsal margin, which, at the apices, bends inwards, forming short, rounded beaks. Sometimes, as in one

of the figures, the dorsal margin is convex. Ventral margin of segments undulated. The inner curve lines arise from the point of the beaks, run a little outwards, then inwards to the nodule, placed very near the ventral margin. Markings entire, coarse, subdistant. Striæ about 12 in 0·001". Between the lateral segments are from five to eight convergent bars, marked with the same subdistant, entire striæ. In one focus, not here figured, nothing is seen but bars from one side to the other, which are thus eight or nine in number.

This very pretty and interesting species occurs in the Glenshira Sand, but the figure given of it in my last plate (*Trans. Mic. Soc.*, vol. v., pl. i., fig. 35), is not, at all events, the usual form. In that figure the markings are too close, and it may possibly represent a different species. Indeed, I have some reason to think that there are two species which resemble each other in several points. But I have not yet ascertained this to be the case. I have found the form now figured, which is the true *A. crassa*, more frequent in Lamlash Bay, where, also, I have observed the detached segments, previously unknown to me, and which, as may be seen, are very peculiar. It occurs also in Loch Fine, though less frequently.

95. Amphora pusilla, n. sp. Pl. XIV., figs. 95 and 95 b. Form linear, with rounded ends. Length from 0·0014" to 0·0021"; breadth 0·0004" to 0·0006". Lateral segments very narrow, dorsal margin straight, except at the ends, nodule not far from dorsal margin, inner curve line also near it; striation conspicuous. Between the lateral segments are five or six narrow bars, separated by very fine sharp lines, and marked by subdistant granules or very short striæ. Striæ about 24 in 0·001", very strong at the margins of the frustule.

This little form is not very rare in the Loch Fine dredging, so often referred to; and occurs also, though more sparingly, in Lamlash Bay. In general aspect, it resembles a delicate miniature copy of the preceding species; but the form of the segments, the curve lines, and the striation, are all totally distinct.

96. Amphora granulata, n. sp. Pl. XIV., figs. 96; 96 b; 96 c; 96 d; 96 e; and 96 f. Form of frustule linear, broad, with slightly convex sides, and truncate extremities. Length from 0.0017'' to 0.003''; breadth 0.0008'' to 0.0013''. Lateral segments slightly arcuate on the dorsal margin, which is suddenly narrowed at the ends; ventral margin quite straight, or slightly concave, apices sub-acute. Segments marked with fine transverse striæ, which are parallel, and from 24 to 36 in 0.001''. Fig. 96 f, represents a detached segment. When the frustule is so focussed that the lateral segments are distinctly seen, and their striæ plainly resolved, the space between appears nearly blank. But in another focus, the whole frustule is seen to be made up of about twelve longitudinal bars convergent on the ends, the backs of which are marked by subdistant granules, from 14 to 18 in 0.001''. Hence the name. I have figured these two views of each of two frustules, one short and broad; the other longer and narrower. One figure, fig. 95 e, represents a somewhat larger form, which also exhibits granulated bars,

and lateral segments approaching in form to those of A. granulata. But on careful comparison, it seems very doubtful whether this form do not belong to a different species. As I have not yet had time to ascertain this precisely, I give it here cum nota.

A. granulata is tolerably frequent in the Loch Fine dredging I have named as being so rich in species of Amphora, especially of complex Amphora. I would observe that in this form the striation of the lateral segments is finer than that on the middle bars, whereas in the next species the reverse is the case. A. granulata sometimes attains a considerably larger size than in the two undoubted specimens here figured.

97. Amphora cymbifera, n. sp. Pl. XIV., figs. 97, 97 b, 97 c. Form of frustule elliptic, rather broad, with very short, produced, and truncate apices. Length 0.0025'' to 0.0045''; breadth in the middle, 0.0012 to 0.0016''. Lateral segments highly arcuate on the dorsal, almost straight on the ventral margin, the former being suddenly contracted at the ends, so as to produce round heads, with very short necks; thus the segments are capitate. Their form is elongated, and the curve regular and graceful. They are marked by somewhat coarse striæ, slightly inclined. Strike about 22 in 0.001". The nodules are on the inner margin, or just within it, and the inner lines are parallel to that margin, and close to it. The segments, when detached, as is seen in one of the figures, exactly resemble the frustules of an elegant Cymbella. Between the lateral segments lie from five to seven convergent bars, and, in one focus, the whole frustule is seen to be made up of these bars (fig. 96 b), which are marked by fine transverse striæ, considerably finer than those on the lateral segments, which became stronger and coarser near the margin, as may be seen by the figures. The bars, as in A. sulcata (fig. 91), appear to be separated by furrows, and in a certain focus these furrows may be seen marked by lines of short transverse striæ. Fig. 96 is the same frustule as that in 96 b, focussed so as to show the lateral segments. Fig. 96 c, is a detached segment.

This fine form is not unfrequent in the Loch Fine dredging above mentioned. The views of it are so different, according to its position, and the detached segments are so like *Cymbella*, that it was some time before I could see my way among these forms, especially mixed as they were with frustules and segments of the preceding, as well as of the next species, which have a similar structure.

98. Amphora proboscidea, n. sp. Pl. XIV., figs. 98; 98 b; 98 c; 98 d. Form of frustule nearly rectangular in the middle, contracted near the ends to truncate extremities. Length from 0·003" to 0·005"; breadth from 0·001" to 0·0015". The longer specimens are narrower than those of middling length. Lateral segments arcuate on the dorsal, often slightly convex, or undulated, on the ventral surface, contracted at the ends so as to be capitate, the heads having longer necks than in the preceding species, which are bent forward at a very obtuse angle.

giving to the detached segment a very peculiar character. The segments are marked by strong, coarse striæ, about 20 in 0·001". In one focus (fig. 97) the segments are well seen in the frustule; in another, fig. 97 b, the frustule is seen to consist of 9 or 10 convergent bars, which are coarsely granulate. In fig. 97 the lateral segments are seen to be nearly in apposition, with a narrow space between them, of varying width, from the undulations of the ventral margin. The inner line of each lateral segment is very slightly curved; the nodule lies nearest to the ventral margin. The detached segments, figs. 97 c, and 97 d, are precisely like Cymbellæ, and for a long time I considered them as such, with those of A. Granulata and G0 and G1 are prevents me from giving figures of the entire frustule corresponding to the segment in fig. 97 d1. The reader is requested to compare fig. 97 with the corresponding view of G1. Granulata2 and G3.

This very striking species occurs only in the stony Loch Fine dredging, so often alluded to, where it is rather frequent, both entire and in detached segments.

99. Amphora costata, Sm. Pl. XIV., fig. 99. This species is described by Professor Smith in his Synopsis, vol. i., where the entire frustule, and also a half frustule, are figured. But little is said of its peculiar structure, and the detached segment is not figured. For this reason, and to show the analogy between this species and the three preceding ones, I have figured a detached segment (fig. 99). Form of segment highly arcuate, very broad in the middle. Ventral margin straight, or slightly concave, but often, as in the example figured, which is a rather small one, with a rounded prominence in the middle close to the nodule. The ends are capitate. Striæ coarse, conspicuous, about 14 or 16 in 0·001″, thicker and stronger near the dorsal margin. Length from 0·002″ to 0·0033″; breadth in the middle 0·0012″ to 0·0016″.

It will be seen that in this species also the segment resembles a Cymbella, although it is a very broad and highly arcuate one. When the segments are united, as in the entire frustule, it is not easy to see their real characters. The backs of these segments, or longitudinal bars, are, as in Professor Smith's accurate figures, marked by very coarse distant granules, which give no indication of the peculiar striation of the detached segments. Hence it was very long before I was able to detect the component parts of the frustule when detached, or to refer the form shown in fig. 99 to A. costata. But some specimens, as in the preceding species, when carefully focussed, clearly show their true nature.

100. Amphora bacillaris, n. sp. Pi. XIV., figs. 100 and 100 b. Form of frustule linear, narrow, with somewhat rounded ends, which are subacute. Length about 0.0017"; breadth about 0.0003". In one focus it exhibits two lateral portions separated by a middle space, the sides of which are perfectly straight, the ends beautifully rounded. In another, the whole frustule is seen to be composed of very narrow bars, separated by very sharp lines, converging on the ends, and

marked with small granules. Striation transverse, fine; number of striæ not counted, but they are much finer than in A. pusilla. The detached segments are not vet known; but, as seen in fig. 98, the segments appear to be very narrow, and linear in form, the dorsal margin being hardly convex. The inner curve-lines and nodules are obscure. These characters, as well as the finer striations, the finer granulation of the bars in fig. 100 b, and the peculiar form of the middle space in fig. 100, sufficiently distinguish it from A. pusilla, the only form it resembles.

This species occurs in the same Loch Fine dredging with those which immediately precede.

The numerous examples here given of complex Amphoræ, to which, as we have seen, two have been added from the simple group, prove that this group of forms is by no means a small one, since so many have been obtained in one locality. It is worthy of remark, that the same dredging, which has yielded at least 12 or 13 of the forms just described, also contains A. costata, Sm., already alluded to as the first Complex Amphora ever figured in this country, though the peculiarities of its structure had not been fully appreciated. In fact, as we have seen A. Grevilliana, A. complexa and A. fascata to form a smaller group of closely allied species, so A. granulata, A. proboscidea, and A. cymbifera also form another such group, to which A. costata also belongs. It would almost seem as if the locality were favourable to these complex forms; for on the waters of the Clyde the whole of them occur. We have also in these waters four Amphiproræ, with the remarkable additions of plates lying on the valves, namely, Apr. pusilla, Apr. lepidopteræ, Apr. plicata, and Apr. maxima; and lastly we have the doubtfully named Apr. complexa, which exhibits the same complex structure in its middle portion as we find in so many species of Amphora, that, namely, of segments packed together, and converging on the ends, like those of an orange or melon. But we must also remember that the same locality is equally rich in new forms of simple Amphoræ.

GROUP VII

MISCELLANEOUS

In this last group I shall describe a few forms of genera not yet named in this communication, and among them one or two whose real nature is doubtful. These are :-

101. Navicula (?) Libellus, n. sp. 102. Nitzschia (?) panduriformis, n. sp.

103. Nitzschia distans, n. sp., G.

104. ... hyalina, n. sp.

105. Pleurosigma (?) reversum, n. sp.

106. Sceptroneis Caduceus, Ehr.

107. Synedra undulata, Greg.

108. Synedra Hennedyana, n. sp. (?)

and, as an Appendix, 109. Creswellia Turris, n. sp., (Arnott).

Toxarium undulatum, Bail.

broad, incurved in the middle, acuminate at the ends, which are usually obtuse and rounded, but sometimes acute and sub-apiculate. Length about 0.003"; breadth in the middle 0.001"; at the shoulders 0.0012". The specimen here figured is longer than usual, and the only one I have seen of this length. Margin punctate. There is a faint indication of a double keel in the middle of the valve. Striation fine, both transverse and oblique; striæ about 48 in 0.001".

This species occurs in several of the Loch Fine dredgings, and is not rare. The striation is similar to that of Tryblionella constricta, Grig. (Mic. Jour., vol. iii, pl. iv., fig. 13); but the present form is much larger, and is distinguished 7 c VOL. XXI. PART IV.

101. Navicula (?) Libellus, n. sp. Pl. XIV., figs. 101, and 101 b. Form of F.V. rectangular, broad, with the angles rounded. The middle part is marked by longitudinal lines or folds, like the leaves of a book; and when the two halves of the F.V. separate, each retains a broad band of this lineate part. The breadth of the detached halves on the F.V. is so great, that, when united, they must, it would seem, mutually overlap, otherwise the resulting frustule would be much broader than it is. S.V. rhombic or elliptic-lanceolate, broad, with obtuse ends. Length from 0.003" to 0.0035"; breadth of F.V. 0.0017" to 0.002". The S.V. is marked by very fine transverse striæ; striæ about 60 in 0.001"; median line distinct; nodule definite. When the edge of the S.V. is seen, as in fig. 101 b, the valve seems to be a compound one, formed of five or six, closely packed one over the other. I cannot ascertain if this be so or not.

This species is frequent in Lamlash Bay, and it much resembles the form figured by me in my second plate from the Glenshira Sand, under the name of N. rhombica, of which also I had figured two of the S.V. in my first plate (Trans. Mic. Soc., vol. iv., pl. v., fig. 1, and Mic. Jour., vol. iii., pl. iv., fig. 16). But I observe several uniform points of difference. N. Libellus is more obtuse and broader, and its striation is not only much finer, but the strize are everywhere of uniform size and at a uniform distance; whereas in N. rhombica, they are near the middle of the valve, not only stronger, but so much more distant than in the rest of the valve as to be almost conspicuous. N. Libellus is also, on the whole, a larger form than N. rhombica.

But it is very doubtful whether either of them be really a Navicula. They have some resemblance, especially on the F.V., to Schizonema Grevillii, Sm., which, however, is a much smaller form. Still they may possibly belong to Schizonema, but this cannot be ascertained except in living, or at least quite recent and uninjured specimens. The F.V., with its foliated or complex structure, appears to me, however, to differ from that of a Schizonema.

I may here add, that there occurs in Lamlash Bay a much smaller form of the same shape, but not foliated, at least not distinctly so. This is perhaps the true S. Grevillii.

102. Nitzschia (?) panduriformis, n. sp. Pl. XIV., fig. 102. Form linear,

by the marginal puncta. Still it resembles a Tryblionella about as much as it does a Nitzschia, and I therefore give it with a query as to the genus.

103. Nitzschia distans, n. sp. Pl. XIV., figs. 103 and 103 b. Form of F.V. nearly rectangular; margin punctate, the puncta being very distant, some in pairs, others single, 5 or 6 in 0·001". The punctate margin bends slightly inwards to each end, so that the ends would be narrower than the middle but for two small hyaline expansions at each end, which renders the extremities a very little broader than the middle. Length about 0·0058"; breadth about 0·001". S.V. linear-lanceolate or rhombic-linear, narrow, broadest in the middle, where the breadth is 0·0005"; ends acute, keel central. The whole form is somewhat hyaline.

This species is not rare in the Glenshira Sand, and I was only prevented from figuring it in my last paper on that deposit by want of room for the figure. Since then I have found it frequent both in Lamlash Bay and in the remarkable stony dredging from Loch Fine, so often mentioned, from which the present figure is taken. It is probably striated, but I have not been able to resolve the striation.

I may here state that the form, of which a drawing was made, but not inserted in the plate just alluded to, seems to differ in some points from this, which is the more frequent. In that form, the puncta, though distant, were regular, and, as stated in the description, which was printed without the figure, appeared to be constricted, and to have fine lines proceeding from one constricted punctum to the constriction in the next. As the F.V. of this form had not the terminal expansions, a circumstance which at the time I attributed to accident, I am inclined to believe that that figure really represented a different species. This I have not had time to ascertain. But the present figure represents accurately the form which from the first I had named Ntz. distans.

104. Nitzschia hyalina, n. sp. Pl. XIV., figs. 104 and 104 b. Form of F.V. rectangular, with expansions at the extremities. On each margin is a row of small puncta. Length 0.0034"; breadth 0.0004". S.V. linear, narow, and towards both ends contracted to long and still narrower terminations. Keel apparently double; but perhaps one is seen through the very hyaline valve. The whole form is so hyaline as to be easily overlooked.

This delicate species is tolerably frequent in the Loch Fine dredging so often mentioned. It is possible that it may be a Homwocladia, but I have no means at present of deciding this point. It is certainly not one of the species of H. figured in the Synopsis.

105. Pleurosigma (?) reversum, n. sp. Pl. XIV., figs. 105 and 105 b. Form linear-lanceolate, narrow, somewhat contracted on each side of the middle portion, and again expanding towards the ends, which are elongated, and have the expansion all on one side, but on opposite sides at the two apices. On the non-expanded side of the elongated ends, the margin is nearly straight, or slightly in-

curved. The whole form has a strange appearance, as if we were to take two long, narrow stockings, cut them across at the widest part, and join them at the cut ends, with the feet pointing opposite ways. From this last character I have named it. Length 0.005'' to 0.006''; greatest breadth 0.0006.'' Median line sigmoid, straight in the middle, and suddenly bent near the ends in opposite directions. Striation so fine that I have not yet succeeded in resolving it, and therefore not easily visible under a power of 400 diameters.

This singular form occurs in the stony Loch Fine gathering so often referred to. I have as yet only seen the two specimens here figured, and two more; but I have not searched for it, these being so remarkable, and so like each other, as to indicate sufficiently, in a general way, the existence of the species. I do not feel quite certain as to its genus; but I think it right to direct the attention of observers to it. It will probably be found more abundantly in some dredging or gathering from a different locality in the Clyde.

106. Sceptroneis Caduceus, Ehr. Pl. XIV., fig. 106. I cannot enter into a detailed description of this species, as the fragment here figured is the only specimen of it I have yet seen in these dredgings, or in any British gathering. And I figure it chiefly as evidence that this genus, which is frequent in several American fossil deposits, yet lives in our waters, although we have yet to find it in such abundance as will probably occur near its true habitat. Ehrenberg thus describes the genus (Bericht der Berlener Akademie, 1844, p. 264), "Animal e Bacillariis Echmelleis, affixum? Lorica simplex æqualiter bivalvis silicea stiliformis compressa, nonconcatenale, cuneata (viva facile pedicellata). Sutura laterum utrusque valva longitudinalis media, umbilicus nullus. Habitus Meridii non concatenati aut Gomphonematis, umbilico laterali carentis."

The species, S. Cuduceus, is distinguished by its long slender form, having a central expansion, and another at one end, while the other end is long and narrow, and by its very coarse moniliform striæ. In this fragment we have the large end, which is unusually large, for it is commonly of a narrower and somewhat elliptical shape.

This form, which adds one to the list of British genera, occurs in the same Loch Fine dredging as the preceding one, and so many more.

107. Synedra undulata, Greg. Toxarium undulatum, Bail. Pl. XIV., figs. 107 and 107 b. Form of frustule very long, and very slender. F.V. rectangular, very narrow; S.V. with an elongated central expansion, and two small semi-elliptic terminal ones. Margin undulated. Striæ conspicuous, moniliform, in the expansions passing, towards the middle, into an indiscriminate punctation. Length 0.023°; greatest breadth of S.V. 0.00035°; breadth of the longer and narrower portions hardly 0.0001." So that the length of the frustule is about 70 times the width of the broadest part of the S.V., and more than 200 times that of the greater part of the valve.

Professor Smith describes the S.V. as arcuate, as in fig. 107 b; but I find it very often quite straight, as in fig. 107. The arcuation seems to be accidental, due only to the great slenderness of the frustule, and therefore common; but it is most probably naturally straight in the S.V. as well as on the F.V. Professor Balley represents it as straight, although he figures a specimen of the enormous length of 0.0265." Those which are not straight are bent quite unequally, some very little, others considerably, others only at one end, and others more at one end than the other. I feel pretty sure, therefore, especially as straight examples are frequent, that it is not essentially an arcuate form.

This very remarkable species, the longest known Diatom, except a Chætoceros, figured along with it by Bailey, which is as long, was first observed in this country, by me, in the Glenshira Sand, in which, however, I could not find, among some hundred specimens, one entire frustule. I figured three fragments, two of them nearly complete, in my first paper on the Sand (Mic. Jour., vol. iii., pl. iv., fig. 23), and was able to calculate, that if entire, its length would be about onefiftieth or one fortieth of an inch, or 0.02" to 0.025". The length of the specimen here figured lies between these measurements, that of Professor Bailey's figure is a little above the highest of them. After my paper with the incomplete figures was published, I became acquainted with the earlier observations of Professor Bailey, who had found it living on Sargassum on the American coast. I found one specimen of it also recent, but still fractured, before my paper was printed, in a gathering made by Professor Smith on the south coast. Subsequently, Professor Smith found it frequent in Cork harbour, though smaller than in America. Last year (1856) I found it frequent in Professor Allman's Lamlash Bay dredging, and sparingly in the other dredgings. As no entire figure of it has yet appeared in this country, I have here given two figures, one arcuate, the other straight.

108. Synedra Hennedyana, n. sp (?) Pl. XIV., fig. 108. This form is in all respects similar to the preceding, except that the margin is not undulated. Fig. 108 represents it of the same length as S. undulata.

I first noticed this form along with *S. undulata*, in July 1856, in Professor Allman's Lamlash Bay dredging, but I considered it as simply a variety of that species. I was led to do so by observing that in *S. undulata* it often happens that a considerable portion of the margin is devoid of undulations. But several other observers who had seen it, adopted the opinion that it was distinct from *S. undulata*. Mr Roper was, I believe, one of these; and I rather think Professor Walker-Arnott, and Mr Hennedy have come to the same conclusion. Professor Arnott informs me that it occurs in a gathering from the Clyde, I believe near Cumbrae, without a single frustule of *S. undulata*. As this gathering was made by Mr Hennedy, if I am not mistaken, and as he has at all events studied the form in question, I have figured it under his name, with a mark of doubt, as I am not yet quite satisfied that it is really a distinct species. In my material it

is mixed with S. undulata; and I know of no distinction beyond that of the absence of undulations on the margin, unless it be that the strice in S. Hennedyana are perhaps a little finer than in S. undulata. Even of this I am not sure. But the figures, which are very accurate, will enable the reader to form his own conclusions.

Such are the results obtained, up to this time, by the examination of these 11 gatherings from the Firth of Clyde and Loch Fine, 10 of which are true dredgings, while the 11th is derived from *Corallina officinalis*, to which a good many Diatoms have adhered.

From the remarkable analogy between the Glenshira Sand and these gatherings, we may regard it simply as another dredging, the marine forms in which have been derived from Loch Fine. I have shown that the period at which it was deposited has not caused any material difference of composition, and that we may say, in general, that it does not differ more from the recent dredgings than they do from each other.

Considering, then, all as supplying us with existing forms, we are struck with the unexpectedly large number of undescribed species which this exploration of the waters of the Clyde, though very limited in the area whence the materials were derived, has yielded in a short space of time.

It is worthy of notice, that the great majority of these new forms are not only new as British species, but have not been observed elsewhere, although Ehrenberg and Balley have both described many rich marine gatherings from different parts of the world.

This proves that the existing stores of marine Diatoms have not vet been by any means fully explored. It is therefore highly desirable that dredgings or soundings from all seas and estuaries, and from every part of them, should be procured and carefully searched. From what has been already recorded, as well as from the results here given, it appears that estuaries and harbours, or other localities near the coast, are likely to be the richest in Diatoms, perhaps from the comparative shallowness of the water. But the conditions of the distribution of these organisms in the sea, and of the accumulation of their indestructible siliceous shells, are not yet known with certainty. Thus, while every one of these Clyde dredgings proved more or less rich in Diatoms, I have found several from the Long Narrows, in the Firth of Forth, kindly given me by Dr HECTOR, to be very poor in comparison, and indeed not worth the trouble of mounting. And while Bailey has found many interesting forms of this class in soundings from a depth of 1700 fathoms, and even of 2700 fathoms, in the Kamtschatka Sea, a number of Atlantic soundings, from depths varying from 85 to 2000 fathoms, which, by the kindness of Professors W. Thomson and Allen Thomson, I was allowed to see, contain indeed Foraminifera and Polycystineæ, but are almost entirely destitute of Diatomaceæ. Yet Bailey has found Diatoms in Atlantic soundings from

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other localities. We have nothing for it, therefore, but to examine every specimen of sea-bottom that we can procure. And the example of the Firth of Clyde is sufficient to prove that much remains to be done.

It should also be stated here, that these Clyde dredgings are not exhausted. Indeed, it is a work both of much time and much labour fully to exhaust any such mixtures as these are.

While these sheets are passing through the press, I am in a position to state, that I have already collected, from the same materials, so considerable a number of additional undescribed forms, that it will be necessary to describe and figure them in a supplementary memoir. Of these forms, a large proportion are discs, many of which are small, or only of a medium size; but there are also Naviculoid forms, Amphoræ, and forms of a few other genera.

I would further direct attention to the fact, that these dredgings differ materially from each other, each being characterized by the prevalence of certain forms, although some forms are common to all. Thus, off Inveraray and Strachur, in Loch Fine, the proportion of large Campylodisci was very much greater in two gatherings than in all the rest, whether there or off Arran; while in Lamlash Bay, the material was remarkable for the great number and variety of Amphoræ, a character found in one only out of the seven dredgings from Loch Fine. This shows that the deposits may vary much in regard to species, and even genera, in localities at no great distance from each other, and points out the advisability of searching every corner.

Lastly, it appears probable that some genera, whether such as have been adopted by Ehrenberg, Kützing, Bailey, and others, or entirely new, will have to be added to Professor Smith's list of British genera. This is especially the case with the numerous new filamentous forms, hardly any of which agree with the genera in the Synopsis. I have not for the present ventured to introduce any entirely new genus, but I have added *Pyxidicula* and *Sceptroneis* of Ehrenberg, and, more doubtfully, *Diadesmis*, also admitted, in a recent paper, by Professor Smith. I refrain from doing more; because I believe that genera established in the present imperfect state of our knowledge of species as well as of genera, are not likely to be permanent. In one case, I have pointed out the possibility of uniting in one genus and in one species three forms, *Campylodiscus simulans*, *Surirella fastuosa*, and *Surirella lata*, at present referred to two genera and three species.

In distinguishing and describing the very numerous new forms figured in this communication, I have been careful to avoid unnecessary multiplication of species. In numerous cases I have united forms apparently distinct which a closer examination showed not to be so. And in every case where I have admitted a new species, it has been because I could not reconcile it with any figures or descriptions which were accessible to me. I have also had the great advantage of frequent consultation with Dr Greville, whose opinion has deservedly

very great weight with all students of the Diatomacee. I have further to thank Mr Roper for many useful hints, and for the use of some very accurate drawings of forms observed by him, in many cases identical with those I had myself described.

It is impossible to do full justice to the scrupulous accuracy and to the artistic beauty of the figures which Dr Greville has made of the forms which I have described, and to the signal success with which Mr Tuffen West has engraved them. I can only say that I have seen no figures of this kind equal to them in these respects, and that the chief value of communications like the present is derived from the presence of good figures. Without figures, descriptions are apt to be misunderstood, and inferior figures tend, more than any other cause, to lead observers to multiply species unnecessarily. Those who are in the habit of studying the Diatomaceæ will agree with me, that a large proportion of the figures in some works on the subject are worse than useless, and lead to hopeless confusion.

There is another point on which good figures throw much needful light. In many species, though by no means in all, the shape, as well as the size of the forms, and even the striation, all vary to a great extent. In such cases, it is most important that every author should figure a sufficient number of selected forms, to show the real extent of the species. These variable species ought to be thus treated individually, by which means many existing species would be got rid of and reduced to a smaller number. I have attempted something of the kind in Navicula varians (Trans. Mic. Soc., vol. iii., p. 10), and in this paper I have done so partially in Navicula Lyra, Nav. Smithii, Amphora Proteus, and Amphora lavis. Such forms as N. elliptica, N. didyma (which I have in part illustrated in my last paper on the Glenshira Sand), N. Crabro and P. Pandura, for example, and even N. Smithii, besides others in different genera, require much fuller illustration than they have yet received.

Finally, I wish it to be understood, that in describing so many new species, I make no pretensions to deciding authoritatively on disputed or doubtful points. My sole object is to bring under the notice of observers, the *forms* which I meet with. To do this, I must needs give them names, and in this respect I endeavour to be as accurate as I can. I observe that Professor Smith, in his last paper in the *Annals*, objects to the establishment of new species, unless the specimens are frequent. But although I have given, as distinct species, some forms which are rare, I have not done so till after I had examined and compared many specimens of each, except in one or two cases, such as *Coscinodiscus umbonatus*, where the form is so striking and well-marked that even one specimen suffices.

If we confine our attention to one or two slides, then, indeed, rare forms can not be sufficiently studied. But in the researches made in connection with this paper, I have explored at least 1000 slides, most of them twice, many three times,

and even oftener. Thus it happens, that I have compared as many specimens of by far the greater number of the forms here mentioned as rare, as if they had been very frequent, and I had only seen one or two slides.

Compared with many forms, all the Complex Amphore would be considered rare, but of these, I have in every instance examined numerous specimens, and have satisfied myself of the constancy of their characters, which is the most important point.

I trust, therefore, that Naturalists will accept this paper as a simple contribution to our knowledge of Diatomaceous Forms. As such I present it, leaving to those who are better qualified for the task than I am, to decide on the conflicting claims of genera and species.

APPENDIX.

the works on the surject will worse that weeken and maded

For the following description and figure of a very beautiful new form, belonging to a new genus, I am indebted to my friend Dr Greville. The form in question has not occurred to me as yet, but as Professor Walker-Arnott has found it in the Clyde, it has a claim to be inserted in this account of new Clyde forms.

Notice of a New Genus of Diatomacea. By R. K. Greville, LL.D., F.R.S.E., &c.

My friend Professor Gregory having permitted me to introduce in this place the description of a new and most interesting diatomaceous form, I gladly avail myself of the privilege. Having been recently discovered in the Clyde, it may, indeed, be considered as possessing some claim to appear in company with the multitude of fine species described by Professor Gregory in the preceding pages. This remarkable Diatom was communicated to me a few weeks ago, by my friend Professor Walker-Arnott, for publication and illustration. It is to be regretted that he did not undertake this office himself; he has, however, very kindly supplied me with notes of his views regarding it, so that he has rendered my labour comparatively light. Professor Walker-Arnott's attention was first directed to the form in question by the Rev. R. Creswell, who obtained it at Teignmouth, from the stomach of Cynthia rustica (Phallusia rustica, Flem.), along with Biddulphia Baileyi and other good things. It is, however, so scarce, that at present it must be reckoned among the rarissima of its tribe. Very fortunately the specimens which have been obtained are in a state to admit of satisfactory description. Like Biddulphia and Isthmia, it forms chains, the links or frustules of which are oblong, somewhat depressed at the ends, highly cellulate, separating transversely into two equal valves. The frustules are united by means of a circle of numerous short, terminal processes of equal length, which ultimately separate in the middle; and the detached frustules then appear furnished at each end with a beautiful coronet, or circle of miniature turrets. This mode of connection is peculiar, although perhaps analogous to that in *Biddulphia*. In the subject of these remarks, however, the connecting processes do not appear to be so distinctly a continuation of the substance and structure of the body of the frustule, as are the horns of that genus, and must rather be regarded in the light of appendages.

With regard to the affinities of this beautiful little object, we may certainly assume, that if a solitary frustule had alone been formed it would have been referred by Kützing at once to the genus *Pyxidicula*. But little or nothing is known of the real nature of the variety of forms brought together under that name. Ehrenberg's own character for the original genus is as follows:—

"Animal e familia Bacillariorum, liberum, lorica simplici, bivalvi (silicea); solitarium, globosum (=Gallionella divisione spontanea perfecta aut nulla). Die Infusionsthierchen, p. 165.

But EHRENBERG subsequently constituted other genera or subgenera to receive the accumulating species; and as the work in which they appear is not generally accessible, I do not hesitate to give the characters verbatim in this place.

- "Dictyopyxis, nov. gen. Pyxidiculæ generis ea bivalves subglobosæ aut turgidæ formæ, quæ valvularum testæ strictura simpliciter cellulosa insignis sunt ab iis, quæ continua et simplici membrana silicea includuntur, aut appendicibus variis instructæ sunt, gravius differunt et facillime distinguuntur. Cellulosas igitur in Dictyopyxidis subgenere colligendas senserim. P. cruciata, Cylindrus, hellenica et Lens huic subgeneri nunc inscribendæ sunt."—Ehrenb. Bericht. der Berl. Akad., 1844. P. 262.
- "Stephanopyxis, nov. subgenus. Pyxidiculæ generis bivalves turgidæ aut subglobosæ formæ, quæ valvularum testæ structura cellulosa insignes sunt et denticulorum, aculeorum aut membranæ coronam in media quavis valvula gerunt in hoc Pyxidiculæ subgenere colliguntur."—Ehrenb., l. c., 1844. P. 264.
- "Xanthopyxis, nov. subgen. Pyxidiculæ subgenus bivalve turgidum subglobosum. Valvularum testæ silicæ continuæ integerrimæ nec cellulosæ, superficie hispida, setosa aut alata."—Ehrenb., l. c., 1844. P. 264.

KÜTZING, in his Species Algarum (1849), reunites the whole, giving twenty-two species, all of which, except two, are fossil. The frustules, according to him, are "non concatenata." Mr Creswell's Diatom is, therefore, by a most important character, excluded. Taking a simple frustule, and leaving the processes out of view, it much resembles Dictyopyxis hellenica (Ehrenb. Microgeologie, tab. xx., fig. 32), and also Stephanopyxis appendiculata of the same work, tab. xviii., fig. 4; but that species has only a single tooth at each end, and is provided with a sort of narrow zone or annulus. It resembles still more closely Stephanopyxis apicu-

lata (Ehrenb., l. c., tab. xix., fig. 13) which is represented with three terminal teeth; but these teeth can scarcely be the remains of a corona, as Kützing, in defining the frustule, says, "utroque fine medio apiculis elongatis hispido." Upon the whole, the safe course seems to be to regard the subject of this notice as not only specifically but generally new; and I gladly adopt the suggestion of Professor Walker-Arnott, that it receive the name of Cresnellia in honour of its discoverer, the Rev. R. Creswell, a gentleman well known to Algeologists, and to whom Professor Harvey has already dedicated a new British Schizothrise. The following character will distinguish it at once from all its allies.

Creswellia. Frustules cylindrical, two-valved, cohering by short, filiform processes into a continuous filament. Valves cup-like, cellulate, destitute of any siliceous connecting band. Pl. XIV., fig. 109.

This singularly interesting Diatom, which may be called *Creswellia Turris*, has only been found in the locality already mentioned by Mr Creswell, and off the Island of Cumbræ, where it was dredged along with the nests of *Lima hians* by Mr Hennedy, and a single frustule detected by Dr Walker-Arnott.

The figure represents four frustules, the largest number which has been hitherto observed in connection. It will be perceived that in two of the frustules one of the valves is dark, and more or less opaque. This appearance we are quite unable to account for. It sometimes happens that the whole frustule is dark. Generally they are all beautifully clear. The structure is highly cellulate, the cells hexagonal. The length of the frustule is about '0028"; the breadth about '0016".

EXPLANATION OF PLATE IX.

Fig.	1. Navicula 2 3 4 5	a minor, n. sp. Cluthensis, n. sp. inconspicua, n. sp. brevis, n. sp. Claviculus, n. sp. Claviculus, n. sp., S.V. \times 800. 5 b, do., F.V. \times 800. 5 c, do. S.V. \times 400.	— 21 Allmaniana, n. sp.
-	6	Musca, n. sp.	 22 Pandura, Bréb., var. β. elongata. 23. Cocconeis distans, Greg.
	7	rectangulata, n. sp.	— 24 ornata, n. sp.
-	8	nebulosa, n. sp.	— 25 dirupta, n. sp.
-	9	Barelayana, n. sp.	— 26 nitida, n. sp.
	10	spectabilis, n. sp.	— 27 pseudomarginata, n. sp.
_	11	praetexta, Ehr.	— 28 major, n. sp.
-	12	Bombus, Ehr.	
-	13 & 13 b,	Lyra, Ehr.	
_	14 & 14 b,	Lyra, var. β.	All the above, except figs. 5 and 5 b, are magnified 400 diameters.
-	15	Smithii, var. \(\beta \), fusca.	Amorphic to the delicence of the second

EXPLANATION OF PLATE X

Fig. 30. Denticula (?) interrupta, n. sp. — 31 (?) capitata, n. sp. — 32 (?) ornata, n. sp. — 33, 33 b, &)	Fig. 34. Denticula nana, n. sp., F.V. 34b; do. S.V. — 35, 35b, & 35c, } minor, n. sp., F.V. 35d; do. S.V.
33 c, \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	— 36 distans, n. sp., F.V. 36 b; do. S.V. — 37 & 37 b, staurophora, n. sp., F.V. 37 c; do. S.V

Fig. 38. Denticula fulva, n. sp., F.V. 38 b; do. S.V. — 39. ... marina, n. sp., 39 b; do. S.V. — 40. Diadesmis (?) Williamsoni, F.V., 40 b; do. — 45. Coscinodiscus nitidus, n. sp. — 46. ... punctulatus. n. sp. — 47. ... concavus, Ehr. — 48. ... umbonatus, n. sp. — 48. ... umbonatus, n. sp. — All the above are magnified 400 diameters.

EXPLANATION OF PLATE XI.

Fig.	49. Coscinodiscus centralis, Ehr.	Fig. 53. Campylodiscus angularis, n. sp.
_	50. Eupodiscus subtilis, n. sp., Ralfs.	- 54 & 54 b, eximius, n. sp.
-	51. Campylodiscus centralis, n. sp.	— 55 limbatus, Bréb.
	52 Ralfsii (?) Sm.	All the above are magnified 400 diameters.

EXPLANATION OF PLATE XII.

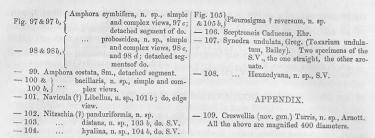
Fig	g. 56.	Amphiprora	pusilla, n. sp., F.V., 36 b; do.	Fig.	64		a nana, n. sp.
			S.V.	-	65.		macilenta, n. sp.
-	- 57.		plicata, n. sp., F.V.		66.	***	angusta, n. sp.
11	- 58.		elegans, Sm. S.V., 58 b; do. F.V.				binodis, n. sp.
-	- 59.		lepidoptera, n. sp., F.V., 59 b;	-	68 &	68 b,	ventricosa, n. sp.
			do., S.V., 59 c; do. peculiar	-	69.		monilifera, n. sp.
			view.	-	70.		lineata, n. sp.
_	- 60.		obtusa, n. sp., F.V.	-	71.	·	Ergadensis, n. sp.
duas	- 61.		maxima, Greg., F.V., 61 b; do.	-	72.		lævissima, n. sp.
			S.V.	-	73.		pellucida, n. sp., 73 b; half frus-
_	- 62	& 62 b (?)	complexa, n. sp., F.V. entire;	TIM			tule of do.
			62 c; do. half frustule, 62 d	-	74,7	4 b, &	[lævis, n. sp., 74 d; Amphora, qu.?
			and 62 e; do. detached seg-	15	74	С,	a form of A. lævis?
			ments,	100	All t	he above	are magnified 400 diameters.
	63	Amphore f	uroida n en	1			

EXPLANATION OF PLATE XIII.

Fig.	75. A	mphora	exigua, n. sp.	Fig.	82.	Amphora	lyrata, n. sp.
_	76.		dubia, n. sp.	_	83.		Milesiana, n. sp.
	77.	100	truncata, n. sp.	-	84.		elongata, n. sp.
-	78 &	78 %,	oblonga, n. sp.	_	85.		quadrata, n. sp.
-	79.		robusta, n. sp., 79 b and 79 c; half	-	86.		excisa, n. sp.
			frustules.	-	87.	***	nobilis.
_	80.		spectabilis, n. sp.; 80 b; do. var. β,	_	88.		Arcus, Greg.
			80 c; do. var. γ; 80 d; do. view	_	89.		Grevilliana, Greg.
			showing the complex structure of the		90.		fasciata, n. sp.
			species; 80 e; do. detached segment.	_	91.		complexa, n. sp.
TOWN		1b, 81 81 d, & e,			All	the above	are magnified 400 diameters.

EXPLANATION OF PLATE XIV.

I movie minerale	acuta, n. sp., detached segment; 93 b; do. pack of similar seg- ments.	Fig. 96, 96 b,	
— 94	crassa, n. sp, 94 b, 94 c, and 94 d; do. detached segments.	96 c, & 96 d,	segment; 96 e; form qu? allied to A. granu-
— 95 & 95 b, {	pusilla, n. sp., simple and complex views.	lime syarili	lata?



Postscript.

While the preceding pages were passing through the press, I have been able to examine with care numerous specimens of most of the forms there described, and I wish here to modify to a small extent some of the views I have expressed. In every instance, I speak after the comparison of a very large number of fine examples.

- 1. Naricula nebulosa, fig. 8. I wish to observe, that after a very careful comparison of this form with N. Hennedyi, I have no longer any doubts as to its being a distinct species. I find it remarkably uniform in its characters, and particularly in its oval form, with the ends on the whole broadly rounded, while it has a slight angularity in the middle, and a slight trace of acumination at the apices. It is equally uniform in the narrowness of the marginal band of striæ, in the fineness of the striation, and in its very peculiar colour and nebulous aspect. In all these points, N. Hennedyi differs from it, as I have stated. But while these points of difference appear trifling, and are difficult to express in words, I must observe, that there is no real resemblance between the forms, and that when, as often happens, both being frequent, they occur close together, and of equal size (though N. Hennedyi is usually a larger form), it is quite impossible, even under a low power, to confound them together, the whole aspect of the two forms being remarkably different.
- 2. Navicula spectabilis, fig. 10. Having found, in certain densities, many very fine specimens of this form, I have to state, that it occurs of nearly twice the size of the individual figured, and that it is perfectly uniform in its characters.
- 3. Navicula Bombus, Ehr., fig. 12. This form also has occurred abundantly in certain densities, and I am now quite satisfied that it is a distinct and well-marked species. In the description I have omitted to mention an important character, namely, that it is never, literally,—not in one out of thousands of examples—sym-

metrical. One-half is always more or less larger than the other, and the amount of surface on each side of the median line is unequal. This does not occur in any other panduriform Navicula, except only occasionally in N. didyma, which cannot be confounded with the present species. N. splendida, N. incurvata, N. Musca, and N. (or P.) Pandura, are all remarkable for symmetry. In addition to this want of symmetry, which is invariable, it may be stated that, although several Naviculæ, and even some of the panduriform group, vary a good deal in shape, there is no species which is more uniform in this respect than N. Bombus.

- 4. Navicula Smithii, var. β , fusca, fig. 15. A careful study of very numerous specimens, both of this form, and of that which I take to be the typical N. Smithii, has now entirely satisfied me that N. fusca is truly a variety of N. Smithii. But it must be added, that this, like the fresh-water N. elliptica, is one of the most variable species, not only in form, but also in the striation, which varies from what may be called fine to exceedingly coarse; in colour, which varies from colourless to dark brown; and in general aspect,—N. Smithii being usually destitute of the remarkable longitudinal ridge or shade on each side of the median line, so conspicuous in N. fusca. In all these points, a perfect gradation may be traced without difficulty.
- 5. Navicula Smithii, var. γ , nitescens, fig. 16. Having found this form abundantly in one density, I have now come to the conclusion that it is no variety, but a distinct species. I find it perfectly uniform in all its characters, and the remarkable peculiarity of the median line, which is invariably a broadish white line with perfectly parallel sides; while that of N. Smithii, including N. fusca, is always doubly conical, being much broader in the middle, and forming a very acute point at each apex, seems effectually to separate it from that species. The shining aspect of the strice is also peculiar.
- 6. Navicula Smithii, var. δ, suborbicularis, fig. 17. This form has also occurred abundantly, and I am now able to state that it is so uniform in its characters, and so peculiar in its aspect, that it must be admitted as a distinct and well-marked species. The only variation, except one to be presently mentioned, is in size, as it now and then occurs of twice the length of the figure, or even more, in which case it is more oval in shape, though always very broad. But the peculiar structure about the median line, giving the appearance of two white, elliptical bands meeting in the nodule, or of one long elliptical band, suddenly constricted in the middle, seems to be quite invariable, and sufficient to distinguish it. The fact, also, that the striæ are hardly visible, except on a broad marginal band, where they are very conspicuous, having the shining aspect of those in N. nitescens, though coarser than in that species, as well as the permanence of its very peculiar form, seem to indicate that it ought to be separated. Neither in this

form nor in the preceding, have I seen the slightest trace of any tendency to pass into N. Smithii, or into its variety N. fusca.

I have, indeed, lately noticed one variety of the present form, namely, a panduriform variety, agreeing with the type in size, in general aspect, and in the peculiar median line. This I shall describe and figure on a future occasion.

I may here add, that I shall also have to describe and figure another new form of Navicula, occurring abundantly with the preceding ones, which at first I was disposed to refer, like them, to N. Smithii. But I find it so uniformly peculiar, that I must separate it also.

7. Denticula (?) levis, fig. 33. I have some reason to think that I have detected the S.V. of this species. The F.V. is frequent in some densities, but it would appear that the entire frustule is so much broader on the F.V., that it never lies on the S.V., and that the valves are never, or hardly ever, separated. Even when separate, the S.V. must be so very narrow, and perhaps so convex, that this side is not usuallyseen. In one case, however, where one of a group has been partly turned, I think I can see that the S.V. resembles in shape that of D. fulva, only smaller and narrower.

I have also to add to the list of British species two forms, both remarkable, which occur in Lamlash Bay.

These are,—1. Coccone Morrisiana, Sm., a very curious species lately found by Professor Smith, I believe, in a gathering from the Levant or from the Black Sea. 2. Pleurosigma compactum, Grev.; described and figured by Dr Greville, from Trinidad. I propose, in a future paper, to figure these two species as British forms.

I have just now been able to add to the figures, one of the very remarkable detached segment of $Amphora\ spectabilis$, as described in the text. It will be found in Pl. XIII., fig. 79 e.

28th May 1857.

CORRIGENDA.

I have to request the reader's attention to the following corrections, which I wish to make in regard to some points in the preceding paper.

- 1. The form represented in fig. 52, Plate XI., as a modification of Campylodiscus Ralfsii, Sm., is, as I am now convinced, entirely distinct from that species, which in fact, occurs in some of the dredgings along with it; and, in addition to its being uniformly small, exhibits a very different aspect. Fig. 52 agrees with the description given by DE BREBISSON of his C. decorus, and I have no doubt belongs to that species, which must therefore be added to the list of British Diatoms.
- 2. Additional observations have satisfied me, that the form represented in fig. 95 e, Plate XIV., is not a form of Amphora granulata, but an entirely distinct species, to be more fully described at a future time.
- 3. I wish to mention, that although I cannot see any reason to separate the two forms, represented in figs. 80 t, and 80 t, Plate XIII., from Amphora spectabilis, fig. 80, so far as the simple view of the latter is concerned, I have not yet been able to trace the complex structure of t. Spectabilis, shown in fig. 80 t, in these smaller forms. Whether this is because I have not yet employed the highest powers of the microscope for this purpose, since these small forms have much finer markings than the larger one, or whether the complex structure occurs in the larger alone, while the smaller remain always simple; or whether, finally, the two smaller forms belong to a different species, are questions which I cannot yet answer.
- 4. Having, by the kindness of Dr A. S. DONKIN, of Morpeth, been enabled to examine a most interesting marine gathering made by him, in which several of the forms described in this paper, as well as several of those yet to be described as occurring in the Clyde, are met with, I have now to state, that I find Amphora Grevilliana in that gathering, with almost exactly the form and aspect of Amphora complexa, fig. 90, Plate XIII., while detached segments also occur, evidently belonging to it, and having the straight dorsal margin, but yet in all other points agreeing with those of A. Grevilliana, as shown in fig. 36*, of my third plate of Glenshira forms, and as seen in the present paper in the entire A. Grevilliana, fig. 89, Plate XIII. I have therefore to withdraw A. complexa as a distinct species, and to request the reader to consider the figure (fig. 90), as representing one view of a straight-sided form of A. Grevilliana. In this variety, as seen in Dr Donkin's gathering, and as I have also observed in the Glenshira Sand and in the Clyde, the detached segments are much narrower than when the dorsum is convex. I have specimens of the convex segments, from the Clyde, nearly three times as broad as Dr Donkin's, with the straight dorsum. I would further observe, that in all probability, fig. 89 represents a frustule, or possibly a half-frustule, viewed from the flat or concave side, while the frustule in fig. 90 is seen from the convex side, so that the flat-lying lateral segments are not so distinctly seen. I must remind the

reader also, that the names and descriptions of figs. 90 and 91, A. Complexa, and A. fasciata, have by some mistake been transposed, as stated in the errata, which I did not discover till it was too late to correct it. Whether A. fasciata, fig. 91, shall also prove a form of A. Grevilliana, for which I gave it in my last paper on the Glenshira Sand, I cannot at present determine.

- 5. The form represented in fig. 74 d, Plate XII., is, as I am now quite satisfied, entirely distinct from Amphora lavis, and must be hereafter described as a new species.
- 6. I have been able to introduce, at fig. 68 c, Plate XII., a figure of the remarkable detached valve of Amphora ventricosa, which resembles a very slender Cymbella, and occurs even longer and narrower than in the figure. In one dredging, I find it tolerably frequent.
- 7. In the disc of Coscinodiscus centralis, Ehr., as represented in fig. 49, Plate XI., the central cells are shown considerably larger than is usually the case in the specimens which I have of this Diatom. Indeed the cells, in the figure, are more like what is seen in the centre of C. Asteromphalus, Ehr., and the question arises, whether the specimen figured may not belong to the last-named species, or whether these two species may not, in reality, be essentially one and the same. In a large number of specimens of C. centralis which I have lately examined, the central cells are invariably but a little larger than the rest, so that the form represented in fig. 49, if it be C. centralis, and I see no other difference, must have been, in this respect, abnormal. I may add, that in these beautiful discs, some of which are considerably larger than the one figured, the cells are distinctly arranged in spiral lines, as in engineturning, and as is seen also in C. radiatus. This character is but slightly indicated in the figure.

1st August 1857.

ERRATA.

P. 510, line 3, for "vertical" read "ventral"

P. 514, line 13 from bottom, for "Plate XIII. fig. 75" read "Plate XII. fig. 75"

P. 518, line 3 from bottom, for "80 e" read "81 e"

P. 523. Transpose the paragraphs numbered 90 and 91, so that they shall be read thus:-90. Amphora complexa, n. sp., &c. &c. And

91. Amphora fasciata, n. sp., &c. &c.

Also same page, line 2, for "to which I now proceed," read "to be presently described."

P. 531, line 22, for "Echmelleis" read "Echinelleis"

" 23, for "nonconcatenale" read "nonconcatenata"

" 23, for "utrusque" read "utriusque"

P. 539. In the Explanation of Plate XII., after -74, insert "-75...exigua, n. sp."

In the Explanation of Plate XIII., expunge the first item.

Also, transpose the words opposite to - 90 and - 91, so that they shall be as follows:

- 90. ... complexa, n. sp.

- 91. ... fasciata, n. sp.

And after - 91 insert

- 92. ... sulcata, Bréb.

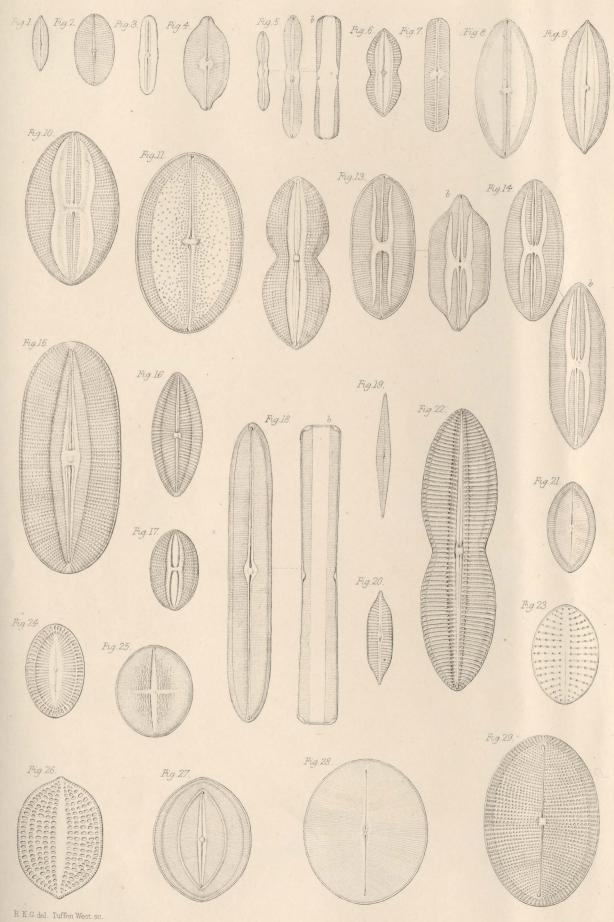
- 93. ... acuta, n. sp. Pack of united segments.

In the Explanation of Plate XIV., for "Fig. 93" read "Fig. 93" b, and expunge the words of the second and third lines.

The reader is requested to make, in the Explanations, as repeated opposite Plates XII.. XIII., and XIV., the corrections above indicated as required on page 539.

EXPLANATION OF PLATE I.

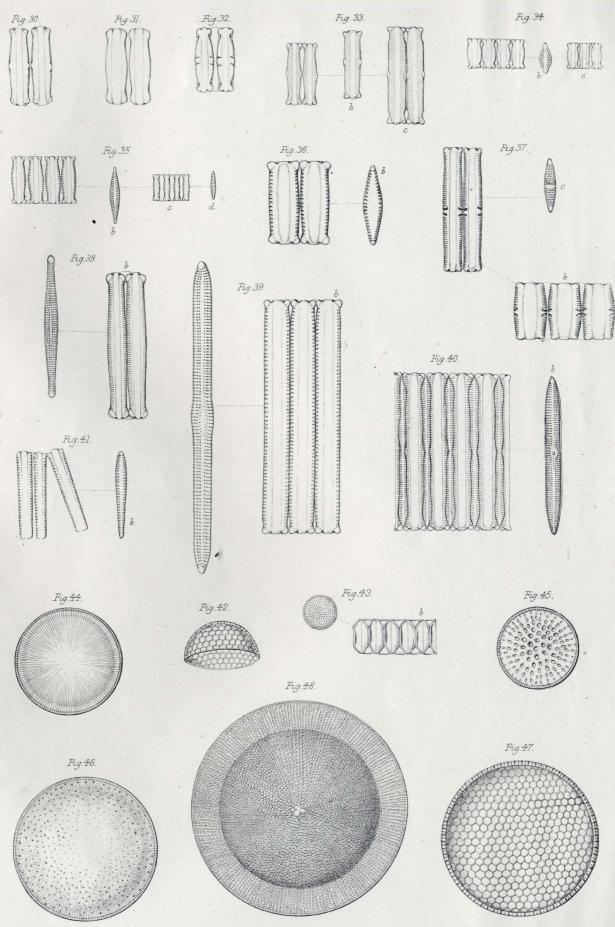
Fig	. 1	Navioula	minor, n. sp.	Fig	16	Navienl	a Smithii, var. γ, nitescens.
1.15			Cluthensis, n. sp.			***	
	3.	***	inconspicua, n. sp.		NAME OF THE OWNER, OF THE OWNER, OF THE OWNER, OF THE OWNER, OWNER, OWNER, OWNER, OWNER, OWNER, OWNER, OWNER,		maxima, Greg., S.V. and F.V.
1,000	4.		brevis, n. sp.				ria subtilis, n. sp.
	5.	20/11/1	Claviculus, n. sp., S.V. × 800.		20.		rostellata, n. sp.
		••••	5 b, do., F.V. × 800. 5 c, do.		21.		Allmaniana, n. sp.
			S.V. × 400.		22.		Pandura, Bréb., var. β . elongata.
-	6.		Musca, n. sp.				is distans, Greg.
	7.		rectangulata, n. sp.		24.		ornata, n. sp.
2	8.		nebulosa, n. sp.		25.	***	dirupta, n. sp.
	9.		Barclayana, n. sp.		26.		nitida, n. sp.
A STATE OF	10.		spectabilis, n. sp.		27.		pseudomarginata, n. sp.
	11.		praetexta, Ehr.		28.		major, n. sp.
	12.	***	Bombus, Ehr.		29.		splendida, n. sp.
	13 &		Lyra, Ehr.		Section 19 and		except figs. 5 and 5 b, are magnified
	14 &	The state of the s	Lyra, var. β.	70.00		00 dian	
	15.		Smithii, var. β , fusca.				



W.West ing

EXPLANATION OF PLATE II.

Fig	. 30. Denticula (?) interrupta, n. sp.	Fig. 40. Diadesmis (?) Williamsoni, F.V., 40 b; do.
-	31 (?) capitata, n. sp.	S.V.
1	32 (?) ornata, n. sp.	— 41. Meridion (?) marinum, n. sp., F.V., 41 b; do.
-	33, 33 b, & \ (2) Impris	S.V.
	000,	— 42. Pyxidicula cruciata, Ehr.
-	34 nana, n. sp., F.V. 34 b; do. S.V.	43. Orthosira angulata, n. sp., F.V., 43 b; do. F.V.
-	35, 35 b, & 35 c, minor, n. sp., F.V. 35 d; do. S.V.	44 75 1 : (0) 5 (0)
		n. sp.
	36 distans, n. sp., F.V. 36 b; do. S.V	V. — 45. Coscinodiscus nitidus, n. sp.
-	37 & 37 b,staurophora, n. sp., F.V. 37 c; do.S.V	V. — 46 punctulatus. n. sp.
	38 fulva, n. sp., F.V. 38 b; do. S.V.	7. — 47 concavus, Ehr.
	39 marina, n. sp., 39 b; do. S.V.	— 48 umbonatus, n. sp.
	All the above are	e magnified 400 diameters.



R.K.C. del. Tuffen West sc.

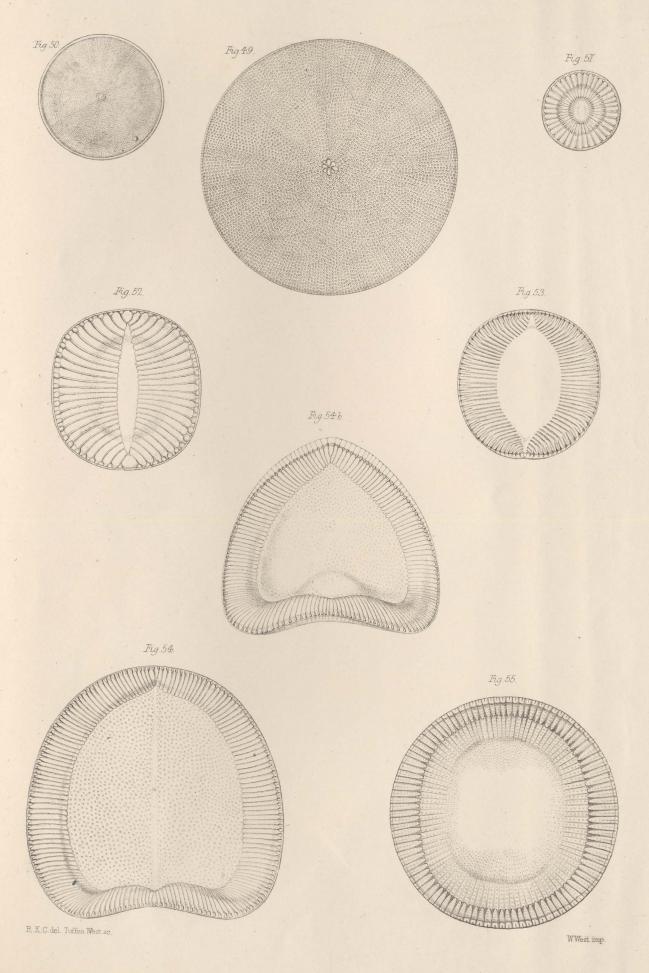
EXPLANATION OF PLATE III.

Fig.		Coscinodiscus centralis, Ehr.
-	50.	Eupodiscus subtilis, n. sp., Ralfs.
-	51.	Campylodiscus centralis, n. sp.
	52.	Ralfsii (?) Sm.

Fig. 53. Campylodiscus angularis, n. sp. — 54 & 54 b, ... eximius, n. sp.

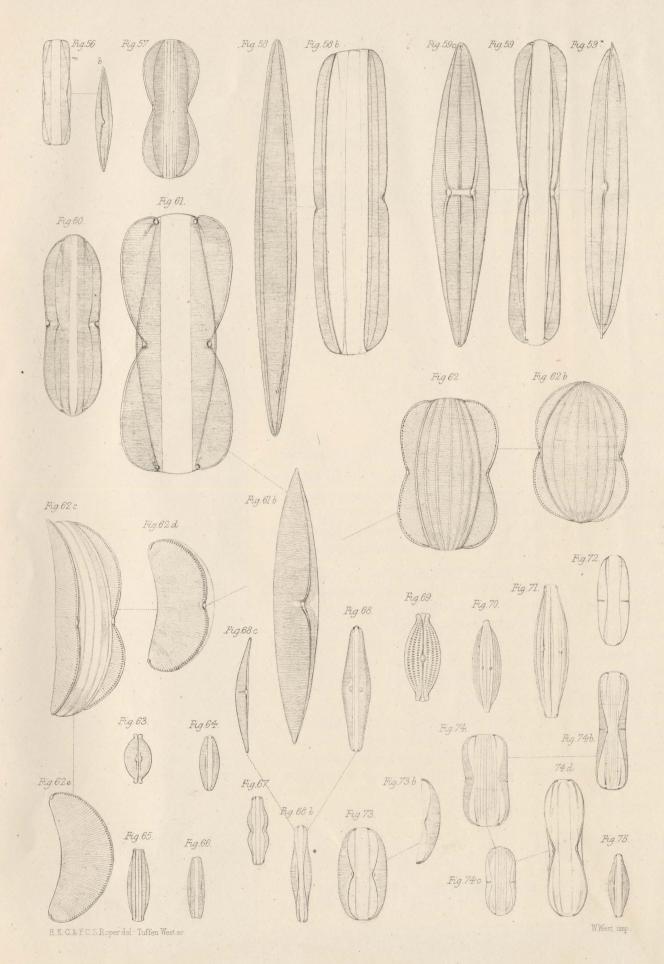
- 54 & 54 b, ... eximius, n. sp. - 55. ... limbatus, Bréb.

All the above are magnified 400 diameters.



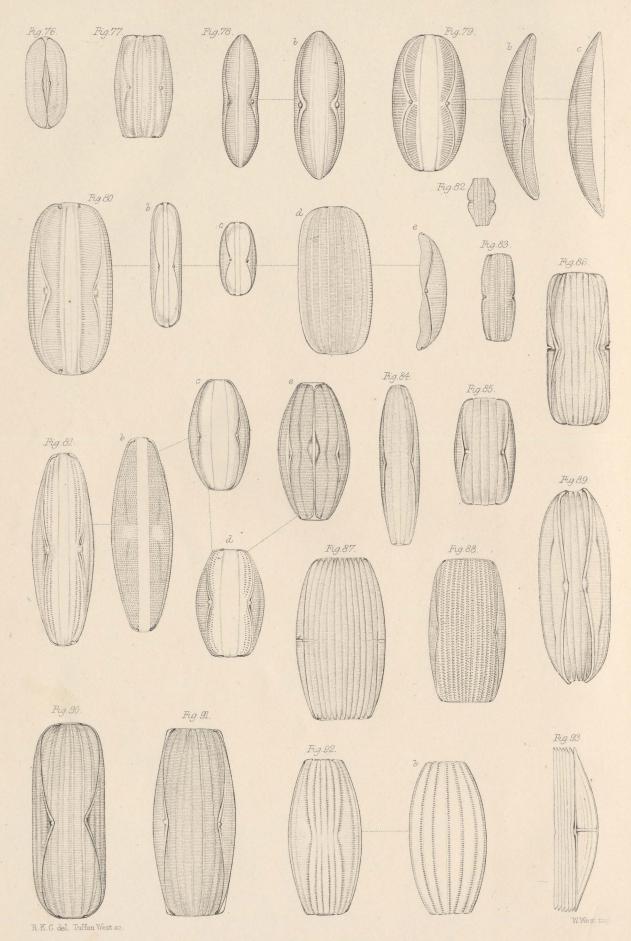
EXPLANATION OF PLATE IV.

Fig.	56.	Amphipro	ra pusilla, n. sp., F.V., 36 b;	o. Fig	. 64.	Amphora	nana. n. sp.
			S.V.	-	65.		macilenta, n. sp.
-	57.	1444	plicata, n. sp., F.V.	-	66.		angusta, n. sp.
-	58.		elegans, Sm. S.V., 58 b; do. F.	V	67.		binodis, n. sp.
-	59.		lepidoptera, n. sp., F.V., 59	; -	68 8	& 68b.	ventricosa, n. sp.
			do., S.V., 59 c; do. peculi	ır —	69.		monilifera, n. sp.
			view.		70.		lineata, n. sp.
	60.		obtusa, n. sp., F.V.		71.	117	Ergadensis, n. sp.
	61.	***	maxima, Greg., F.V., 61 b; d	0	72.		lævissima, n. sp.
			S.V.	-	73.		pellucida, n. sp., 73 b; half frus-
-	62	& 62 b (?)	complexa, n. sp., F.V. entire	:			tule of do.
			62 c; do. half frustule, 62	d -	74.	74 6. &	lævis, n. sp., 74 d; Amphora, qu.?
			and 62 e; do. detached se	r-	74	£ c.	a form of A. lævis?
			ments.				are magnified 400 diameters.
	63.	Amphora	turgida, n. sp.	1		0_ 11	Gamea 200 diameters.
			700 ON 174				



EXPLANATION OF PLATE V.

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Fig. 75. Amphora exigua, n. sp.
                                                   Fig. 82. Amphora lyrata, n. sp.
    76. ...
                dubia, n. sp.
                                                                      Milesiana, n. sp.
— 77. ... truncata, n. sp.
                                                                      elongata, n. sp.
- 78 & 78 b.
                oblonga, n. sp.
                                                                      quadrata, n. sp.
— 79. ...
                robusta, n. sp., 79 b and 79 c; half - 86.
                                                                      excisa, n. sp.
                  frustules.
                                                    - 87.
                                                                      nobilis.
__ 80. ...
                 spectabilis, n. sp.; 80 b; do. var. \beta, — 88.
                                                               ...
                                                                      Arcus, Greg.
                  80 c; do. var. γ; 80 d; do. view — 89.
                                                                      Grevilliana, Greg.
                  showing the complex structure of the - 90.
                                                                     fasciata, n. sp.
                  species; 80 e; do. detached segment. - 91.
                                                                     complexa, n. sp.
    81,816,81)
                                                        All the above are magnified 400 diameters.
     c, 81 d, & ... Proteus, n. sp.
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EXPLANATION OF PLATE VI.

Fig.	93. Ampho	ra acuta, n sp detached sogment.	Fig 100 e) A 1 1 m :
0	<u>L</u>	93 b: do, pack of similar seg-	Fig. 100 & Amphora bacillaris, n. sp., simple and complex views.
		ments.	complex views.
	94	crassa, n. sp, 94 b, 94 c, and 94 d;	— 101. Navicula (?) Libellus, n. sp., 101 b; do, edge
	01	crassa, n. sp, 94 0, 94 c, and 94 d;	
		do. detached segments.	— 102. Nitzschia (?) panduriformis, n. sp.
1	958.956	pusilla, n. sp., simple and complex	103 distans, n. sp., 103 b, do. S.V.
	,	pusilla, n. sp., simple and complex views.	— 104 hyalina, n. sp., 104 b, do. S.V.
	1	···granulata, n. sp., simple and com-	Try continue, it. Sp., IUT O. U. V.
-	96, 96 b,	plex views of two frustules;	-105 $& 105 b$, Pleurosigma ? reversum, n. sp.
		96 f, detached segment; 96 e;	
	96 7	form and all the segment; 96 e;	
	30 a,	form qu.? allied to A. granu-	- 107. Synedra undulata, Greg. (Toxarium undula-
		lata ?	tum Bailey). Two specimens of the
	200	···cymbifera, n. sp., simple and com-	SV the one straight the other and
-	97 & 97 b, {	plex views, 97c; detached seg-	uate.
		ment of do.	
			— 108 Hennedyana, n. sp., S.V.
-	98 & 986,	ploy views 00 1 00 7	APPENDIX.
	00000,	plex views, 98 c, and 98 d;	
	00	detached segments of do.	— 109. Creswellia (nov. gen.) Turris, n. sp., Arnott.
-	99	costata, Sm., detached segment.	All the above are magnified 400 diameters.

