REPORT ON THE DIATOMS OF THE ALBATROSS VOYAGES IN THE PACIFIC OCEAN, 1888–1904.

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[Assisted in the bibliography and citations by P. L. RICKER.]

INTRODUCTION.

The paper here offered is a report of the diatoms found in the sea dredgings and soundings of the United States Bureau of Fisheries steamer *Albatross*, which covers all the material collected and available up to January 1, 1905, exclusive of what is embraced in a short report already published by the author.[a]

The preliminary work was done in the Smithsonian Institution, Washington, D. C., during the winters of 1899–1900 and 1904–5. The crude material, as a rule bottled and preserved in alcohol, was first examined under the microscope, using magnifying powers ranging from 23 to 590 diameters, so as to discover which gatherings gave promise of affording diatomaceous material. In very many cases no trace of diatoms was discoverable. The gatherings thus selected were then prepared for more accurate investigation by methods that are briefly described as follows:

The mud is first passed through a sieve of bolting cloth with a mesh of about one thirty-second inch, so as to strain out large pieces of foreign material, such as bits of animal tissue, fragments of shells, etc. The alcohol is then eliminated by washing in filtered or distilled water in a glass beaker and decanting of the liquid after all solid material has settled. The mud is next boiled in a beaker with concentrated commercial hydrochloric acid for one-half hour. The acid when cold is decanted and the residue washed with water to get rid of the resultant salts. The material is then boiled in concentrated commercial nitric acid for fifteen to thirty minutes and again washed. This suffices in

[a] Proc. U. S. Nat. Mus. **16**: 303–312. 1894.

many instances to destroy all organic matter and to prepare for the further step of separating the diatoms from coarse sand, Radiolaria, etc. Often, however, a third treatment is necessary, especially where the percentage of organic matter is high and where clay is present. The third boiling is in concentrated commercial sulphuric acid. As much water as possible is extracted from the mass by careful decantation and removal of the last drops with a pipette. The acid is then slowly added, the quantity being about ten times the volume of the mass, and the whole is boiled in a porcelain evaporating dish over a sand bath for one-half hour. At the expiration of this time powdered potassium chlorate is slowly added to the boiling acid until the black color gives place to a gray or yellow. Very thorough washing follows this to remove the last trace of acids and salts. In those instances where a fine siliceous flock is present, this can be removed by bringing the washed residue to a boil in a solution of soap, made by adding about 5 per cent of a saturated alcoholic soap solution to distilled water. The soap water holds the flocculent matter in suspension and allows its removal by decantation. As, however, very delicate forms like Chaetoceros, Nitzschia, etc., are liable to be lost by this method, it is to be used only where unavoidable.

The coarse sand, Radiolaria, and like impurities are now removed by rotating the material in a glass evaporating dish. By quickly revolving the lowest point of the dish in a small circle of, say, one-half inch a peculiar motion is given to the contents, on account of which the large sand and other coarse ingredients collect in a mound at the center, while the diatoms are held in suspension. The liquid is quickly poured off from the sand, the process being repeated until the sand is found under the microscope to be free from diatoms. The cleaned diatoms are then preserved in bottles in a 40 per cent solution of alcohol with distilled water.

In the preparations accompanying this report the diatoms were picked up separately with a mechanical finger from strewn masses of the cleaned material and mounted singly in the proper medium, generally Canada balsam. They are attached to the cover glasses of the preparations by a delicate film of acetic-acid gelatin, and so placed as to occupy the center of a minute ring of india ink spun on the glass slide. This mounting each specimen separately as a labeled preparation, although involving much labor, was the only satisfactory method of rendering available for future examination the forms herein described. Strewn slides of diatomaceous material containing certain species, like the H. L. Smith type slides and most of those of Cleve and Möller, are valuable; but every student consulting these for identification must have felt the great inconvenience and uncertainty of hunting among a mass of mixed diatoms for a certain species, the exact appearance of which is, under the circumstances, not

known. Only when each species is mounted by itself and in such a position on the slide as to be instantly found under the microscope can diatom preparations be considered worthy to be compared with other scientific specimens of reference.

In addition to these preparations of single forms, representing each species found, this report is accompanied by a series of group slides of selected forms. Each of these preparations has from 10 to 100 diatoms, arranged in rows on the cover glass or massed in the center of the india ink ring. Their purpose is to afford a type gathering of each of the more important diatomaceous dredgings and soundings examined.

As has been remarked, a large number of the *Albatross* gatherings were found to be destitute of diatoms. Naturally, these barren samples included most of those obtained at great depths, say 1,200 fathoms and upward. There are, however, many cases where deep dredgings were particularly rich in diatoms, as, for example, station 3607, having a depth of 987 fathoms, and 3712II, at 1,744 fathoms. It was also found that a considerable number of the gatherings made in shallow water and at points where diatoms would naturally be looked for contained no trace of them. It would certainly be a mistake to infer from the absence of diatoms in most of the deep-sea gatherings and in many of those from shallower places or from the sea surface that none were present at these points. In many instances their absence is to be explained by the methods by which these gatherings were made. It is evident that devices perfectly adapted to securing larger forms of animal and vegetable life may fail completely to retain any specimens of these very minute plants. The modes of making the gatherings, the way they are brought aboard the ship, and the process of assorting the contents would often eliminate all traces of the diatoms, at least of all forms that grow without attachment to other bodies. Diatoms are to be found in richest quantity in the upper and lighter layers of mud of the sea bottoms, and those on the surface of the sea can be secured only when a special appliance is attached to the tow nets. As a consequence, a large majority of the gatherings now in the possession of the U. S. National Museum are destitute of diatoms, although many of them were made at points where with different methods rich supplies could have been secured. The cruise of the *Albatross* under Dr. Alexander Agassiz, just completed, is reported, however, to have resulted in obtaining an unusually rich supply of the diatoms.

I have tried to supply this deficiency of diatomaceous material in some of the dredgings by examining the contents of the stomachs of animals, chiefly holothurians, taken at these points. This is, however, a very partial and unsatisfactory substitute. The stomach contents are generally rich in diatoms, so far as number of individuals

is concerned; but as the diatoms would find their way into the stomachs of these animals only in connection with the grosser material on which they feed, the forms thus secured would represent only such as happened to be mixed with or attached to their food. A host of other forms, on or in the sea mud in that vicinity, would therefore be missed entirely.

As our Government, so far as I can learn, has not, previously at least to the last cruise just mentioned, made any special effort to collect the diatoms, in connection with its general gathering of other organic forms, I think it will be opportune to point out here the great importance of this work being thoroughly carried on in the future. The Diatomaceae are not only equally worthy of investigation with other forms of plant and animal life as inhabitants of the ocean surfaces and beds, but they have a unique value, shared by no other forms, for determining important questions regarding the extent and direction of ocean currents and the origin of the materials composing the sea bottoms. This comes from several peculiar circumstances affecting the diatoms: The first is the indestructibility of their siliceous remains; whence it results that, unlike most aquatic plants, they are not subject to decay, those which were formed centuries ago being as well preserved as those of this year's product. This is also true of some other organisms, as the Radiolaria and the siliceous parts of sponges. But, second, the diatoms differ from these in being as a class of such extreme minuteness as to be readily transported by even quite slow ocean currents or surface drifts from their places of origin to remote points and finally sifted down upon the sea bottom. No other organism of permanent structure has any such transportability. Both of the foregoing facts, however, would be of little importance for the purposes mentioned were it not for the third circumstance, that the Diatomaceae constitute an enormous group of plants containing somewhat above 4,000 well-known species. Many of these are exclusively fossil, and are therefore derivable only from those localities on the land where the geological stratum in which they occur crops out and is subject to "weathering" and other methods of detrition, resulting in carrying these forms into streams and rivers and finally into the sea. Other forms, fresh water as well as marine, are peculiar to certain localities; and, in point of latitude, there is a tropical, a temperate, and a frigid flora among the diatoms as well as among the phanerogams. So that when the siliceous remains of these species are discovered on the sea bottom or in surface gatherings there are trustworthy data available for determining their place of origin and consequently the direction and extent of the currents or drifts by which they were transported. A proper tabulation of the species found at the different stations would be, for these reasons, an exact means of tracing ocean currents, and in

many instances of determining the origin of the materials composing the sea bottom in which they were found.

The investigations here reported are of value for the purposes just mentioned mainly as a means of illustrating the necessity of wider and more thorough work in this line. Nor can these valuable results be secured unless methods particularly adapted to securing djatoms are added to those commonly in vogue in sea dredgings and surface gatherings. As both the expenditure of time and the expense incident to combining these researches with those already being carried on would be insignificant compared with the results to be obtained, it is reasonable to hope that the necessary measures will be taken.

In the body of this report there will be found many references to the service the diatoms are capable of rendering in the determination of sea currents and of the origin of sea bottoms. A few examples may be cited here. In the United States cable survey from California to the Hawaiian Islands and return,[a] a long series of soundings from the stations numbered 2655H to 3202H were found to be very rich in the rather uncommon quadrate variety of *Biddulphia favus* (Ehrenb.) Van Heur. They constitute a practically unbroken series beginning with station 2912H in latitude 155° 58′ 30″ W., longitude 22° 18′ 00″ N., running westward to the Hawaiian Islands and on the return voyage eastward ending at about the starting point, namely at station 3018H in latitude 155° 57′ 30″ W., longitude 21° 56′ 00″ N. This form, therefore, is as truly a local species at this part of the sea as any phanerogam is of a terrestrial locality. And this is confirmed by one of H. L. Smith's type slides, No. 599, equally rich in this variety, which he says came from the "*Tuscarora* soundings south of Sandwich Islands in 1,468 fathoms," a depth duplicated by several of the soundings in the series just referred to. Similarly on the outward voyage at station 2917H a sounding was made containing, in addition to the quadrate *B. favus* already mentioned, a number of other diatoms, as *Coscinodiscus nodulifer* Jan., *Navicula aspera* Ehrenb., *Navicula lyra* Ehrenb., *Navicula splendida* Greg., *Hemidiscus cuneiformis* Wallich; and on the return voyage at station 3013H these same diatoms were found. The two stations differ in latitude only 6′ 30″ and in longitude only 5′ 30″. This locality is therefore characterized by the foregoing combination of species. Boyer[b] speaks of *Biddulphia robertsiana* (Grev.) Boyer as quite rare and coming from Pacific soundings 20° 10′ 00″ N. and 158° 14′ 00″ W., etc. I found it in large quantities at 21° 21′ 00″ N. and 157° 09′ 00″ W., namely, at station 2920H. So also Boyer discovered his *Biddulphia keelei* on the coast of California; and it is abundant in the soundings of station

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[a] Townsend, C. H. Dredgings and other records of the U. S. Fish Commission steamer *Albatross*. Rep. U. S. Comm. Fish. **1900**: 387–562. 1901.

[b] Proc. Acad. Phila. **1900**: 707. 1901.

4505H made near the mouth of Aptos Creek in Monterey Bay, California, in 10 fathoms. *Biddulphia papillata* (Gr. & St.) Mann, is not infrequent at station 2920H, that is, near the west coast of the Hawaiian Islands. The original specimen was discovered in the fossil deposit at Oamaru, New Zealand; but two subsequent finds of this rare diatom, one by Grove and one mentioned by Schmidt,[a] were made in the same vicinity as station 2920H. A solution of the question of origin of these forms at this point of the sea bottom, to which they were necessarily transported (the depth being 570 fathoms), would doubtless be of interest.

Many species first found in Bering Sea and showing their origin in their names, as *Coconeis arctica* Cleve, have been rediscovered in these investigations at the type localities. References to these coincidences will be found in the text of this work under the several species.

Though not included in the work here reported, I wish to mention another case recently brought to my notice which illustrates the value of diatoms in determining locality on the sea bottom. In the cable survey of the U. S. steamer *Nero* a series of soundings was made over a long belt of sea bottom between the islands of Guam and Luzon which I find are full of the gigantic *Coscinodiscus rex* Wallich, a diatom by no means common, but found here in such enormous quantities that the gatherings are often a pure siliceous mass of the remains of this one species. This belt is over 3,000 miles long east and west and of unascertained width, perhaps 20 miles or a little over. On the return voyage, whenever the ship's course entered this belt great quantities of this diatom were again secured. Thus, for example, at survey station 746, latitude 14° 24′ 00″ N., longitude 135° 31′ 00″ E., 2,788 fathoms, the material is practically pure *Coscinodiscus rex*. Unquestionably such enormous quantities of this single diatom must have been transported to this belt of sea bottom by long-continued and constant currents; and it would therefore be quite possible, by the study of soundings and especially of surface gatherings made in the future, to determine the origin of this vast supply and consequently the trend and extent of the transporting current.

In connection with more thorough and extensive work upon the diatoms for the purposes already mentioned, the Government would be doing valuable service in adding to the supply of available and trustworthy literature on the Diatomaceae. Probably no department of botany is at the present time in such dire confusion and supplied with such meager literature. Many of the authoritative works on the subject were long since out of print, and are either not procurable at any price or so expensive as to make impossible the systematic study of these plants by new investigators. A series of good works easily procured would be a stimulus to further study. As in all

[a] Schmidt, Atlas *pl. 162*, 1891.

special departments of science, the demand for such literature would be limited. But where properly prepared it would be, unlike some forms of scientific literature, permanently authoritative. Many of the works referred to in this report date back to a period of fifty or more years ago, yet remain to-day of the highest value; whereas scientific investigations in other fields, prepared at that date with equal care and skill, are to-day antiquated and worthless.

On account of this scattered and unsatisfactory character of the literature upon this subject, there is some hesitation in publishing the identifications that follow, and in one or two cases in naming the new species here figured and described for the first time. Nearly every work of any merit on this subject has been consulted for this report (see appended list); but if, as is likely, errors have crept in, their correction will be gratefully acknowledged by the writer.

In the following list of genera and species the authors quoted are those who first formed and applied the names now given. But in many instances subsequent investigators have so modified and reconstructed the original conceptions as to entirely change their application. There are a few instances in which the development of a peculiar genus concept has been the gradual product of many investigators, who have more or less perfected the genus as it now stands. It would be practically impossible to give credit to all these scientists without going into the subject of nomenclature beyond the limits of space justified in a descriptive report of this kind. In such instances reference is therefore made to such works as contain an accurate and thorough history of this development. Thus, for example, the genus Coscinodiscus was formed by Ehrenberg in 1840, but included many forms now classed elsewhere, while it excluded some forms now recognized as members of this genus. Rabenhorst, Gregory, Greville, W. Smith, Van Heurck, Grove, Grunow, Rattray, and others have helped to modify and correct the original boundary of Ehrenberg's conception.

From some genera all the original species have been removed, the name still being retained "emended" for a group of diatoms wholly different from that to which it was originally applied. This method of work will hardly meet with the approval of present systematists. A careful examination of the original publication and application of all genera of Diatomaceae will be necessary before their classification can be placed on an enduring basis.

A critical study by Mr. Ricker of the literature bearing upon the types of over one hundred genera included in this report has demonstrated the impracticability of extending this work to include all the generic names here considered, as the time required would seriously delay the publication of the report. The traditional application of the generic names has therefore been followed in the

majority of cases, the few changes made being on account of an earlier known valid name or homonym.

In syaonymy, also, both as to genera and species, a strictly exhaustive list has not here been attempted. There are instances where the horde of synonyms would be so great as to become most misleading unless accompanied by extensive explanations. Thus, this same genus Coscinodiscus is wholly or partly synonymous with Symbolophora Ehrenb., Endyctia Ehrenb., Odontodiscus Ehrenb., Heterostephania Ehrenb., Cestodiscus Grev., Cosmiodiscus Grev., Stoschia Jan., Janischia Grun., Micropodiscus Grun., Willemoesia Castr., Ethmodiscus Castr., etc. To enter into a discussion of the intersecting boundaries of all these untenable genera and discuss the reasons for their abandonment would be quite foreign to the purpose of this report. With species the synonyms are even more abundant. Thus, for example, *Actinocyclus ehrenbergii* Ralfs has somewhat over 120 synonyms. Manifestly to give in full this and similar lists in a work of this kind would be to obscure rather than to aid the purpose here in hand, namely, a report of the Diatomaceae found by the steamer *Albatross*. Therefore, as has been stated, a strictly exhaustive list of synonyms has not always been attempted. In a few instances where the number is abnormally large the writer has omitted those which are so trivial and obscure as to give no promise of being useful in the future study of these plants.

The generic and specific names assigned are given according to the rules now generally prevailing in botanical nomenclature. This has necessitated in some instances the substitution of obscure and inappropriate names for those universally known and recorded among living diatomists. The writer feels it to be a grave misfortune, for which some remedy should be found, that no alternative is provided in these cases. At this time, when the much-needed systematizing of our nomenclature is being attempted and drastic measures are being taken to that end, it should be possible by the concurrence of living diatomists (the number of whom is not great) to agree to the preservation of a few classical names, and especially the names of certain genera by making them exempt from these changes. This would save the most valuable works of the science from being unintelligible to future students, and would in no wise interfere with the application of strict rules to new cases in the future. The genera and species needing this exception are so few as to make this suggestion wholly practicable, and the writer sincerely trusts that some scheme will be devised to retain certain names universally known to

the science which have been set aside in this work for the first time. Thus would be preserved the old name Pleurosigma for Gyrosigma; the old name Aulacodiscus for Tripodiscus; the old name Arachnoidiscus for Hemiptychus; the old name Rhabdonema for Tessella. It is little short of vandalism to call that universally known diatom *Pleurosigma angulatum* by the hitherto unknown compound here applied to it, *Gyrosigma thuringicum*.

The large number of citations to diatom literature in this report, together with the many taxonomic questions involved, have demanded a most careful review of the manuscript. This has been undertaken by Mr. P. L. Ricker, of the Department of Agriculture. The task has been accomplished with such accuracy and thoroughness as to greatly increase the value of these portions of the report. In expressing here my thanks to Mr. Ricker for his able cooperation I wish at the same time to state that I hold myself alone responsible for any errors in identification or any untenable positions in taxonomy that may here occur.

The long list of stations at which the material obtained has been found to be destitute of diatoms is here omitted. The appended list of stations will be found to give the exact location of each station by latitude and longitude, the sea temperature at the surface and at the bottom, the depth in fathoms, the character of the sea bottom, and the general position along the coast. By referring in this table to the stations mentioned under each species all the available data regarding any diatom or any diatomaceous gathering can be secured without the text being cumbered with repetitions. There is also added a full bibliography of works used in preparing this report.

The purposes of these investigations have been three:

First. That of contributing to the systematic study of this group of plants.

Second. That of affording a collection of carefully identified specimens of all species here enumerated, including the types of all new species herein named, for the use of future investigators. This has been placed at their disposal in the United States National Museum.

Third. That of calling attention to the value of further investigations in this field for the purposes previously discussed—namely, for throwing valuable light upon certain meteorological and geological problems connected with marine investigations.

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U. S. NATIONAL MUSEUM,
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ANNOTATED CATALOGUE OF GENERA AND SPECIES.

The following key to the genera included in this report is offered merely as an aid in identifying these genera. From a phylogenetic standpoint its value is probably small. The arrangement is practically that of F. Schutt in Engler & Prantl's Pflanzenfamilien,[a] the changes being mainly the restoration of the earlier names of some of the genera in the place of those given by Schutt. Some slight rearrangement has been found necessary, for reasons explained in the text, as the placing of Vanheurckia, Reicheltia, and other genera under Frustulia, and the closer union of Actinocyclus with Coscinodiscus. Minor changes in the wording were also required in a few places. This general arrangement of Schutt appears more workable than that of H. L. Smith,[b] on which it is partly based. They both avoid the fatal difficulty of the classification of Pfitzer,[c] worked out on the basis of chromatophores, etc., of the living cell. Although Pfitzer's arrangement is of great biological value, its distinctions are so uncertain of application to the diatoms as a class, the great majority of which are known only in a fossil state, that it can never come into general use from a taxonomic standpoint.

No attempt is made here to carry the classification down into the separate species of the different genera. Despite the great industry and ability in making keys to the species based on verbal distinctions exhibited in the monographs of Cleve, Rattray, and other diatomists, the writer must confess to his inability to use these with any feeling of security. Verbal descriptions are very valuable, but without accompanying illustrations they are rarely conclusive. The differences between species being based on the varied and often immensely complicated sculpturing of the valves, it is almost impossible to describe these differences clearly and at the same time tersely enough to serve the purpose of analysis. A good photograph or drawing of a diatom will always be of more value for identification than any amount of word painting. As it is not practicable to accompany this report with figures of all the species here enumerated, copious references are given to works in which satisfactory illustrations are to be found.

SYNOPTICAL KEY.

Subfamily I. **CENTRICAE**. Valve centrally built; that is, arranged in relation to a central point or focus rather than in relation to a median line; outline circular, oval, or elliptical, sometimes polygonal, rarely crescent-shaped or spindle-shaped; neither a raphe, cryptoraphe, nor pseudoraphe present; valve-markings either concentric, radial, decussating, or irregular, never pinnate; processes (horns, spines, etc.) common.

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[a] Pflanzenfamilien, A. Engler & K. Prantl, Theil I, Abteilung 16. Leipzig, 1896.
[b] Conspectus Diatomaceae, H. L. Smith, The Lens 1: 1-19, 72-93, 151-157. 1872.
[c] Hanst. Bot. Abhand. 3: 1871.

A. Valve circular, its surface flat or convex, sometimes hemispherical; zonal diameter generally shorter than valval (except in a few species of Melosira and Stephanopyxis); spines frequent; horns, when present, small. (DISCOIDEAE.)

a. Valves circular; not divided into definite sectors by ridges or partitions, though sometimes having radial lines of interrupted dashes. (COSCINODISCEAE.)

a. Frustules usually united into chains; each frustule in zonal view short-cylindrical, spherical, or nearly lenticular; zone sculptured. (MELOSIRINAE.)

Chains usually of many frustules; marking of valve either uniform and delicate or with a hyaline or rugose central area surrounded by a strongly sculptured band; no true central umbilicus.....*Melosira* (p. 236).

Chains usually short, of not more than 2 to 4 frustules; valve never having a strongly sculptured external part or band; a distinct central umbilicus, granular, usually contrasting strongly with the rest of the valve and separated from it by an evident wavy ridge or line; diameter of the umbilicus varying from one-half that of the valve to very minute, in extreme cases disappearing; marking of the rest of the valve delicate, radially arranged, generally of the watch-case milling pattern; sometimes divided into obscure sectors by radial delicate lines.....*Podosira* (p. 240).

Chains of many or few frustules united to each other by spines; zonal diameter of each frustule equaling or much exceeding the valval; no central umbilicus or hyaline area; valve having generally one or more circles of strong marginal or submarginal spines, (rarely near the center or scattered,) uniting the frustules into a chain.....*Stephanopyxis* (p. 243).

b. Frustules solitary; zone narrow, hyaline, or in rare cases obscurely dotted; valve circular, surface slightly convex, rarely strongly convex, sometimes approaching flat or barely concave.

(COSCINODISCINAE.)

Valve uniformly marked, with a hexagonal network or with beading arranged in radial, concentric, or decussating order; no central area sharply separated from the outer portion and strikingly contrasted with it by difference in character or coarseness of marking; marginal spines wanting or minute.

Valve without pseudonodule near or at the margin.

Coscinodiscus (p. 246).

Valve with a pseudonodule near or at the margin.

Actinocyclus (p. 260).

Valve with two strongly contrasted areas of different markings; a large clearly separated, slightly depressed central area marked with network or beading, and a broad encircling area or band marked with network of different sized mesh from that of the central area; margin of valve massive; no marginal spines .....*Craspedodiscus* (p. 264).

Valve with two strongly contrasted areas; a central area hyaline or lightly marked with radiating dotted lines, and a broad or narrow encircling area or band strongly marked with radial costea or lines of beading and usually bearing a row of submarginal spines; a portion of the central area is concentrically or excentrically elevated, so that the valve profile, as seen in zonal view, appears undulate.....*Cyclotella* (p. 265).

b. Valve circular, divided into complete or incomplete sectors by radiating ridges or wide hyaline limbs; no horns or prominent spines. (ACTINODISCEAE.)

a. Valve partly or fully divided into sectors by radiating ridges running from the margin toward or to the center; marking strong; margin massively sculptured; no process at the marginal end of the dividing ridges; sectors all on one plane. (STICTODISCINAE.)

Valve surface flat or nearly so; radial ridges many, the main ones reaching the generally rosetted center; more or less united to each other by concentric cross lines, thereby giving a spider-web sculpturing to the valve; outline of valve uniformly circular.....*Hemiptychus* (p. 266).

Valve surface often elevated at the center, one valve of the frustule more so than the other; radial ridges generally few, rarely reaching the center, which is without a rosette; no definite concentric lines forming a spider-web pattern, though a shadowy reticulation is sometimes present. Outline of valve sometimes polygonal.....*Stictodiscus* (p. 267).

b. Valve divided into sharply distinct sectors by radial ridges uniformly running from the margin to the hyaline central area; small but evident spines usually at the marginal ends of these dividing ridges; alternate sectors generally depressed; that is, sectors in two planes (ACTINOPTYCHINAE).....*Actinoptychus* (p. 269).

c. Valve sharply divided into sectors by broad hyaline bars or limbs running from a hyaline center toward or to the margin, their outer ends marked with a minute wart or spine; the hyaline center divided into more or less wedge-shaped divisions confluent with the limbs; spaces between the radiating limbs marked with fine but closely set beading, arranged in radial or decussating order. (ASTEROLAMPRINAE.)

Radiating limbs all of the same width and generally tapering to the margin; central area either reticulated or divided by straight lines into the same number of parts as the limbs.

Asterolampra (p. 272).

One of the radiating limbs narrower than the others; limbs not tapering to the margin; central area never reticulated; unequally divided into the same number of parts as the limbs by zigzag lines.....*Asteromphalus* (p. 273).

c. Valve circular; surface imperfectly divided into sectors by alternate undulating elevations and depressions, which are highest and lowest at the margin and decrease or disappear toward the center; each elevation bearing at its highest point a blunt nipple-like horn, pointing radially outward and upward. (TRIPODISCEAE).....*Tripodiscus* (p. 277).

d. Valve circular or round elliptical; surface marked with two (rarely more or only one) large opposite submarginal ocellae or ringed eyes, slightly or considerably elevated above the plane of the valve; valve markings of beading, lines, or both, arranged symmetrically with reference to the ocellae. (AULISCEAE).....*Aulisc*us (p. 281).

B. Valve oval or circular; frustule long-cylindrical, the zonal diameter much exceeding the valval; zone made up of a series of rings or imbricated bands, without internal septa; frustules united into chains by their valves. (SOLENOIDEAE.)

Valve in the form of a tall, tapering cone, its apex excentrically placed and tipped with a stout, sometimes very long, hollow bristle or spine.

Rhizosolenia (p. 283).

C. Frustule a box, with zonal diameter generally shorter, sometimes slightly longer, than the valval diameter; valve generally oval, sometimes polygonal, circular or semicircular; unipolar, bipolar, or multipolar, each pole represented by an angle or (in Chaetoceros) by a horn or spine or by both angles and horns. (BIDDULPHIOIDEAE.)

a. Horns much longer than the frustule, not tipped with a claw; frustules in chains; valve circular or oval. (CHAETOCEREAE). *Chaetoceros* (p. 285).

b. Horns generally shorter than the frustule; when longer, only slightly so and then tipped with a claw. (BIDDULPHIEAE.)

a. Valve tripolar to multipolar; angles not bearing dome-like protrusions or horns; not tipped with a claw. (TRIGONIINAE.)

Valve strong; marking distinct; no central erect spine.
Trigonium (p. 289).

Valve delicate; marking delicate; a central erect spine.
Ditylum (p. 296).

b. Valve generally bipolar, sometimes tripolar to multipolar; each angle bearing a dome-like protrusion or a horn; not tipped with a claw. ..... *Biddulphia* (p. 298).

c. Valve unipolar, oval; frustule having zonal diameter longer than valval; valve massively sculptured, unsymmetrically elevated. (Isthmiinae.)
Isthmia (p. 311).

d. Valve bipolar, tripolar, or quadripolar, each angle having a long vertical horn tipped with a claw; or in the bipolar form either as described or having the angles of only one valve turned vertically upward into short-pointed ends without claws. (HEMIAULINAE.)

Frustule in zonal view not concavo-convex, but having two similar valves; valve bipolar, tripolar, or quadripolar, each angle having a long vertical horn tipped with a claw ..... *Hemiaulus* (p. 312).

Frustule in zonal view strongly concavo-convex; the apices of the concave valve being sharply turned up into a short point destitute of a claw; center of this concave valve raised into a strong dome, lacking on the convex valve; in valval view the dome is seen to be imperceptibly merged into the rest of the valve, not separated from it by a strong rectangular ridge ..... *Ploiaria* (p. 313).

e. Horns rudimentary, reduced to low domes, or wanting; frustule in zonal view having a rectilinear outline; internal septa massive, with enlarged ends. (ANAULEAE.)

Internal septa straight, except at the tip, which is sharply bent toward the center of the frustule and enlarged into a bulbous end, so that each septum resembles a music note ..... *Terpsinoe* (p. 314).

Internal septa not straight, beginning as transverse septa on the valves near their extremities, proceeding vertically downward parallel to the zonal axis, then twice bent and extending parallel to the longitudinal axis to near the center of the frustule, similar to the internal septa in Grammatophora, the ends straight and moderately enlarged.
Porpeia (p. 315).

d. Horns wanting; valve without internal septa, semicircular, broader than long; frustule in zonal view cuneate. (HEMIDISCEAE). *Hemidiscus* (p. 316).

D. Valve narrow or broad spindle-shaped; ends elevated or knobbed; marking generally radial; center of valve usually bearing a massive process, shaped like the Greek epsilon and interlocking with the process of the next valve, thereby uniting the frustules into chains. (RUTILARIOIDEAE) ..... *Rutilaria* (p. 317).

Subfamily II. **PENNATAE.** Valve not centrally built; that is, not arranged in relation to a central point or focus, but rather to a median line; outline generally boat-shaped or rod-shaped, sometimes oval, cuneate, crescent-shaped, or sigmoid; markings generally pinnate or transverse (imperfectly radiate in some species of Campylodiscus); true raphe, or hyaline median line (pseudoraphe), or raphe obscured by lateral wings or keel (cryptoraphe) always present; processes (horns, spines, etc.) uncommon.

A. No true raphe; a hyaline median line (pseudoraphe) present, rarely obscure. (FRAGILARIOIDEAE.)

a. Frustules united to form a ribbon or zigzag chain; outline in zonal view rectilinear; zone generally composed of separate bands; valve long-oval or lanceolate. (TABELLARIEAE.)

a. Frustule in zonal view unbent; valves not concave and convex. (TABELLARIINAE.)

Valve transversely partitioned by internal vertical septa; that is, perpendicular to zone in zonal view.....*Denticula* (p. 318).

Valve not transversely partitioned (may be transversely undulate, species of Grammatophora); internal septa parallel to zone in zonal view.

Internal septa massive, generally undulate, approaching from either end of the frustule toward but not to the center, leaving a nonseptate central space which appears in valval view as a central oval in each valve; zone hyaline or longitudinally dotted.....*Grammatophora* (p. 319)

Internal septa delicate, discontinuous, not undulate, interrupted at three or more places, the nonseptate spaces appearing in valval view as so many ovals along the valve; zone or zonal bands transversely marked.....*Tessella* (p. 321).

b. Frustule in zonal view bent; one valve concave, the other convex. (ENTOPYLINAE.)

Valve transversely ribbed, the ribs on one side of the median line alternating with those on the other side, the median line therefore zigzag; internal septa on each side of the valve pierced with oval openings set in a straight row parallel to and near margins of the valve.....*Entopyla* (p. 323).

Valve transversely ribbed, the ribs on one side of the median line continuous with those on the other side, the median line therefore straight; internal septa on each side of the valve pierced with oval openings set in a zigzag row parallel to but distant from the margins of the valve.....*Gephyria* (p. 324).

b. Frustule solitary, or united into a fan or forming a spiral band; not forming a ribbon or zigzag chain; outline in zonal view rod-shaped or wedge-shaped; valve club-shaped. (MERIDIONEAE.)

Zone composed of separate bands; internal septa pierced by a row of large oval openings which in valval view give a stepladder appearance to the club-shaped valve.....*Climacosphenia* (p. 325).

c. Frustules united to form a ribbon or zigzag chain; zone not composed of separate bands. (FRAGILARIEAE.)

a. Valve with transverse septa. (DIATOMINAE)...*Plagiogramma* (p. 325).

b. Valve without transverse septa. (FRAGILARIINAE).

Dimeregramma (p. 327).

B. Frustule having one valve with true raphe, the other with distinct or obscure hyaline median line (pseudoraphe). (ACHNANTHOIDEAE.)

a. Frustule in zonal view bent, one valve concave, the other convex; outline of valve long-oval or boat-shaped. (ACHNANTHEAE).*Achnanthes* (p. 327).

b. Frustule in zonal view straight; outline of valve broad-oval or nearly round. (Cocconeideae).....*Cocconeis* (p. 328).

C. True raphe generally evident; valve generally not keeled: if keeled, the raphe coincident with keel (Nitzschia). (NAVICULOIDEAE.)

a. Valve with evident raphe; keel generally absent, or when present, without beading; markings generally pinnate. (NAVICULEAE.)

a. Frustule not wedge-shaped in either zonal or valval view; valve straight or sigmoid; never crescent-shaped. (NAVICULINAE.)

Frustule without internal compartments along the margins of the valves.

Valve without keel. (NAVICULIDAE.)

Raphe straight or barely undulate, its tips turned toward the same side of the valve; outline of valve boat-shaped. (NAVICULAE.)

Halves of the raphe not surrounded by an elevated parallel ridge; both ends of each half terminating in a rounded or elongated bead; central and terminal nodules of valve round or broadened transversely.

Navicula (p. 333).

Halves of raphe surrounded by an elevated parallel ridge, the ends not terminating in beads, or rarely the outer end of each half terminating in a round bead; central nodule greatly narrowed laterally and prolonged longitudinally, thereby separating the two halves of the raphe by a ridged space of from one-sixth to fully two-thirds the length of the valve.

Frustulia (p. 359).

Raphe strongly curved into an S, rarely into a C; sides of valve usually corresponding to the same curve; marking uniform over entire valve, of fine, closely set lines, arranged either in two series, one transverse and one longitudinal, or in three series, one transverse and the other two at angles of 60° to each other; tips of the raphe turned to opposite sides of the valve. (GYROSIGMAE.)

Gyrosigma (p. 362).

Valve with keel. (AMPHIPLEUROIDAE.)

Raphe straight, not median ..... *Plagiotropis* (p. 367).

Raphe sigmoid, median ..... *Amphiprora* (p. 368).

Frustule with internal compartments along the margin of the valve. Characters, except the lateral compartments, the same as in Naviculae. (MASTOGLOIAE) ..... *Mastogloia* (p. 368).

b. Frustule wedge-shaped in both the zonal and valval view; valve straight. (GOMPHONEMINAE) ..... *Gomphonema* (p. 370).

c. Frustule wedge-shaped as to its transverse axis, that is, the two valves approaching nearer on one side than on the other; valve more or less crescent-shaped. (COCCONEMINAE.)

Valve without transverse ribs; raphe evident.

Valve not strongly asymmetrical; the raphe nearer the median line than the concave side of the valve; zone narrow, hyaline ..... *Cocconema* (p. 371).

Valve strongly asymmetrical, the raphe much nearer the concave side of the valve than the median line; zone wide, composed of several bands, beaded ..... *Amphora* (p. 373).

Valve with transverse ribs; raphe obscure or represented by a form of pseudoraphe consisting of a continuous bow-shaped ridge.

Cystopleura (p. 377).

b. Valve apparently without raphe, this being obscured by the beaded, marginal keel; markings always transverse. (NITZSCHIEAE).
Nitzschia (p. 378).

D. Raphe hidden in lateral winged keel. (SURIRELLOIDEAE.)
a. Valve surface undulated in a series of transverse depressions and elevations.....*Sphinctocystis* (p. 382).
b. Valve surface not undulated in a series of transverse depressions and elevations.
a. Valve outline elliptical, ovoid or rarely long-lanceolate; marked with transverse ribs not quite extending to the center, thus leaving a hyaline median line; valve surface nearly flat, rarely spirally twisted; keel winged.....*Surirella* (p. 383).
b. Valve outline nearly circular; ribs or other markings radial; valve surface saddle-shaped, rarely almost flat; keel not winged.
Campylodiscus (p. 386).

MELOSIRA C. Ag.

Melosira C. Ag. Syst. Alg. 8–9. 1824. Kütz. Bacill. 48, 52. 1844; Sp. Alg. 30. 1849; Linnaea **8**: 70. 1833. Ralfs, Ann. Mag. Nat. Hist. **12**: 346. *pl. 9*. 1843. Thwaites, Ann. Mag. Nat. Hist. II. **1**: 167. 1848, in part. W. Smith, Synop. Brit. Diat. **3**: 54. 1856. Pritch. Hist. Infus. ed. 4. 815. *pl. 5. f. 62–65, 71*. 1861. Rabh. Fl. Eur. Alg. **1**: 7, 37. *f. 8*. 1864. Griff. & Henf. Micr. Dict. ed. 4. 494. *pl. 17. f. 5–6, 15*. 1883. Castr. Rep. Voy. Chall. Bot. **2**: 92. *pl. 21. f. 1–2*. 1886. Van Heur. Synop. 197. *pl. 85–91*. 1881; Treat. Diat. 438. *f. 165–168, pl. 18. f. 608–613, pl. 19. f. 614–624*. 1896. Brun, Diat. Alp. 134. *pl. 1. f. 1–5, 9*. 1880.
Gaillonella Bory, Dict. Hist. Nat. **7**: 101. 1825, not Bory. 1823.
Gallionella Ehrenb. Infus. 166. 1838. De Toni, Syll. Alg. **2**: 1331. 1894.
Lysigonium Link; Nees, Hor. Phys. Berol. 4. 1820? O'Meara, Proc. Roy. Irish Acad. II. **2**: 248. *pl. 26. f. 4*. 1875. De Toni, Syll. Alg. **2**: 1328. 1894.
Orthoseira Thwaites, Ann. Mag. Nat. Hist. II. **1**: 167. 1848. in part. W. Smith, Synop. Brit. Diat. **2**: 59. 1856.
Aulacoseira Thwaites, Ann. Mag. Nat. Hist. II. **1**: 167. 1848, in part.
Paralia Heib. Krit. Overs. Danske Diat. 33. 1863, in part. De Toni, Syll. Alg. **2**: 1349. 1894. Grun. Denkschr. Akad. Wien **48**[2]: 93. 1884. Cleve, Bih. Sv. Vet. Akad. Handl. **1**[13]: 7. 1873.

Two generic names antedate Agardh's Melosira. The first is Lysigonium Link. It seems that his type species was one of the then indefinitely fixed algae called *Conferva moniliformis*, but was probably not a diatom. At least Ehrenberg so contends.[a] Link himself, according to Ehrenberg, abandoned the name in 1824. If it can be unmistakably proved to have been applied to a diatom of this character, Link's name must replace that of Agardh. The second name is Gallionella (Gaillonella), given by Bory St. Vincent in 1823, but without definite outline or the enumeration of any species. Two years later, 1825, in the same work Bory does describe two species, *G. nummuloides* and *G. moniliformis*. But in the preceding year, 1824, Agardh gave the generic name Melosira to these diatoms and described five species. This name is therefore valid, unless, as above stated, Link's Lysigonium can be clearly identified with this genus. The genus has been variously divided by different authors. The most important attempt at division, a thing desirable in itself on account of the large number of species in the genus, was carried out by W. Smith,[b] based on the analysis of Thwaites.[c] Smith accepts the division of this

[a] Ehrenb. Infus. 166. 1838.
[b] W. Smith, Synop. Brit. Diat. **2**: 54. 1856.
[c] Ann. Mag. Nat. Hist. II. **1**: 167. 1848.

genus into two, viz: Melosira (Ag.) Thwaites and Orthosira Thwaites, rejecting, however, Thwaites's third genus Aulacoseira. Smith defines the two as follows: Melosira. "Filaments cylindrical, of numerous frustules, attached or free; frustules spherical or subcylindrical, more or less convex at the junction surfaces;" Orthosira, "Filaments cylindrical, of numerous frustules, continuous, attached or free; frustules and valves cylindrical; junction surfaces plain, line of junction usually spinous or denticulated." Schmidt, in his Atlas, and a few other authors have adopted this division, but as a general rule the distinctions are felt to be too unimportant and inconstant to warrant the change. Many authors, as Van Heurck, while rejecting Smith's division, have made use of these minor differences within the genus for subgeneric classification. The untenable proposal of H. L. Smith to unite this genus with Podosira and Hyalodiscus will be discussed under the name Podosira in this report.

Melosira ? coronaria Mann, sp. nov. PLATE LI, FIGURES 1, 2.

Valves consisting of two portions: First, a broad border curving downward, its outer half closely punctate with shining granules and its inner half marked with fine radiating lines closely set, the line of division between the punctate and striate halves being a wavy one; second, a central area raised above the border by a cylindrical hoop, seen in the zonal view, this central area being flat and perfectly hyaline. In the zonal view of the valve is seen, rising above the curved border, the before-mentioned hoop or band, the lower two-thirds of which is cylindrical and terminates in a row of small but stout tubular processes equidistant and having blunt ends, extending obliquely outward and upward, their bases surrounded by a fringe of irregular spines. Between each pair of these processes are one to three smaller ones. The upper one-third of the hoop or band, that is, between the ring of processes and the flat hyaline top, is a flaring ornamented rim. The cylindrical lower two-thirds of the hoop or band is covered with minute beading, arranged in regular 3-line order; the upper flaring one-third of the hoop or band is covered with fine vertical lines forming a leaf-like sculpture by each of four or five bending together at the top.

Diameter of valve, 0.83 mm.; height of valve (zonal view), 0.25 mm.

This diatom is certainly generically the same as *Porodiscus* (*Pyrgodiscus* ?) *calyptos* Temp. & Brun,[g] which is the same as *Porodiscus interruptus* Gr. & St.,[b] this in turn being the same as *Porodiscus hirsutus* Gr. & St.,[c] Grove and Sturt's specimens being the inner area of Tempère & Brun's. It is even closer to what Schmidt calls *P. calyptos* Temp. & Br.[d] which is misnamed, as his figures 10, 11 of the same plate, called *P. hirsutus* Gr. & St. are Tempère & Brun's type. If, therefore, my specimens are to follow the generic assignment of these very similar forms, they would bear the name *Porodiscus coronarius* Mann. But I am convinced that this generic name is utterly inapplicable to all these forms. They have nothing in common with Greville's genus except the central pore-like area.[e] As even this disappears in the figures of *P. calyptos*,[f] and in my own specimens, this character, totally inadequate in itself, is eliminated and there does not remain any semblance to the Porodiscus type. Neither can they be included in Pyrgodiscus Kitt.[g] Tempère & Brun suggest this idea by bracketing Pyrgodiscus with their name. But Kitton's genus, with its central tower-like elevation (whence the name) bearing four enormous spines with

[a] Mem. Soc. Phys. et Hist. Nat. Geneva **30**[2]: 50. *pl. 4. f. 11, 11a.* 1889.
[b] Journ. Quek. Micr. Club, II. **3**: 67. *pl. 5. f. 8.* 1887.
[c] Op. cit. 143. *pl. 14. f. 54.*
[d] Schmidt, Atlas *pl. 158. f. 8, 9.* 1890.
[e] Cf. Porodiscus Grev. Trans. Micr. Soc. Lond. n. s. **11**: 63. *pl. 4. f. 1–5.* 1863.
[f] Schmidt, Atlas *pl. 158. f. 9.* 1890.
[g] Journ. Quek. Micr. Club II. **2**: 173. *pl. 13. f. 13 a–c.* 1885.

four more a little lower and alternating, and a ring of smaller but stout spines around the basal rim, has a massive and unique aspect to which there is no analogy in the forms here under consideration. A very much closer affinity is found in Melosira. Many members of this genus have a level central area elevated above the rim by a cylindrical or conical hoop or band. In fact this might almost be said to be characteristic of the genus. For example, see *M. saturnalia* Brun.[a] where even the flaring upper rim of the band or hoop, described above, is perfectly paralleled; also *M. ferox* Schmidt,[b] where the ring of zonal processes is also paralleled. If we also remember, we have here to do with small diatoms, *P. caleyllos* being 0.06 to 0.075 mm. and *M. coronaria* 0.83 mm. in diameter, we shall see we are well within the average size of Melosira. It will perhaps be eventually preferable to construct a new genus for these allied forms, especially if other species are found which retain the essential characteristics of those already known; and this would have the advantage of simplifying somewhat the complex group of forms now included in Melosira. Careful attention to the description and the figures of *M. coronaria*, especially to the zonal view, will show that it is clearly distinct from the Oamaru or Japan specimens.

Type in the U. S. National Museum, No. 590116, from station 2807, Galapagos Islands, April 4, 1888; 812 fathoms, bottom of Globigerina ooze and coral mud.

Melosira febigerii (Grun.) Mann.

Podosira febigerii Grun. in Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 119. 1880. Van Heur. Synop. *pl. 84. f. 22–24.* 1881. De Toni, Syll. Alg. **2**: 1362. 1894.

I see no reason for including this form, nor the others so named in the above plate of Van Heurck, in the genus Podosira. If that genus is to be defined as it generally is (for full details of which see under Podosira in this report), and if Melosira and Podosira are to retain any valid marks of distinction, such forms as the above can not be separated from Melosira. In order to avoid repetition in this report, the position of the author in this matter must be considered in connection with his remarks under the genus Podosira.

As both Grunow and De Toni observe in the above citations, there is some resemblance between this species and the more robust and coarsely marked *P. hormoides* (Mont.) Kütz.,[c] a species, by the way, that Montagne rightly renamed *Melosira hormoides*.[d]

Found at station 3607, Bering Sea.

Melosira medusa Mann, sp. nov. PLATE L, FIGURE 3.

Valve with border and central area; the latter about four-fifths the diameter of the valve, has in its center a low, rugose, broad knob or boll, the rest of the area being thinly spotted with irregular flecks. The border, one-fifth the radius in width, begins internally in a row of small, granular, wedge-shaped markings, from the points of which proceed fine wavy lines to the margin. A circle separates this granulated part of the border from the outer portion. The latter, three-fourths the width of the entire border, is delicately marked with transverse lines proceeding from the points of the granular wedges, as above stated, and with finer lines interspersed between them. The lines sometimes anastomose.

Diameter of valve, 0.078 mm.

An unnamed figure of Schmidt's[e] has some resemblance to this species, though it seems entirely to lack the peculiar circle of small beaded triangles within the striated border. Schmidt there says, "Nach Grove vielleicht eine innere Schale von Stephanopyxis, vielleicht zu einem andern Genus zu ziehen." Neither of these suggestions

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[a] Schmidt, Atlas *pl. 180. f. 24–25.* 1892.
[b] Op. cit. *pl. 180. f. 23.*
[c] Kütz. Bacill. 52. *pl. 29. f. 84.* 1844.
[d] Mont. in d'Orbig. Voy. Amer. Merid. 7: 2. 1839.
[e] Schmidt, Atlas *pl. 202. f. 6.* 1896.

seems to me good. This figure of Schmidt's is practically identical with an earlier one[a] there marked "fraglich." There is also some resemblance, especially in the striation of the border, to *Melosira imperfecta* Herib.[b] The above name refers to the resemblance of this species to some of the disciform Medusae.

Type in the U. S. National Museum, No. 590117, from station 3346, off Washington, September 22, 1890; 786 fathoms, bottom of green mud.

Melosira (**sulcata** var.?) **scopos** Mann, sp. nov. PLATE L, FIGURE 4.

Valve circular, convex; the center marked with a beaded circle one-fifth the valve's diameter, the beads set wide apart in regular quadrate order; surrounding this a rugose ring extending to one-fifth the radius from the border and separated from this by a narrow hyaline band; border narrow, massive, ornamented with a double row of alternating beads; diameter of valve, 0.07 mm.

The form most nearly resembling this species is an unnamed figure of Schmidt's,[c] which, with the above, might be classed as very wide varieties of *Melosira sulcata* (Ehrenb.) Kütz. But such an identification would be altogether unsatisfactory. My species also shows a slight likeness to *Cyclotella umbilicata* (Ehrenb.) Ralfs, as figured (*Discoplea umbilicata* Ehrenb.) by Ehrenberg;[d] but, as Ralfs says,[e] though represented in Ehrenberg's figure with a punctate center that diatom has a smooth central umbo, and it is so described by Ehrenberg.[f] Ehrenberg's species is probably identical with *Melosira westii* W. Smith.[g]

Type in the U. S. National Museum, No. 590118, from station 3712H, Okhotsk Sea, September 4, 1896; 1,744 fathoms, bottom of green sand and fine mud.

Melosira sol (Ehrenb.) Kütz. Sp. Alg. 31. 1849. Pritch. Hist. Infus. ed. 4. 819. 1861. Van Heur. Synop. *pl. 91. f. 7–9.* 1881. Schmidt, Atlas *pl. 179. f. 21.* 1892. De Toni, Syll. Alg. **2:** 1341. 1894. Wolle, Diat. N. A. *pl. 58. f. 1, 2.* 1890. Truan & Witt, Diat. Hayti, 17. *pl. 4. f. 18.* 1888. Castr. Rep. Voy. Chall. Bot. **2:** 93. *pl. 10. f. 3, pl. 17. f. 3, pl. 21. f. 7.* 1886.

Gallionella sol Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 202. 1845; Mikrog. *pl. 35A. XXII. f. 12.* 1854.

Gallionella oculus Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 202. 1845.

Melosira oculus Kütz. Sp. Alg. 31. 1849. Pritch. Hist. Infus. ed. 4. 819. 1861.

Cyclotella radiata Bright. Quart. Journ. Micr. Sci. **8:** 96. *pl. 6. f. 11.* 1860.

Melosira radiata Grun. in Fenzl, Reise Novara Bot. **1:** 27. 1870.

Melosira (*sol* var.?) *potaris* Grun. Denkschr. Akad. Wien **48**[2]: 95. *pl. 5. f. 33.* 1884.

Found at station 2844, off Alaska.

Melosira sulcata (Ehrenb.) Kütz. Bacill. 55. *pl. 2. f. 7.* 1844. Rabh. Fl. Eur. Alg. **1:** 42. 1864. Schmidt, Atlas *pl. 177. f. 23–39.* 1892. Wolle, Diat. N. A. *pl. 58. f. 13, 14.* Truan & Witt, Diat. Hayti, 17. *pl. 4. f. 19, 20.* 1888. Van Heur. Synop. *pl. 91. f. 16–18, 22–24.* 1881. Pritch. Hist. Infus. ed. 4. 819. *pl. 9. f. 131, pl. 11. f. 26.* Jan. Abh. Schles. Ges. Vaterl. Cult. **1862**[2]: 10. *pl. 1. f. 22.* 1862. H. L. Smith, Sp. Diat. Typ. no. 233. 1874.

Gallionella sulcata Ehrenb. Ber. Akad. Wiss. Berl. **1837:** 61. 1838; Infus. 170. *pl. 21. f. 5.* 1838; Phys. Abh. Akad. Wiss. Berl. **1839:** 171. *pl. 3. f. 5a–e.* 1841; **1841:** 437. *pl. 1. I. f. 17.* 1843; Mikrog. *pl. 18. f. 1a–e, pl. 20. II. f. 25, pl. 25 A. XVII. f. 11, 12.* 1854.

[a] Schmidt, Atlas, *pl. 176. f. 23.* 1892.
[b] Herib. Diat. Auverg. 32 *pl. 10. f. 11.* 1893.
[c] Schmidt, Atlas *pl. 176. f. 21.* 1892.
[d] Ehrenb. Mikrog. *pl. 35B. f. 9.* 1854.
[e] Pritch. Hist. Infus. ed. 4. 811. 1861.
[f] Ber. Akad. Wiss. Berl. **1854:** 239. 1855.
[g] W. Smith, Synop. Brit. Diat. **2:** 59. *pl. 32. f. 33.* 1856.

Orthosira marina W. Smith, Synop. Brit. Diat. **2:** 59. *pl. 53. f. 338.* 1856. Lewis, Proc. Acad. Phila. **1861:** 71. 1862.

Melosira marina Jan. Abh. Schles. Ges. Vaterl.-Cult. **1862**[2]**:** 11. *pl. 1. A. f. 3 4.* 1862.

Paralia marina Heib. Krit. Overs. Danske Diat. 33. 1863.

Paralia sulcata Cleve, Bih. Sv. Vet. Akad. Handl. **1**[13]**:** 7. 1873. De Toni, Syll. Alg. **2:** 1349. 1894. Schmidt, Atlas *pl. 175. f. 6–14, pl. 176. f. 11–20, 22, 24–26, 28–29, 32–37, 44–46.* 1892. Pant. Beitr. Bacill. Ung. **2:** 80. *pl. 18. f. 295, 297.* 1886. Grun. Denkschr. Akad. Wien **48**[2]**:** 93. *pl. 5. f. 34* (?), *35–36.* 1884.

Orthosira sulcata O'Meara, Proc. Roy. Irish Acad. II. **2:** 252. 1875.

Found at stations 2823, 3691H, Gulf of California and Okhotsk Sea.

Melosira undulata (Ehrenb.) Kütz. Bacill. 54. *pl. 2. f. 9.* 1844. Van Heur. Synop. *pl. 90. f. 5–6, 8–9.* 1881. Pritch. Hist. Infus. ed. 4. 819. 1861. De Toni, Syll. Alg. **2:** 1339. 1894. Schmidt, Atlas *pl. 180. f. 1–21.* 1892. Wolle, Diat. N. A. *pl. 112. f. 4 5.* 1890. Pant. Beitr. Bacill. Ung. **3:** *pl. 3. f. 44, pl. 9. f. 146, 149.* 1893.

Gallionella undulata Ehrenb. Ber. Akad. Wiss. Berl. **1840:** 17. 1841; Mikrog. *pl. 12, f. 9a (pl. 15A. f. 8a–d?).* 1854.

Melosira punctigera Ralfs; Pritch. Hist. Infus. ed. 4. 819. 1861.

Gallionella punctigera Ehrenb. Ber. Akad. Wiss. Berl. **1842:** 339. 1843; Mikrog. *pl. 12. f. 9b–i, pl. 15B. f. 5.* 1854.

Melosira (*undulata* var.?) *normanii* Arnott; Van Heur. Synop. *pl. 90. f. 7.* 1881.

Melosira gourenii Schmidt, Atlas *pl. 176. f. 4–6* (name in *pl. 177*, footnote; see also *pl. 180. f. 21*, remark). 1892.

As De Toni indicates, it is questionable about including here *Gallionella punctata* Ehrenb.[a]

Found at stations 2680H and 2866, off central California and British Columbia.

PODOSIRA Ehrenb.

Podosira Ehrenb. Ber. Akad. Wiss. Berl. **1840:** 161. 1841; Phys. Abh. Akad. Wiss. Berl. **1839:** 158. 1841. Rabh. Fl. Eur. Alg. **1:** 7, 37. *f. 9.* 1864. Pritch. Hist. Infus. ed. 4. 817. 1861. De Toni, Syll. Alg. **2:** 1360. 1894. Van. Heur. Treat. Diat. 447. 1896. Kütz. Bacill. 52. 1844. Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]**:** 115. 1880. Petit, Fonds de la Mer **3:** 172. 1877 (sub Hyalodiscus). Castr. Rep. Voy. Chall. Bot. **2:** 109. 1886. W. Smith, Synop. Brit. Diat. **2:** 52. 1856.

Cyclotella Kütz. Bacill. 50. *pl. 1. f. II, III.* 1844, in part.

Hyalodiscus Ehrenb. Ber. Akad. Wiss. Berl. **1845:** 78. 1846. Van Heur. Synop. 213. 1881; Treat. Diat. 448. *f. 173.* 1896. Pritch. Hist. Infus. ed. 4. 814. 1861. Petit, Fonds de la Mer **3:** 172. 1877. Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]**:** 116. 1880. Castr. Rep. Voy. Chall. Bot. **2:** 139. 1886. De Toni, Syll. Alg. **2:** 1365. 1894.

Craspedodiscus Ehrenb. Mikrog. *pl. 35A, XXIII. f. 6; pl. 35B. f. 11.* 1854, in part.

Melosira C. Ag. in part; H. L. Smith, The Lens **1:** 87. 1872. Lagers. Bih. Sv. Vet. Akad. Handl. **3**[18]**:** 9. *pl. 1. f. 1.* 1876.

Pyxidicula Ehrenb. in part; O'Meara, Journ. Linn. Soc. Bot. **15:** 58. *pl. 1. f. 9.* 1876.

Actinocyclus Ehrenb. in part; Grun.; Van Heur. Synop. *pl. 118. f. 5.* 1881.

Hyalodiscus and Podosira have become indistinguishable, and in uniting them it is preferable to retain the older name, both from its clear right of priority and the misleading meaning of Hyalodiscus, none of the species being hyaline. Many authors have recognized the unity of these forms. Castracane unites them, but under the later name, Hyalodiscus. H. L. Smith went so far as to unite both under Melosira

[a] Phys. Abh. Akad. Wiss. Berl. **1870:** 56. 1871.

C. Ag. I agree with Castracane that this union is to be rejected. For, as he points out,[a] the present genus is never met with growing as Melosira invariably does- in long, solid, thread-like filaments. And although a few species of Melosira present a roughened center of the valve slightly resembling the "umbilicus" of Podosira, it is not characteristic of the genus, and where it does occur the blotch is insignificant, never shows a sutural line of separation from the rest of the valve—in short, is an altogether different thing. So that although individual valves of Melosira and Podosira may be found somewhat to resemble each other, the typical forms and the modes of growth are so widely different that their union would create much confusion and add unnecessarily to the already unwieldy bulk of Melosira. I think the only author following this plan of Smith's is Lagerstedt.

Kützing wished to merge Podosira in Cyclotella; but its generally larger size, more delicate structure, convex valves, and, above all, its prominent central umbilicus, make such a classification impossible.

Ralfs[b] distinguishes between Podosira and Hyalodiscus by stating that in the latter the valves are flat. This distinction is not true, and would not be important if it were. None of the species or varieties of Hyalodiscus are flat, though in some cases the convexity of the valve is slight. Both have the characteristic central umbilicus, bounded by an evident suture. Both show the same sort of markings, that of the umbilicus being blotched or rugose, that of the rest of the valve being delicate beading, generally arranged in curved lines, producing the appearance of "watch-case milling." Both grow in the same way, one or a few frustules joined by short, stout, gelatinous stipes. Some species previously classified as Podosira (or still so classified by anyone who runs the genus into Melosira) are wholly destitute of the before-mentioned umbilicus; but that it has been generally looked upon as an essential mark of Podosira is not only expressly stated by Ralfs, but evident from hundreds of figures of both Podosira and Hyalodiscus. Cleve & Grunow[c] get into the difficulty common with many authors of trying to distinguish between the two genera on the basis of the umbilicus. After having stated that "*Hyalodiscus* hat ein mehr oder weniger scharf abgesondertes Centrum," it is admitted that this is not universally so, as in varieties of *H. subtilis* Bail., "so dass sie sich in dieser Hinsicht gar nicht von manchen Formen der *Podosira maxima* unterscheiden!" In another place, after stating that Podosira may be looked upon as without an umbilicus, the writers add that in the case of *P. maxima* and *P. ambigua* "ein ganz entschiedener Umbilicus vorkommt." The whole discussion is a good illustration of the impossibility of holding these two genera separate. It is certainly well known to all who have examined gatherings rich in Podosira that in the same species and from the same locality the umbilicus varies greatly in size and distinctness, and individuals are not hard to find where scarcely a trace of it remains. Thus in the five species of Podosira given in the H. L. Smith type, four are with very strong umbilici; one, *P. montagnei* Kütz., a possible Melosira, without. In *P. hormoides* (Mont.) Kütz. the umbilicus is generally strong, in some cases quite small, and in at least a dozen valves on this single strewn slide almost impossible to see. Van Heurck[d] says: "The Hyalodiscus are not essentially different from Podosira, except in the umbilicus, which is more or less distinct according to species."

If, therefore, we remove from this genus the forms that evidently belong to other genera, chiefly Melosira and Coscinodiscus, we may define it as follows:

Frustules growing singly or in a series of a few members, attached to a support and to the next in the series by short, stout, gelatinous stipes, centrally placed, these usually causing a pronounced "umbilicus" or rugose scar situated in the center of

[a] Castr. Rep. Voy. Chall. Bot. **2**: 139. 1886.
[b] Pritch. Hist. Infus. ed. 4. 814 815. 1881.
[c] Sv. Vet. Akad. Handl. **17**²: 115 116. 1880.
[d] Van Heur. Treat. Diat. 448. 1896.

of each valve; the umbilicus generally (not always) separated from the rest of the valve by an irregular line or suture; size of the umbilicus varying from a mere speck (rarely wanting) to two-thirds the diameter of the valve; valves slightly convex to hemispherical; markings, outside of the umbilicus, of delicate beading arranged in close straight or curved lines crossing each other obliquely to the radii; radial lines, continuous or discontinuous, sometimes proceeding from the umbilicus toward or to the border, in the latter case dividing the valve into unequal segments; border narrow, hyaline; connecting zone narrow, hyaline.

Podosira argus Grun. in Schneider, Beitr. Kennt. Kauk. 132. 1878; Jour. Roy. Mier. Soc. **2:** 691. *pl. 11. f. 6.* 1879. De Toni, Syll. Alg. **2:** 1364. 1894.

Podosira variegata Schmidt, Atlas *pl. 140. f. 3 6.* 1889. Wolle, Diat. N. A. *pl. 69. f. 3.* 1890.

Podosira pacifica Chase in Walk. & Chase, Notes on Diatoms **1:** 5. *pl. 1. f. 5.* 1886.

This exquisitely beautiful diatom is a wide departure from the type of this genus. The umbilicus is reduced to an indefinite scar, which is sometimes wanting. The valve is divided into three definite areas, like those of Cestodiscus, but without processes. It agrees in these particulars with the equally aberrant *Podosira* (*Pyxidicula*) *radiata* O'Meara.[a] Both these stand so much alone that they almost merit separation from this genus. It will, however, be observed that three authors independently assigned it to the present genus. There is also a close enough likeness to *Podosira corolla* Schmidt,[b] to give support to this identification.

The species is fairly abundant at station 2920H. I am quite sure that in all the specimens examined the massive bosses ornamenting the central area are not, as Schmidt claims, thickenings on both sides of the valve, but are on the under (concave) side only. The outer of the three bands is also different, being not hyaline but plainly crossed with two sets of lines, diagonal (45°) to the radii, as is common in this genus; within this is the band of fine radiating lines, as depicted by Schmidt.

Found at stations 2920H and 3008H, California to Hawaiian Islands.

Podosira stelliger (Bail.) Mann.

Hyalodiscus stelliger Bail. Smithson. Contr. Knowl. **7:** 10. 1854. Van Heur. Synop. 213. *pl. 84. f. 1, 2.* 1881; Treat. Diat. 448. *f. 173, pl. 22. f. 650.* 1896. De Toni, Syll. Alg. **2:** 1367. 1894. Pritch. Hist. Infus. ed. 4. 814. 1861. Grun. in Fenzl, Reise Novara Bot. **1:** 27. 1870. Cleve, Bih. Sv. Vet. Akad. Handl. **1**[3]: 4. 1873.

Craspedodiscus? stella Ehrenb. Mikrog. *pl. 35B. IV. f. 11.* 1854; Ber. Akad. Wiss. Berl. **1854:** 238. 1855; Pritch. Hist. Infus. ed. 4. 939. 1861.

Podosira maculata W. Smith, Synop. Brit. Diat. **2:** 54. *pl. 49. f. 328.* 1856. Pritch. Hist. Infus. ed. 4. 815. 1861. Schmidt, Atlas *pl. 139. f. 7* (*f. 42* unnamed). 1889.

Hyalodiscus stelliger Bail.; Fricke's Verzeich. 1902. H. L. Smith, Sp. Diat. Typ. no. 420. 1874. Schmidt, Jahresb. Komm. Deut. Meere **2:** *pl. 3. f. 26.* 1874. Wolle, Diat. N. A. *pl. 69. f. 4–5.* 1890 (figures poor).

Hyalodiscus maculatus Cleve, Bih. Sv. Vet. Akad. Handl. **1**[3]: 4. 1873.

Melosira maculata Lagers. Bih. Sv. Vet. Akad. Handl. **3**[15]: 9. *pl. 1. f. 1.* 1876.

The peculiar radiating lines of this species, dividing the disk, outside of the umbilicus into what Bailey calls "sectorial groups" and its relatively coarse beading define this species well. It, of course, grades somewhat into other species, being like all members of this genus variable. Its umbilicus is generally small. The Cleve & Möller type no. 1 bearing this name is very wide of the mark. It has practically no umbilicus but rather a ring, small and obscure, with radial interrupted dashes, like an Actinocyclus; in fact it differs from *Actinocyclus interpunctatus* (Bright.) Ralfs

[a] Journ. Linn. Soc. Bot. **15:** 58. *pl. 1. f. 9.* 1876.

[b] Schmidt, Atlas *pl. 140. f. 11, 12.* 1889.

in little but the absence of a pseudonodule. O'Meara's description of this species[a] is deceptive and his figure is a mere caricature. The identity of *C. stella* Ehrenb. is unquestionable and is one of the few instances where Ehrenberg's diagnosis and illustration leave no doubt of the species. In this respect it differs markedly from a case to be mentioned under the next species. Both names were given in 1854. Bailey's was published in February and Ehrenberg's Mikrogeologie appeared somewhere between August 1, the date attached to his "Vorrede," and November 9, the date when he exhibited the first copy to the Berlin Academy.[b] Bailey's name is therefore the earlier one.

Found at station 2807, Galapagos Islands.

Podosira subtilis (Bail.) Mann.

Hyalodiscus subtilis Bail. Smithson. Contr. Knowl. **7**: 10. *pl. 1. f. 12.* 1854. Schmidt, Atlas *pl. 139. f. 11, 15* (unnamed). 1889. W. Hendry, Quart. Journ. Micr. Sci. n. s. **2**: 179. fig. 1861. Pritch. Hist. Infus. ed. 4. 815. *pl. 5. f. 60.* 1861. Witt. Verh. Russ. Min. Gesell. II. **22**: 163. *pl. 7. f. 10.* 1886. Grun. in Fenzl, Reise Novara Bot. **1**: 27. 1870. H. L. Smith, Sp. Diat. Typ. no. 201. 1874. Jan. & Rabh. in Rabh. Beitr. 8. *pl. 1. f. 16.* 1863. Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 116. 1880. De Toni, Syll. Alg. **2**: 1366. 1894. Castr. Rep. Voy. Chall. Bot. **2**: 140. *pl. 18. f. 4.* 1886. Petit. Trans. Roy. Micr. Soc. **1**: 239. 1878. H. L. Smith, Am. Journ. Micr. **3**: 247. 1878. Gr. & St. Journ. Quek. Micr. Club II. **3**: 67. 1887.

Hyalodiscus franklini in Cleve & Möll. type no. 2.

Craspedodiscus franklini Ehrenb. Ber. Akad. Wiss. Berl. **1853**: 526. 1854; Mikrog. *pl. 35A. XXIII. f. 6a, b.* 1854 ? not *Podosira franklini* Grun. 1878.

Melosira franklini Cleve. Bih. Sv. Vet. Akad. Handl. **25**: 216. 1868.

Whether or not Ehrenberg's *C. franklini* is identical with this can only be determined by knowledge based on a study of the original material collected by the expedition of Captain Penny in 1850 at Assistance Bay. That the diagnosis of Ehrenberg as well as his figure would suggest the above is certain; and many authors accept this without question. In that case the species would require a new name; but until certainty takes the place of conjecture Bailey's name should be undisturbed. A testimony adverse to looking on the two as the same is that of Petit,[c] who says that *P. franklini* "has very fine radiating striae, certainly invisible with the objectives used by Bailey twenty years ago." This may be so or not. One thing is evident, that Ehrenberg's figures of *C. franklini* are far more convex than they should be for *P. subtilis*. I have concluded that the two are probably the same, not certainly so; and I have accordingly placed Ehrenberg's name in the synonymy with a question mark.

Found at stations 2848, 3603, 3604, and 3607, Bering Sea.

STEPHANOPYXIS Ehrenb.

Stephanopyxis Ehrenb. Ber. Akad. Wiss. Berl. **1844**: 264. 1845, as subg.; **1845**: 80. 1846. Char. Emend. Grun. Denkschr. Akad. Wien **48**[2]: 34. 1884. Grev.; Greg. Trans. Roy. Soc. Edinb. **21**: 537. 1857. Pritch. Hist. Infus. ed. 4. 826. *pl. 5. f. 74, 75.* 1861. Ehrenb. Mikrog. *pl. 18. f. 4, 6* and *f. 7*; *pl. 19. f. 13.* 1854. Castr. Rep. Voy. Chall. Bot. **2**: 87. *pl. 9. f. 5, 9.* 1886. De Toni, Syll. Alg. **2**: 1137. 1894. Van Heur. Treat. Diat. 434. *f. 158.* 1896.

Systephania Ehrenb. Ber. Akad. Wiss. Berl. **1844**: 264. 1845. Mikrog. *pl. 33. XV. f. 22, XVII. f. 16, XVIII. f. 11.* 1854. Kütz. Sp. Alg. 126. 1849. Castr. Rep. Voy. Chall. Bot. **2**: 150. *pl. 9. f. 11. pl. 30. f. 3* (not *f. 2*). 1886.

[a] Proc. Roy. Irish Acad. II. **2**: 250. *pl. 26. f. 5a.* 1875.

[b] Ber. Akad. Wiss. Berl. **1854**: 629. 1855.

[c] Journ. Roy. Micr. Soc. **1**: 239. 1878.

Pyxidicula Ehrenb. in part; Ber. Akad. Wiss. Berl. **1844:** 264. 1845 (cf. Mikrog. *pl. 18. f. 6.* 1854.).

Dictyopyxis Ehrenb. in part; Ber. Akad. Wiss. Berl. **1844:** 262. 1845.

Coscinodiscus Ehrenb. in part; Mikrog. *pl. 38 B. XXII. f. 9.* 1854.

Cresucllia Grev.: Greg. Trans. Roy. Soc. Edinb. **21:** 536. *pl. 14. f. 109.* 1857. Grev. Quart. Journ. Micr. Sci. 7: 164. 1859.

Of the original genus Pyxidicula Ehrenb. no clear idea can be obtained, as Greville points out.[a] Ehrenberg's diagnosis[b] being equally applicable to any of a half dozen genera and his figures being beyond much question solitary frustules and valves of Gallionella Ehrenb.,[c] that is, of Melosira C. Ag. Indeed, he says in his diagnosis of Pyxidicula, "=Gallionella divisione spontanea perfecta aut nulla." The indefinite Pyxidicula was then divided into several genera and subgenera,[d] namely, Dictyopyxis to accommodate the forms with smooth cellular valves and Stephanopyxis for those with spinose cellular valves. The former was loosely formed and included evident examples of other genera, especially Melosira and Coscinodiscus, and, as the spines of Stephanopyxis are often obscure, perhaps even wanting, on single valves, members of Stephanopyxis would also fall into Dictyopyxis. Stephanopyxis includes in its diagnosis and figures the first consistent concept of these diatoms, and as elaborated by Grunow it is the genus to be preferred. Unfortunately, however, it was not published as a genus until 1846.[e] Systephania was published as a genus in 1845, and is truly identical, its first figures cited above being unmistakable examples of Stephanopyxis; but Systephania has never been taken up by the diatomists and until all diatomaceous genera have been typified there is no knowing but that there may be an older name. The above is, therefore, retained until it can be considered more critically. The diatom of Donkin's *Systephania anglica*[f] is excluded. As Grunow points out the present genus is very variable as between species, different individuals of one species, and even the two valves of one individual, it being not unusual for one valve to be deeper than the other, to show greater development of spines, etc. The confounding of specimens of the spurious genus Xanthiopyxis Ehrenb., with this genus has further complicated the subject.

Stephanopyxis appendicula Ehrenb. Mikrog. *pl. 18. f. 4.* 1854. Pritch. Hist. Infus. ed. 4. 826. 1861. Schmidt, Atlas *pl. 180. f. 18–26, 29, 31 32, 34 35.* 1888. Wolle, Diat. N. A. *pl. 62. f. 12 15.* 1890.

Pyxidicula appendicula Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 85. 264. 1845. Kütz. Sp. Alg. 22. 1849. Weisse, Mel. Biol. Acad. Sci. St. Petersb. **2:** 241. *pl. 1. f. 17.* 1855.

Pyxidicula hellenica Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 85. 1845.

Pyxidicula apiculata Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 85. 1845. Kütz. Sp. Alg. 22. 1849. Weisse, Mel. Biol. Acad. Sci. St. Petersb. **2:** 241. *pl. 1. f. 16.* 1855.

Stephanopyxis apiculata Ehrenb. Mikrog. *pl. 19. f. 13b.* 1854. Pritch. Hist. Infus. ed. 4. 826. 1861. De Toni, Syll. Alg. **2:** 1137. 1894. Grun. Denkschr. Akad. Wien **48**[2]: 86. 1884. Wolle, Diat. N. A. *pl. 62. f. 16.* 1890.

Dictyopyxis hellenica Ehrenb. Mikrog. *pl. 19. f. 13a.* 1854.

Cresucllia turris Arnott; Greg. Trans. Roy. Soc. Edinb. **21:** 538. *pl. 14. f. 109.* 1857.

Stephanopyxis turris Ralfs in Pritch. Hist. Infus. ed. 4. 826. *pl. 5. f. 74.* 1861. Grun. Denkschr. Akad. Wien **48**[2]: 87. *pl. 5. f. 7–16 (f. 18–21* doubtful; not *f. 22, 23, 25).* 1884. De Toni, Syll. Alg. **2:** 1138. 1894. Van Heur. Synop. *pl. 83ter. f. 12.*

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[a] Trans. Roy. Soc. Edinb. **21:** 537. 1857.

[b] Ehrenb. Infus. 165. *pl. 10. f. 1a-f.* 1838.

[c] Cf. Gallionella op. cit. *pl. 10. f. 2–7.*

[d] Ber. Akad. Wiss. Berl. **1844:** 262–264. 272. 1845.

[e] Op. cit. **1845:** 80. 1846.

[f] Quart. Journ. Micr. Sci. n. s. **1:** 12. *pl. 1. f. 14.* 1861.

1881. H. L. Smith, Sp. Diat. Typ. no. 507. 1874. Castr. Rep. Voy. Chall. Bot. **2**: 88. 1886. Schmidt, Atlas *pl. 130. f. 43.* 1888. Wolle, Diat. N. A. *pl. 62. f. 3, pl. 66. f. 3, 4.*

Cresswellia minuta Grev. Trans. Micr. Soc. Lond. n. s. **13:** 4. *pl. 1. f. 13.* 1865. Moeb. Diat.-taf. *pl. 62. f. 13.* 1890.

Stephanopyxis niejahri Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1872:** 214. *pl. 6. II. f. 2.* 1873.

Stephanopyxis cylindrica Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1873:** 214. *pl. 6. II. f. 1.* 1874.

Grunow considers *S. apiculata* Ehrenb. as separate because its spines are close to the center of the valve. De Toni also ranks it as separate. I think the distinction is a very weak one. The poor figures by Weisse of *P. apiculata* and *P. appendiculata* are identical. *S. campanula* Castr.[a] differs from this species solely in the increasing fineness of the network as it approaches the margin; in this respect it agrees with *S.* (*Cresswellia*) *palmeriana* Grev.,[b] and especially its variety,[c] which, like Castracane's form, is not easily separated from the above.[d] *S.* (*Cresswellia*) *turgida* Grev.[e] is also too close for easy distinction. Greville's figure is probably too coarse; he claims the network is much finer than in *S. turris*, though the valves are considerably larger. Grunow[f] also holds them to be distinct and draws attention to the enlarged ends of the spines.

Greville repeatedly spells the name "Creswellia," but later "Cresswellia;" the latter is correct, so far as the English family name of Cresswell is concerned.

Found at stations 2844, 4029H, Aleutian Islands and Bering Sea.

Stephanopyxis corona (Ehrenb.) Grun.; Van Heur. Synop. *pl. 83bis. f. 10, 11.* 1881; Treat. Diat. 434. *f. 158.* 1896. Grun. Denkschr. Akad. Wien **48**[2]: 38. 1884. Schmidt, Atlas *pl. 123. f. 10–17, 19–20, pl. 130. f. 13, 16–17, 36.* 1888. De Toni, Syll. Alg. **2:** 1142. 1894. Wolle, Diat. N. A. *pl. 62. f. 1. 6. pl. 67. f. 20.* 1890.

Systephania corona Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 272. 1845; Mikrog. *pl. 33. XV. f. 22, XVII. f. 16.* 1854. Griff. & Henf. Micr. Dict. ed. 4. *pl. 18. f. 57.* 1883. Pritch. Hist. Infus. ed. 4. 832. *pl. 5. f. 81.* 1861.

Systephania diadema Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 272. 1845; Mikrog. *pl. 33. XVIII. f. 11.* 1854. Griff. & Henf. Micr. Dict. ed. 4. *pl. 18. f. 58.* 1883. Pritch. Hist. Infus. ed. 4. 833. 1861. Kütz. Sp. Alg. 126. 1849.

Stephanopyxis diadema Ehrenb. Ber. Akad. Wiss. Berl. **1845:** 80. 1846. Pritch. Hist. Infus. ed. 4. 826. 1861.

Pyxidicula diadema Kütz. Sp. Alg. 21. 1849.

But one specimen was found, identical with that figured by Schmidt.[g]

Found at station 3696.

Stephanopyxis trisculpta Mann, sp. nov. PLATE XLV, FIGURE 6.

Valve hemispherical, covered with large hyaline regular bosses, giving an obscure appearance of hexagonal network; no circle of spines, but instead of these short knob-like processes interspersed somewhat irregularly among the bosses or heads; these processes almost wanting at the center, becoming frequent at one-half the radius and from there outward increasing and near the margin regularly filling all the inter-

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[a] Castr. Rep. Voy. Chall. Bot. **2:** 88. *pl. 19. f. 14.* 1886.
[b] Trans. Micr. Soc. Lond. n. s. **13:** 2. *pl. 1. f. 9.* 1865.
[c] Schmidt, Atlas *pl. 130. f. 44.* 1888.
[d] Cf. Schmidt, Atlas *pl. 130. f. 43. 1888.*
[e] Quart. Journ. Micr. Sci. **7:** 165. *pl. 7. f. 14.* 1859.
[f] Denkschr. Akad. Wien **48**[2]: 90. 1884.
[g] Schmidt, Atlas *pl. 130. f. 13.* 1888.

spaces between the bosses or beads; below this double-marked outer plate a second plate regularly dotted (or perforated?), the dotting appearing through the bosses and interspaces, giving a shadowy granular appearance to the whole valve; rim, or margin of juncture of the two valves, hyaline (not seen in the accompanying figure, being out of focus).

Diameter of valve, 0.078 mm.

I confess to some doubt in referring my form to this genus; though its resemblance makes me prefer to classify it here rather than accept the less advisable alternative of creating a new genus for it. The correctness of placing it here is rendered more probable by its near resemblance to *Stephanopyxis broschii* Grun.,[a] especially the last figure. My species differs from that of Grunow in everything except the secondary punctation; in the large number of knob-like processes, toward the margin filling all the interspaces, in the evident hyaline border, in the absence of "two to five spines remote from the center." Of Grunow's figure which most nearly resembles this species, namely, figure 30, he says: "Fig. 30. Form ohne Stacheln, fraglich hieher gehorend."

Type in the U. S. National Museum, No. 590119, from station 2807, Galapagos Islands, April 4, 1888; 812 fathoms, bottom of Globigerina ooze and coral mud.

COSCINODISCUS Ehrenb.

Coscinodiscus Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1838**: 128. 1840. Ratt. Proc. Roy. Soc. Edinb. **16**: 449. 1889. De Toni, Syll. Alg. **2**: 1200. 1894.
Symbolophora Ehrenb. in part; Ber. Akad. Wiss. Berl. **1844**: 205. 1845.
Endictya Ehrenb. Ber. Akad. Wiss. Berl. **1845**: 71. 1846?
Odontodiscus Ehrenb. Ber. Akad. Wiss. Berl. **1845**: 72. 1846.
Heterostephania Ehrenb. Mikrog. 15. *pl. 35A, XIII, B. f. 4, 5.* 1854.
Cestodiscus Grev. Trans. Micr. Soc. Lond. n. s. **13**: 48. *pl. 5. f. 8, 9.* 1865.
Cosmiodiscus Grev. Trans. Micr. Soc. Lond. n. s. **14**: 79. *pl. 8. f. 11–13.* 1866.
Stoschia Jan.; Van Heur. Synop. *pl. 128. f. 6.* note. 1881.
Janischia Grun.; Van Heur. Synop. *pl. 95. f. 10–11.* 1881.
Micropodiscus Grun. Denkschr. Akad. Wien **48**: 79. 1884.
Willemoesia Castr. Rep. Voy. Chall. Bot. **2**: 165. *pl. 8. f. 8, 8a, 8b.* 1886, no species.
Ethmodiscus Castr. Rep. Voy. Chall. Bot. **2**: 166. *pl. 3. f. 1, 9.* 1886.

The above condensation results in a genus of huge proportions, the type of the discoidal diatoms, as the genus Navicula is of the elongated forms. The general structure of its valves is, as the name indicates, a circle covered with a hexagonal network, a "sieve-disk." But the rather unwieldy dimensions of the genus is more than offset by the definiteness of type which it affords. The differences upon which the above synonyms were formed are none of them confined to the species that would be therein included, but grade off into other forms that are unmistakable examples of Coscinodiscus. One example will suffice, Cestodiscus Grev. Its generic character rests on the small submarginal processes that adorn the valves. But such processes, a little smaller, are the rule rather than the exception in Coscinodiscus, as for example in *C. subtilis* Ehrenb. Greville himself remarks: "I honestly confess that the best generic character I can frame is weak." The foregoing is equally applicable to Heterostephania Ehrenb. The most unsatisfactory member of the above combination to me is Endictya Ehrenb. The close resemblance of its members to the evident Coscinodiscus forms *C. robustus* Grev. and *C. marginatus* Ehrenb. is responsible for this union. But they are also close to some specimens of Stephanopyxis, and besides have certain peculiarities found in no other Coscinodiscus. The valves are not flat or convex disks, but cups; not bounded by a ring-like margin, but when viewed from the valval side, encircled by a somewhat raised and pointed edge from

[a] Denkschr. Akad. Wien **48**[2]: 90. *pl. 5. f. 26 30.* 1884.

which the valves turn vertically downward to form a band, ornamented like the face of the valve with a rugged network; so that the two valves if placed together form, without the connecting girdle, a cylindrical pill box. In this they agree with Melosira, though differing from that genus in mode of growth. I have adopted here the generally admirable classification of Rattray, although in this and some other respects it seems open to criticism, a state of things probably inevitable under any arrangement.

Some of the members of this genus approach, through their markings, Stictodiscus and Hemiptychus Ehrenb., and, through their processes, Tripodiscus Ehrenb.

Coscinodiscus africanus Jan. Diat. Gaz. Exped. *pl. 3. f. 2*, ined. Schmidt, Atlas *pl. 59. f. 24, 25.* De Toni, Syll. Alg. **2:** 1258. 1894. Ratt. Proc. Roy. Soc. Edinb. **16:** 534. 1889.

This remarkable form shows two sets of border markings; one of fine radial lines, i. e., perpendicular to the margin, the other of strong spirally and obliquely arranged markings, made very prominent in the above figure by Schmidt. I am convinced these latter are an optical illusion. They are caused by the fact that the actual border markings, the fine cross lines, do not lie parallel on the two surfaces of the border, the upper and under sides, belonging to the upper and under valves of the frustule. In other words, the two sets of lines cross each other at a very acute angle. This peculiarity is the result of the excentric arrangement of all the markings of the valve. The two foci are not directly above each other; and therefore the lines radiating from them, including the fine lines on the border, are not parallel. As a consequence the false spiral markings appear best under low powers of magnification or when slightly out of focus. Under a one-twelfth inch objective and with careful focusing they are not to be seen.

The curious excentric arrangement of the network and the spiral appearance of the border seem like an abnormality. But the species is very true to its type. My specimens come from the same locality as the original, the Galapagos Islands. They are another illustration of the value of the diatoms for indicating locality. Castracane's "var. *rotunda*" of this species,[a] though recognized by De Toni, has nothing to recommend such an assignment except the mere accident of an excentric arrangement of markings.

Found at station 2807, Galapagos Islands.

Coscinodiscus asteromphalus Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 77. 1845; Mikrog. *pl. 18. f. 45, pl. 33, XV. f. 7.* 1854. Pritch. Hist. Infus. ed. 4. 828. 1861. Grun. Denkschr. Akad. Wien **48**[2]**:** 78. *pl. 3. f. 9.* 1884. Pant. Beitr. Bacill. Ung. **1:** 73. *pl. 17. f. 153.* 1886. Ratt. Proc. Roy. Soc. Edinb. **16:** 549. 1889. Schmidt, Atlas *pl. 63.* 12. 1878; *pl. 113. f. 22–23.* 1888. Cleve & Möll. type no. 57. 164. Jan. Diat. Gaz. Exped. *pl. 4. f. 9.* Van Heur. Synop. *pl. 128. f. 1–3, 5; pl. 130. f. 1–2, 5–6.* 1881. De Toni, Syll. Alg. **2:** 1268. 1894.

Coscinodiscus omphalanthus Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 266. 1845. Pritch. Hist. Infus. ed. 4. 828. 1861. Cleve & Möll. type no. 57, 215. H. L. Smith, Sp. Diat. Typ. no. 95 (not Schmidt, Atlas *pl. 63. f. 2.* 1878).

Coscinodiscus oculus-iridis Ehrenb.; Schmidt, Atlas *pl. 63. f. 5.* 1878.

Coscinodiscus centralis Ehrenb.; Schmidt, Atlas *pl. 63. f. 1.* 1878.

Rattray says, "This species is distinguished by the evident puncta on the markings." But many other species share this character, as *C. marginatus* Ehrenb. and *C. robustus* Grev. Ralfs says,[b] "It differs from the other species with stellate umbilicus by its minutely punctate cellules." These two distinctive characters should be taken together.

Found at stations 2929, 3570, 2287H, 3635H, 4023H, 4025H, off California to Bering Sea.

[a] Castr. Rep. Voy. Chall. Bot. **2:** 159. *pl. 24. f. 3.* 1886.

[b] Pritch. Hist. Infus. ed. 4. 828. 1861.

Coscinodiscus borealis Bail. Amer. Journ. Sci. II. **22:** 3. 1856. Pritch. Hist. Infus. ed. 4. 838. 1861. H. L. Smith, Sp. Diat. Typ. no. 90, 93, 95. 1874. Ratt. Proc. Roy. Soc. Edinb. **16:** 558. 1889. Schmidt, Atlas. *pl. 63. f. 11.* 1878. De Toni, Syll. Alg. **2:** 1274. 1894.

Coscinodiscus oculus-iridis Ehrenb. var.; Cleve, in Nordensk. Vega Exped. **3:** 488. 1883. Grun. Denkschr. Akad. Wien **48**[2]**:** 77. 1884.

Bailey says, "This resembles *C. oculus-iridis;* but the cellules forming the star are more rounded, and the other cellules are larger." Rattray says, "Distinguished from *C. oculus-iridis* by the coarser and more robust markings." The species is nevertheless of doubtful worth; and Cleve and Grunow have perhaps done rightly in classing it as a variety of *C. oculus-iridis.* Ehrenberg[a] gave the name to a quite different diatom, a variety of his *C. radiatus.*

Found at stations 2844, 3607, 3361H, Aleutian Islands and Bering Sea.

Coscinodiscus centralis Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1838:** 129. 1840 (?); Ber. Akad. Wiss. Berl. **1844:** 78. 1845; Mikrog. 18. *f. 39, pl. 22. f. 1.* (not *pl. 21. f. 3*). 1854. Pritch. Hist. Infus. ed. 4. 828. 1838. Greg. Trans. Roy. Soc. Edinb. **21:** 501. *pl. 11. f. 49.* 1857. Van Heur. Synop. *pl. 103. f. B.* 1881. H. L. Smith, Sp. Diat. Typ. no. 91, 92. 1874. Cleve & Möll. type no. 57, 164, 207, 215. Castr. Rep. Voy. Chall. Bot. **2:** 155. *pl. 2. f. 3.* 1886. Ratt. Proc. Roy. Soc. Edinb. **16:** 555. 1889. De Toni, Syll. Alg. **2:** 1272. 1894.

Coscinodiscus asteromphalus Ehrenb. var.; Grun. Denkschr. Akad. Wien **48**[2]**:** 79. 1884.

This species is, like the two preceding ones, too close in some of its varieties to *C. oculus-iridis* Ehrenb. In fact, we have here to do with a group of forms that run into one another and render the specific boundaries unsusceptible of sharp definition.

A figure in Schmidt's Atlas[b] represents the more common variety in the following dredging.

Grunow does not recognize this as belonging to the present species; but I think with Schmidt it should be classed here.

Many figures of this species are worse than worthless, notably that by O'Meara.[c]

Found at Station 2807, Galapagos Islands.

Coscinodiscus cocconeiformis Schmidt, Atlas *pl. 58. f. 24–28.* 1878. Ratt. Proc. Roy. Soc. Edinb. **16:** 599. 1889. De Toni, Syll. Alg. **2:** 1302. 1894. Wolle, Diat. N. A. *pl. 94. f. 4, 5.* 1890.

The forms found in the following dredging are larger than those figured by Schmidt, and the dots radiate regularly from the elliptical center, a variation wider than the inconsequential ones shown in Schmidt's figures, to which Rattray gives three varietal names.

Found at station 2807, Galapagos Islands.

Coscinodiscus concavus (Ehrenb.) Greg. Trans. Roy. Soc. Edinb. **21:** 500. *pl. 10. f. 47.* 1857. Cleve, Bih. Sv. Vet. Akad. Handl. **1**[1]**:** 4. 1873. Ehrenb. Phys. Abh. Akad. Wiss. Berlin **1841:** 412. 1843; Ber. Akad. Wiss. Berl. **1844:** 78. 1845; Mikrog. *pl. 21. f. 4* (not *pl. 18. f. 38*). 1854; Phys. Abh. Akad. Wiss. Berlin **1871:** 260. 1873. Schmidt, Atlas. *pl. 62. f. 8* (not *pl. 59. f. 16*). 1878. Kütz. Sp. Alg. 125. 1849. Ratt. Proc. Roy. Soc. Edinb. **16:** 469. 1889. De Toni, Syll. Alg. **2:** 1215. 1894.

Coscinodiscus concavus africae Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 79. 1845.

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[a] Ber. Akad. Wiss. Berlin **1861:** 294. 1862.

[b] Schmidt, Atlas *pl. 60. f. 12.* 1878.

[c] Proc. Roy. Irish Acad. II. **2:** *pl. 26. f. 19.* 1875.

Endictya oceanica Ehrenb. Ber. Akad. Wiss. Berl. **1845:** 76. 1846; Mikrog. *pl. 35A, XVIII. f. 6, 7.* 1854. Pritch. Hist. Infus. ed. 4. 831. *pl. 5. f. 70.* Cleve & Möll. type no. 110, 259. H. L. Smith, Sp. Diat. Typ. no. 148. 1874. Schmidt, Atlas *pl. 65. f. 10, 12, 13, 15.* 1881. De Toni, Syll. Alg. **2:** 1189. 1894.

Endictya minor Schmidt, Atlas *pl. 65. f. 14, 16.* 1881.

In this list Rattray also includes *Orthosira oceanica* Bright.,[a] which is synonymous with *Melosira oceanica* (Bright.) Leud-Fort.[b] To this I can not agree. Rattray does not take note of Brightwell's figure, which is so unquestionably a Melosira (Orthosira type) that it is impossible to classify it in this genus. It is true that Brightwell states his form may be the same as Gregory's above-cited figure of *C. concavus.* It is also true that the valval view resembles *Endyctia oceanica* Ehrenb. and *E. minor* Schmidt, classified by Rattray with this species and here admitted into the synonymy. But if they all are the same as Brightwell's form, then there is nothing to do but transfer them all to the genus Melosira. The same is true of *Melosira cribrosa* Breb.,[c] if we take Brebisson's statement of its zonal view and mode of growth, rather than that observed by Smith. I have, therefore, not included this in the above synonymy, though Rattray treated it as a synonym. There is no question about the forms found by me being Coscinodiscus; nor is there any reason to doubt that the similar specimens figured by Ehrenberg[d] and by Gregory[e] are also members of this genus. Ehrenberg's example is unfortunately abnormal; but that it stands for his *C. concavus,* rather than the quite different form previously figured,[f] is proved by the fact that in his summary of his genera and species[g] he refers to his figure in plate 21, but excludes that in plate 18. It may be added that the difficulty here brought out of placing the above Endictya forms with this species gives emphasis to the doubt expressed by me in discussing the present genus as to the union of Endictya with Coscinodiscus.

Found at station 2807, Galapagos Islands.

Coscinodoscus concinnus W. Smith, Synop. Brit. Diat. **2:** 85. 1856. Roper, Quart. Journ. Micr. Sci. **6:** 20. *pl. 3. f. 12.* 1858. Pritch. Hist. Infus. ed. 4. 828. *pl. 5. f. 89.* 1861. Jan. Diat. Gaz. Exped. *pl. 2. f. 6.* Schmidt, Atlas *pl. 114. f. 8, 9.* 1888. H. L. Smith, Am. Journ. Micr. **2:** 102. 1877. Cleve & Möll. types no. 215, 319. Ratt. Proc. Roy. Soc. Edinb. **16:** 531. 1889. De Toni, Syll. Alg. **2:** 1256. 1894. H. L. Smith, Sp. Diat. Typ. no. 92. 1874. Grun. Denkschr. Akad. Wien **48²:** 79. 1884.

Coscinodiscus moseleyi O'Meara, Quart. Journ. Micr. Sci. n. s. **15:** 330. 1875; Journ. Linn. Soc. Bot. **16:** 57. *pl. 1. f. 6.* 1877. Castr. Rep. Voy. Chall. Bot. **2:** 153. 1886.

Coscinodiscus ? tenuis Bail. Bost. Journ. Nat. Hist. **7:** 333. *pl. 7. f. 9.* 1862.

Coscinodiscus centralis Schulze; Grun. Journ. Roy. Mic. Soc. **2:** 688. 1879. H. L. Smith, Sp. Diat. Typ. **92:** 1874, not Ehrenb. 1854.

Coscinodiscus papuanus Castr. Rep. Voy. Chall. Bot. **2:** 154. *pl. 3. f. 3.* 1886.

Coscinodiscus commutatus Grun. Denkschr. Akad. Wien **48²:** 79. 1884.

Eupodiscus ? commutatus Grun. Denkschr. Akad. Wien **48²:** 79. 1884.

Eupodiscus jonesianus Grev. Trans. Micr. Soc. Lond. n. s. **10:** 22. *pl. 2. f. 3.* 1862. Cleve, Bih. Sv. Vet. Akad. Handl. **1¹¹:** 5. 1873. H. L. Smith, Sp. Diat. Typ. no. 163. 1874. Moeb. Diat.-taf. *pl. 42. f.* 3. 1890.

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[a] Quart. Journ. Micr. Sci. **8:** 96. *pl. 6. f. 14 a–b.* 1860.
[b] Mem. Soc. Emul. St. Brieuc 72. 1879.
[c] Ann. Mag. Nat. Hist. II. **19:** 11. *pl. 2. f. 15.* 1857.
[d] Ehrenb. Mikrog. *pl. 21. f. 4.* 1854.
[e] Greg. Trans. Roy. Soc. Edinb. **21:** *pl. 10. f. 47.* 1857.
[f] Ehrenb. Mikrog. *pl. 18. f. 38.* 1854.
[g] Phys. Abh. Akad. Wiss. Berl., **1871:** 260. 1873.

This very delicate species is with some difficulty separated from *C. centralis* Ehrenb. W. Smith claims that its markings are so much finer that Ehrenberg could not have seen them with his microscope. This is indeed the difference. But it is a question if this offsets their close resemblance, in both having a central rosette of very large cells surrounded by unusually fine markings, in both having the two peculiar marginal processes which led Greville to class them as Eupodiscus, etc. The separation is at least open to question. Greville's beautiful figure of *E. jonesianus* is inaccurate, and Roper's figure emphasizes too strongly the radiating lines.

Found at stations 2807, 4516H, Galapagos Islands, and off Lower California.

Coscinodiscus curvatulus Grun.; Schmidt, Atlas *pl. 57. f. 30, 33–37.* 1878; *pl. 113. f. 6.* 1888. Grun. Denkschr. Akad. Wien **48**[2]: 83. *pl. 4 D. f. 8–16.* 1884. Jan. Diat. Gaz. Exped. *pl. 2. f. 7, pl. 5. f. 2, 3, 8, pl. 6. f. 2, pl. 20. f. 17.* Cleve & Möll. types no. 57, 154, 162, 164, 276, 319. Ratt. Proc. Roy. Soc. Edinb. **16**: 486. 1889. De Toni, Syll. Alg. **2**: 1226. 1894.

Coscinodiscus (Odontodiscus) curvatulus Grun.; Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 113. *pl. 7. f. 129.* 1880. Cleve in Nordensk. Vega Exped. **3**: 488. 1883.

Coscinodiscus szontaghii Pant. Beitr. Bacill. Ung. **1**: 74. *pl. 15. f. 133, pl. 28. f. 278.* 1886.

In my specimens the curvature of the fascicles is so slight as to be easily overlooked, a characteristic which, though emphasized in the name, is unimportant and variable. There can be no doubt that this form and *Actinocyclus curvatulus* Jan.[a] are the same diatom except for the accident of a pseudonodule in the latter. I do not regard the figures by Janisch[b] as belonging here, though Rattray so classifies them. His reference to H. L. Smith type no. 99 as containing this species under the name of *Odontodiscus curvatulus* Grun. is wrong, so far as the slide I have is concerned. It comes from Japan and is marked *C. scintillans* Grev., and although it shows abundant examples of *C. subtilis* Ehrenb., which has some slight resemblance to this species, it is a quite distinct form, as Rattray points out. It is probable that Rattray's slide of Smith's no. 99 shows this species; but the reference is faulty as a general reference. Pantocsek's figures of *C. szontaghii* are so utterly different from this species that they are worse than useless. By reading his description it is, however, plain that Rattray is correct in uniting this form with the above. It would be well for diatomists to either forego the luxury of illustrations or make them near enough like the objects in nature to be capable of recognition.

Found at stations 3604, 4022H, Bering Sea.

Coscinodiscus decrescens Grun.; Schmidt, Atlas *pl. 61. f. 8–10, 15.* 1878. Grun. Denkschr. Akad. Wien **48**[2]: 80. *pl. 3. C. f. 11, 18.* 1884. Ratt. Proc. Roy. Soc. Edinb. **16**: 525. 1889. De Toni, Syll. Alg. **2**: 1252. 1894.

Rattray, followed by De Toni, includes in the above *C. heteroporus* Ehrenb.[c] and *C. argus* Grun.[d] I think the assignment in Schmidt is much better. Rattray places a question mark after Schmidt's plate 61, figure 10, which, if an example of this species, must certainly be looked on as abnormal. Castracane has assigned this name to a totally different diatom,[e] for which Rattray proposes the name *C. minuens.*

Found at station 3361H, Bering Sea.

Coscinodiscus deformatus Mann, sp. nov. PLATE XLVIII, FIGURES 1, 2.

Valves nearly flat for four-fifths of the radius, thence curving slightly downward; network radially arranged, somewhat irregular at the center, but with no umbilicus;

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[a] Cf. Schmidt's figures above with his *pl. 57. f. 31.*

[b] Jan. Diat. Gaz. Exped. *pl. 1. f. 6, pl. 4. f. 4.*

[c] Schmidt, Atlas *pl. 61. f. 6–7.* 1878.

[d] Schmidt, Atlas *pl. 113. f. 7.* 1888.

[e] Castr. Rep. Voy. Chall. Bot. **2**: 159. *pl. 12. f. 14.* 1886.

the cells not small, but with very delicate walls; nearly uniform in size until within one-fifth of the radius from the margin, then rapidly decreasing to the margin; no dots or puncta within the hexagons; interradial lines frequent toward the margin; border a thin hyaline band; outline uniformly irregular by depression of one side.

Diameter of valve from 0.138×0.109 mm. to 0.080×0.071 mm.

Type in the U. S. National Museum, No. 590120, from station 2807, Galapagos Islands, April 4, 1888; 842 fathoms, bottom of Globigerina ooze and coral mud; collected also at station 3013H, Hawaiian Islands.

This form is not to be confused with the irregular, generally subtriangular examples of *C. heteroporus* Ehrenb., classed as *C. decrescens irregularis* Grun.[a] The far greater delicacy of the network, the absence of papillae, and the uniformity in the hexagons over the greater part of the valve, clearly distinguishing them. It is very abundant at both the above stations, the first of which is close to the Galapagos Islands and the second close to the Hawaiian Islands. This unusual form must therefore be looked upon as a subtropical littoral species.

Coscinodiscus denarius Schmidt, Atlas *pl. 57. f. 19–22.* 1878. Ratt. Proc. Roy. Soc. Edinb. **16:** 504. 1889. De Toni, Syll. Alg. **2:** 1238. 1894.

Coscinodiscus variolatus Castr. Rep. Voy. Chall. Bot. **2:** 155. *pl. 2. f. 5.* 1886.

It is doubtful if this has sufficient specific difference from *C. symmetricus* Grev. to warrant the above name. It is certainly not sufficiently different from the figures so named by Schmidt.[b] Compare also Greville's original figure.[c]

Found at station 3097, off central California.

Coscinodiscus elegans Grev. Trans. Mier. Soc. Lond. n. s. **14:** 3. *pl. 1. f. 6.* 1866. Schmidt, Atlas *pl. 58. f. 7, pl. 163. f. 10.* 1878. Pant. Beitr. Bacill. Ung. **1:** 73. *pl. 16. f. 141* (?), *pl. 24. f. 216.* 1886. Jan. Diat. Gaz. Exped. *pl. 4. f. 6.* Cleve & Möll. type no. 164. Truan & Witt, Diat. Hayti 14. *pl. 2. f. 22.* 1888. Ratt. Proc. Roy. Soc. Edinb. **16:** 585. 1889. De Toni, Syll. Alg. **2:** 1293. 1894. Moeb. Diat.-taf. *pl. 70. f. 6.* 1890.

Coscinodiscus margaritaceus Castr. Rep. Voy. Chall. Bot. **2:** 164. *pl. 18. f. 3.* 1886.

Of the above figures the first of Pantocsek's is worthless; those in Janisch and in Luard & Witt must be looked upon as representing extreme varieties.

In the specimen accompanying this report the frustule has two valves quite different in the arrangement of the beading, a good commentary on the constantly repeated absurdity of making "new species" out of such trifles.

Found at station 3604H, Bering Sea.

Coscinodiscus excentricus Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1839:** 146. 1841; **1841:** 323. *pl. 3. VII. f. 5.* 1843; Mikrog. *pl. 18. f. 32, pl. 21. f. 6.* W. Smith, Synop. Brit. Diat. **1:** 23. *pl. 3. f. 38.* 1853. Schmidt, Atlas *pl. 58. f. 46–49;* Jahresb. Komm. Deut. Meere **2:** *pl. 3. f. 36–38.* 1874. Grun. Denkschr. Akad. Wien **48²:** 84. *pl. 4D. f. 7.* 1884. Van Heur. Synop. 217. *pl. 130. f. 4, 7, 8.* 1881. Jan. Diat. Gaz. Exped. *pl. 2. f. 3, pl. 6. f. 3, 7–11.* H. L. Smith, Sp. Diat. Typ. no. 93. 1874. Van Heur. Typ. Diat. Belg. no. 529, 530. Cleve & Möll. type no. 148, 150, 183, 207, 210, 211, 215, 228, 257, 258, 276. Ratt. Proc. Roy. Soc. Edinb. **16:** 461. 1889. De Toni, Syll. Alg. **2:** 1210. 1894.

Odontodiscus excentricus Ehrenb. Ber. Akad. Wiss. Berl. **1845:** 79. 1846. Schmidt, Jahresb. Komm. Deut. Meere **2:** 94. 1874.

Eupodiscus excentricus O'Meara, Quart. Journ. Mier. Sci. **7:** 245. *pl. 7. f. 2.* 1867. Moeb. Diat.-taf. *pl. 77. f. 2.* 1890.

Coscinodiscus minor Schmidt, Atlas *pl. 113. f. 9.* 1888.

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[a] Schmidt, Atlas *pl. 61. f. 7.* 1878.

[b] Op. cit. *pl. 57. f. 25–27.*

[c] Trans. Mier. Soc. Lond. n. s. **9:** 68. *pl. 8. f. 2.* 1861.

Coscinodiscus labyrinthus Roper, Quart. Journ. Micr. Sci. **6:** 21. *pl. 3. f. 2 a–b.* 1858. Moeb. Diat.-taf. *pl. 19. f. 2 a–b.* 1890. Pritch. Hist. Infus. ed. 4. 831. Ratt. Proc. Roy. Soc. Edinb. **16:** 471. 1889. Cleve & Möll. type no. 276. De Toni, Syll. Alg. **2:** 1215. 1894. Grun. Denkschr. Akad. Wien[a] **48²:** 73. 1884.

As the central portion of *C. sol* Wallich and this species are almost identical, and as the outer border is weakly silicified and easily destroyed, specimens of the two may easily be confused. It may ultimately be found that the two are only striking varieties of the same species, in which case O'Meara's *E. excentricus* would represent an intermediate form. Comparing it with the second figure of *C. sol*, where the investing ring is greatly reduced, it is easy to see how an extension of the puncta into lines in the otherwise hyaline border of O'Meara's form, and a reduction in the deposit of silica would give us *C. sol.* Variation in these respects is by no means unknown. An analogous case will be found described under *C. robustus* Grev., where in some cases a massive investing ring is present, no trace of which is to found in most examples of that species. There is, however, at this time no justification for claiming the identity of *C. excentricus* and *C. sol.*

The variety called *C. labyrinthus* by Roper occurs at station 4505H. The peculiar symmetrical grouping of the hexagons that gives a strongly dotted appearance to the valve is obscure when mounted in Canada balsam, but very striking in the dry specimens. Finding this in connection with large quantities of *C. excentricus*, I have been able to establish beyond question that this is simply a variety of the above. It is given separate rank by Ralfs, Schmidt, Rattray, and De Toni. It should be here stated that Schmidt's plate 59, figure 14, has nothing to do with the above forms.

Found at stations 2807, 2844, 2859, 3091, 3361H, 2604H, 3693H, 3694H, 2691H, 4023H, 4025H, 4505H, Galapagos Islands, off Kamchatka, south of Alaska, off Oregon, Bering Sea, off California, and Okhotsk Sea.

Coscinodiscus galapagensis Ratt. Proc. Roy. Soc. Edinb. **16:** 574. *pl. 2. f. 20.* 1889. De Toni, Syll. Alg. **2:** 1285. 1894.

Coscinodiscus griseus galapagensis Grun.; Van Heur. Synop. *pl. 128. f. 7, pl. 132. f. 1.* 1881.

Coscinodiscus griseus Grev.; Schmidt, Atlas *pl. 58. f. 1.* 1878.

Coscinodiscus scintillans Grev.; Schmidt, Jahresb. Komm. Deut. Meere **2:** *pl. 3. f. 33.* 1874 (?).

Coscinodiscus appolinis compacta Ratt. Proc. Roy. Soc. Edinb. **16:** 579. 1889.

I think Rattray is correct in making this a new species rather than a variety of *C. griseus* Grev. Greville's species[b] is quite different. I also think the form cited above as *C. scintillans* Grev. (?), which Rattray makes subspecies *compacta* of *C. appolinis* Ehrenb., is the same diatom. Indeed, the only doubt of the validity of Rattray's species is its closeness to forms of *C. scintillans* Grev. (*C. appolinis* Ehrenb.), as represented in this figure of Schmidt's, rather than to forms of *C. griseus.*

Found at station 2808, Galapagos Islands.

Coscinodiscus heteroporus Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 265. 1845. Pritch. Hist. Infus. ed. 4. 831. 1861. Grun. Denkschr. Akad. Wien **48²:** 74. 1884. Schmidt, Atlas *pl. 61. f. 1, 4, 6* (7?). 1878. Ratt. Proc. Roy. Soc. Edinb. **16:** 540. 1889. De Toni, Syll. Alg. **2:** 1262. 1894.

Rattray refers Schmidt's figure[c] to *C. decrescens* Grun. As stated under that species, I think Schmidt is correct in assigning it here. Figure 7 is doubtful.

Found at station 3569H, Pribilof and Commander Islands.

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[a] Cf. Trans. Micr. Soc. Lond. n. s. **8:** 38. *pl. 2. f. 1–2.* 1860.

[b] Quart. Journ. Micr. Sci. n. s. **3:** 230. *pl. 9. f. 7.* 1863. Moeb. Diat.-taf. *pl. 47. f. 7.* 1890.

[c] Schmidt, Atlas *pl. 61. f. 6.*

Coscinodiscus lentiginosus Jan.; Schmidt, Atlas *pl. 58. f. 11.* 1878; Diat. Gaz. Exped. *pl. 4. f. 1–2, pl. 5. f. 7.* Grun. Denkschr. Akad. Wien **48**[2]: 81. 1884. Ratt. Proc. Roy. Soc. Edinb. **16:** 491. 1889. De Toni, Syll. Alg. **2:** 1230. 1894.

The extreme delicacy of the markings, slightly excentric in arrangement, and the obscurity of the minute spine just within the margin, which are the distinguishing characters of this species, makes identification difficult. Castracane's form bearing this name[a], seems to lack these marks, and shows nothing to warrant its assignment here.

Found at station 3513, Bering Sea.

Coscinodiscus lineatus Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1838:** 129. 1840; **1841:** 371. *pl. 3. VII. f. 7, 8* (not *pl. 1. III., f. 20*). 1843; Mikrog. *pl. 18. f. 33, pl. 22. f. 6 a–b, pl. 35A. XVI. f. 3, pl. 35A. XVII. f. 7.* 1854. Kütz. Bacill. 131. *pl. 1. f. 10.* 1844. Pritch. Hist. Infus. ed. 4. 830. 1861. O'Meara, Proc. Roy. Irish Acad. II. **2:** 264. 1875. Van Heur. Synop. 217. *pl. 131. f. 3.* 1881. Jan. Diat. Gaz. Exped. *pl. 4. f. 8, pl. 20. f. 14.* Schmidt, Atlas *pl. 59. f. 26–32.* 1878: *pl. 114. f. 13.* 1888. Cleve & Möll. types no. 57, 114, 148, 150, 162, 207, 276. Ratt. Proc. Roy. Soc. Edinb. **16:** 472. 1889. De Toni, Syll. Alg. **2:** 1216. 1894. Wolle, Diat. N. A. *pl. 87. f. 10.* 1890.

Coscinodiscus ehrenbergii O'Meara, Proc. Roy. Irish Acad. II. **2:** 264. *pl. 26. f. 24.* 1875.

Two specimens mounted on one slide, accompanying this report, show how unimportant the marginal spines in this species are, one having very large spines and the other barely a trace of them. The single "pseudo-process" is present but inconspicuous in both.

A figure of Ehrenberg's[b] frequently included here is clearly that author's *C. excentricus*, and in his index to the plates[c] he gives this figure as "*Coscinodiscus lineatus*? an *excentricus*?"

Found at stations 2680II, 2807, off California and Galapagos Islands.

Coscinodiscus marginatus Ehrenb. variety (?) PLATE XLIX, FIGURE 2.

Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 142. 1843; Mikrog. *pl. 18. f. 44, pl. 33. XII. f. 13, pl. 38B, XXII. f. 8.* 1854. Cleve & Möll. types no. 114, 164, 215. Schmidt, Atlas *pl. 62. f. 1–5, 9, 11, 12.* 1878. H. L. Smith, Sp. Diat. Typ. no. 94, 95. 1874. Ratt. Proc. Roy. Soc. Edinb. **16:** 509. 1889. De Toni, Syll. Alg. **2:** 1241. 1894 (not *C. marginatus* Ehrenb.; Kütz. Bacill. 131. *pl. 1. f. 7.* 1844; not *C. marginatus* Ehrenb.; Jan. Abh. Schles. Ges. Vaterl. Cult. **1862**[2]: 3. *pl. 1A. f. 20.* 1862).

Coscinodiscus fimbriatus-limbatus Ehrenb.; Mikrog. *pl. 19. f. 4.* 1854. Schmidt, Atlas *pl. 65. f. 3–6.* 1881; *pl. 113. f. 2.* 1888.

Coscinodiscus limbatus Ehrenb.[d] Ber. Akad. Wiss. Berl. **1840:** 206. 1841; Mikrog. *pl. 20. f. 29 a.* 1854. Schmidt, Atlas *pl. 65. f. 7.* 1881.

Coscinodiscus radiatus forma *heterosticta* Grun.; Pant. Beitr. Bacill. Ung. **1:** 70. *pl. 20. f. 184.* 1886.

Coscinodiscus radiatus subaequalis forma *parva* Pant. Beitr. Bacill. Ung. **1:** *pl. 22. f. 203.* 1886.

Coscinodiscus robustus Grev.; Schmidt, Atlas *pl. 62. f. 6.* 1878.

Coscinodiscus robustus intermedia Grun. Denkschr. Akad. Wien **48**[2]: 72. 1884.

Coscinodiscus subconcavus forma *major* Schmidt, Atlas *pl. 62, f. 7.* 1878.

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[a] Castr. Rep. Voy. Chall. Bot. **2:** 160. *pl. 5, f. 4.* 1886.

[b] Phys. Abh. Akad. Wiss. Berlin **1841:** *pl. 1. III. f. 20.* 1843.

[c] Op. cit. 438.

[d] This name as used by Grun. Denkschr. Akad. Wien **48**[2]: 72. 1884 = *C. fimbriatus* Schmidt.

I have here figured a form common in several dredgings, which, according to present interpretations, passes under the above name. I do this in order to illustrate a confusion in the taxonomy of this species that should receive attention. Anyone who will compare Greville's original figure of *C. robustus*[a] with the original figure of Ehrenberg's *C. marginatus*[b] will see little resemblance between them. Yet Grunow, Schmidt, Pantocsek, Rattray, and others give no satisfactory marks of distinction, and we have all sorts of discordant opinions connected with most of the modern figures. Grunow gives us, on the one hand, a *C. robustus intermedia* Grun.[c] which Rattray makes *C. marginatus intermedia* Ratt.,[d] and on the other hand Grunow gives a *C. marginatus submarginata* Grun.,[c] which Rattray puts under *C. robustus* Grev.[e] Rattray further states that though the original slide of Greville's *C. robustus* is not available, two slides marked by him (Greville) "*C. robustus*" now in the British Museum are *C. marginatus* Ehrenb. In view of the foregoing facts I offer the suggestion that some one who has access to the material sift out these forms, and, if necessary, drop Greville's species entirely in favor of Ehrenberg's. The name *C. marginatus* might necessarily be retained, instead of the earlier *C. limbatus*, because of the uncertainty of the two figures Ehrenberg gives for that species.[f] Under present conditions no such thing as a positive identification is possible. I have labeled some specimens that show a narrow border and an absence of radial arrangement, with obscure or broad papillae in the hexagons, *C. robustus* Grev., and others, with broad and massive borders, somewhat radial and slightly diminishing areolation showing pronounced papillae, *C. marginatus* Ehrenb.; but though the best possible under the present circumstances, these can not be looked upon as critical identifications.

Diameter of valve here figured, 0.176 mm.

Found at stations 3361H, 3712H, off Panama and Okhotsk Sea.

Coscinodiscus nitidulus Grun.; Schmidt, Atlas *pl. 58. f. 20–21.* 1878 (not *pl. 113. f. 18.* 1888). Van Heur. Synop. *pl. 132. f. 2.* 1881. Pant. Beitr. Bacill. Ung. **1:** 73. *pl. 24. f. 214.* 1886. Ratt. Proc. Roy. Soc. Edinb. **16:** 480. 1889. De Toni, Syll. Alg. **2:** 1222. 1894. Jan. Diat. Gaz. Exped. *pl. 5, f. 13.*

Found at station 4516H, off Lower California.

Coscinodiscus nitidus Greg. Trans. Roy. Soc. Edinb. **21:** 499. *pl. 19. f. 45.* 1856. Schmidt, Atlas *pl. 58. f. 16–19.* 1878; Jahresb. Komm. Deut. Meere **2:** 94. *pl. 3. f. 32.* 1874. Pritch. Hist. Infus. ed. 4. 831. *pl. 8. f. 18.* 1861. Jan. Diat. Gaz. Exped. *pl. 5. f. 12, 14–16* (not *f. 13*). Pant. Beitr. Bacill. Ung. **1:** 75. *pl. 18. f. 166.* Van Heur. Synop. Suppl. *pl. C. f. 41.* 1885. Wolle, Diat. N. A. *pl. 94. f. 22–23.* 1890. Ratt. Proc. Roy. Soc. Edinb. **16:** 478. *pl. 1. f. 21.* 1889? De Toni, Syll. Alg. **2:** 1221. Cleve & Möll. type no. 150, 155, 208, 210, 257. 311.

Coscinodiscus foraminosus Grev. MS. in Coll. Brit. Mus.

This and the former species show considerable resemblance to certain members of the genus Stictodiscus.[g]

Found at station 2807, Galapagos Islands.

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[a] Trans. Micr. Soc. Lond. n. s. **14:** *pl. 1. f. 8.* 1866.

[b] Ehrenb. Mikrog. *pl. 18. f. 44.* 1854.

[c] Denkschr. Akad. Wien **48²:** 72. 1884.

[d] Proc. Roy. Soc. Edinb. **16:** 511. 1889.

[e] Op. cit. 512.

[f] Ehrenb. Mikrog. *pl. 20. f. 29a b.* 1854.

[g] Cf. Schmidt, Atlas *pl. 202. f. 4.* 1896 and Journ. Quek. Micr. Club II. **3:** *pl. 5. f. 7.* 1887.

Coscinodiscus nobilis Grun. Journ. Roy. Micr. Soc. **2:** 687. *pl. 21. f. 1.* 1879. Jan. Diat. Gaz. Exped. *pl. 6. f. 13, pl. 2. f. 6,* unnamed.[a] De Toni, Syll. Alg. **2:** 1266. 1894. Ratt. Proc. Roy. Soc. Edinb. **16:** 545. 1889.

Coscinodiscus regius Wall. in Schneider, Beitr. Kennt. Kauk. 27. 1878. Journ. Roy. Micr. Soc. **2:** 687. 1879.

This large and extremely delicate species is close to *C. fulguralis* Brun,[b] and to *C. diorama* Schmidt;[c] the chief mark of distinction being the far more rapid increase of the areolation from the center outward, and the consequently more robust size of the network in the last-named forms.

Found at stations 2882, 2919, 2923, 2929, 3346, 3712H, 4014H, off Oregon, southern California, Washington, Okhotsk Sea, and Honshu Island, Japan.

Coscinodiscus nodulifer Schmidt, Atlas *pl. 59. f. 20–23.* 1878. Jan. Diat. Gaz. Exped. *pl. 2. f. 4–5.* Wolle, Diat. N. A. *pl. 94. f. 7.* 1890. Ratt. Proc. Roy. Soc. Edinb. **16:** 520. 1889. De Toni, Syll. Alg. **2:** 1249. 1894. Cleve & Möll. type no. 57, 155.

Coscinodiscus radiatus Ehrenb. err. det. H. L. Smith, Sp. Diat. Typ. no. 98. 1874.

Rattray erroneously credits the name to Janisch. In both the first and second edition of Schmidt's Atlas it is credited to Schmidt, as well as in the note of Rattray's in his revision of the genus,[a] containing a list of the identifications by Janisch of his plates of the Gazelle Expedition.

Found at stations 2690H, 2807, 2916H, 2917H, 2920H, 3013H, off California, Galapagos Islands, to Hawaiian Islands.

Coscinodiscus normanni Greg.; Grev. Quart. Journ. Micr. Sci. **7:** 80. *pl. 6. f. 3.* 1859. Moeb. Diat.-taf. *pl. 20. f. 3.* 1890. Ratt. Proc. Roy. Soc. Edinb. **16:** 500. 1889. De Toni, Syll. Alg. **2:** 1235. 1894.

Coscinodiscus normannicus Greg.; Van Heur. Synop. *pl. 131. f. 1.* 1881; type no. 532.

Odontodiscus subtilis Grun.; Schmidt, Jahresb. Komm. Deut. Meere **2:** 95. 1874. Van Heur. Synop. 218. 1885.

Coscinodiscus subtilis Ehrenb.; Eulen. Diat. Sp. Typ. no. 115 (cf. Van Heur. Synop. 218. *pl. 131. f. 1.* 1881–85).

Coscinodiscus curvatulus Grun. var.; Cleve, in Nordensk. Vega Exped. **3:** 488. 1883.

Coscinodiscus fasciculatus Schmidt, Jahresb. Komm. Deut. Meere, **2:** 95. *pl. 3. f. 41.* 1874; Atlas *pl. 57. f. 9, 10.* 1878.

My specimens are with very obscure apiculae or wholly without them, a condition noted by Rattray. The specimen from station 3669H is placed here with some doubt. The beads are slightly oval. It is nearest to the unnamed figure,[d] on which Schmidt[e] has given reasons for withholding from this species. Rattray erroneously refers a figure *f* to this species to which Janisch gives the name *C. atlanticus* Grun.,[g] which should probably be *C. atlanticus* Castr. as figured in the subspecies,[h] a form recognized as valid by Rattray.

Found at stations 2844, 3526, 3571H, 3607, 3669H, Aleutian Islands, Bering Sea, Pribilof and Commander Islands, and along Kuril Chain.

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[a] Cf. Proc. Roy. Soc. Edinb. **16:** 462. 1889.

[b] Mem. Soc. Phys. et Hist. Nat. Geneva **31**[1]: 21. *pl. 21. f. 6.* 1891.

[c] Schmidt, Atlas *pl. 64. f. 2.* 1878.

[d] Schmidt, Jahresb. Komm. Deut. Meere **2:** *pl. 3. f. 42.* 1874.

[e] Op. cit. 95.

[f] Jan. Diat. Gaz. Exped. *pl. 5. f. 6.*

[g] Proc. Roy. Soc. Edinb. **16:** 462. 1889.

[h] Castr. Rep. Voy. Chall. Bot. **2:** *pl. 3. f. 7.* 1886.

Coscinodiscus obscurus Schmidt, Atlas *pl. 61. f. 16 18.* 1878. Grun. Denkschr. Akad. Wien **48**[2]: 74. 1884. Ratt. Proc. Roy. Soc. Edinb. **16:** 513. 1889. De Toni, Syll. Alg. **2:** 1244. 1894.

Cestodiscus obscurus Van Heur. Synop. *pl. 129. f. 4.* 1881.

The general cell structure of my specimens agrees well with the above, and the characteristic minute beads at the inner ends of the semiradial lines are very evident. They do not appear in the somewhat doubtful photograph of this diatom by Doctor Woodward.[a] The specimen from Sendai, Japan, called by Brun *C. obscurus floralis*.[b] can hardly be classed here; the fine beaded secondary markings in the hexagons and the absence of a striated border mark them as distinct. Brun's form is, except for the coarser marking, nearer to *C. floridulus* Schmidt, which, like the above, has minute beads at the terminations of the semiradial lines.

Found at station 2844, south of Alaska.

Coscinodiscus oculus-iridis Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1839:** 147. 1841; Mikrog. *pl. 18. f. 42, pl. 19. f. 2.* 1854. Jan. Abh. Schles. Ges. Vaterl. Cult. **1862**[2]; 3. *pl. 1B. f. 6, pl. 2A. f. 4.* 1862. Schmidt, Atlas *pl. 63. f. 4* (no name), *6–9.* 1878; *pl. 113. f. 1, 3–5, 20.* 1888. Grun. Denkschr. Akad. Wien **48**[2]: 77. 1884. Jan. Diat. Gaz. Exped. *pl. 2. f. 2.* Cleve & Möll. type no. 3, 57, 162, 215, 258, 259, 276. 319. Ratt. Proc. Roy. Soc. Edinb. **16:** 559. 1889. Pritch. Hist. Infus. ed. 4. 828. 1861. De Toni, Syll. Alg. **2:** 1275. 1894.

Coscinodiscus centralis Ehrenb. Mikrog. *pl. 21. f. 3.* H. L. Smith, Sp. Diat. Typ. no. 91 (not no. 92). 1874.

Rattray unites with the above list *C. omphalanthus* Grun.,[c] *C. asteromphalus* Ehrenb.,[d] and *Cestodiscus radiatus* Ehrenb.[e] I do not think these can be classed here. I also look on Rattray's *C. oculus-iridis loculifera f* as of doubtful worth.

Found at stations 2929, 3604, 4530H, off southern California and Bering Sea.

Coscinodiscus pentas (Ehrenb.) Mann.

Symbolophora pentas Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 205. 1845; Mikrog. *pl. 35A. XXII. f. 19.* 1854. Griff. & Henf. Micr. Dict. ed. 3. *pl. 43. f. 56.* 1875. Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1872:** 283. *pl. 12. II. f. 1.* 1873.

Symbolophora microtrias Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 205. 1845; Mikrog. *pl. 35A, 21. f. 16.* 1854. Pritch. Hist. Infus. ed. 4. 833. 1861. Griff. & Henf. Micr. Dict. ed. 3. *pl. 43. f. 55.* 1875.

Symbolophora tetras Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 205. 1845. Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1872:** 394. *pl. 12. II. f. 1.* 1873.

Symbolophora hexas Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 205. 1845.[g]

Coscinodiscus stellaris Roper, Quart. Journ. Micr. Sci. **6:** 21. *pl. 3. f. 3.* 1858. Moeb. Diat.-taf. *pl. 13. f. 3.* Pritch. Hist. Infus. ed. 4. 828. *pl. 5. f. 83.* 1861. Castr. Rep. Voy. Chall. Bot. **2:** 155, 158. *pl. 3. f. 2. pl. 5. f. 9.* Grove; Schmidt, Atlas

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[a] Van Heur. Synop. *pl. 129. f. 4.* 1881.

[b] Mem. Soc. Phys. et Hist. Nat. Geneva **31**[1]: 23. *pl. 20. f. 2.* 1891.

[c] Schmidt, Atlas *pl. 63. f. 2.* 1878.

[d] Schmidt, Atlas *pl. 60. f. 7.* 1878 and Grun. Denkschr. Akad. Wien **48**[2]: 77. 1884.

[e] Van Heur. Synop. *pl. 129. f. 5.* 1881.

[f] Proc. Roy. Soc. Edinb. **16:** *pl. 1. f. 2.* 1889.

[g] *Symbolophora microtetras* Ehrenb., *S. micropentas* Ehrenb., and *S. microhexas* Ehrenb. Monatsber. Akad. Wiss. Berl. **1855:** 302. 1856, are all nomina nuda. *S. trinitatis* Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 88. 1845. Pritch. Hist. Infus. ed. 4. 833. *pl. 11. f. 46.* 1861. Griff. & Henf. Micr. Dict. ed. 3. *pl. 19. f. 6.* 1875. Am. Journ. Sci. **48:** *pl. 4. f. 7.* 1845 is here excluded, as it is an Actinoptychus.

pl. 164. f. 4. O'Meara, Proc. Roy. Irish Acad. II. **2:** 261. 1875. Ratt. Proc. Roy. Soc. Edinb. **16:** 493. 1889. Grun. Denkschr. Akad. Wien **48²:** 82. 1884. De Toni, Syll. Alg. **2:** 1231. 1894.

Coscinodiscus symbolophorus Grun. Denkschr. Akad. Wien **48²:** 82. *pl. 4. f. 3–6.* 1884. Ratt. Proc. Roy. Soc. Edinb. **16:** 492. 1889. Schmidt, Atlas *pl. 138. f. 1–5.* De Toni, Syll. Alg. **2:** 1230. 1894.

I include in this species a large number of varieties found in the various dredgings and soundings named. I am convinced that there is no reasonable ground for Grunow's *C. symbolophorus* as distinguished from Roper's older name *C. stellaris.* Grunow admits that the difference is one of relative fineness of marking—too slight a character for creating a new species, especially when this difference is by no means striking and many intermediate forms are obtainable. Both have the same relative convexity of valve; the same striking stellate cluster at the center; the same arrangement of fine beading, namely, in fascicles whose component rows are parallel to the longest radial middle row. By thus abandoning the untenable distinction separating these two we have a sharply defined species, its nearest relative being *C. subtilis* Ehrenb., from which it is distinguished by the stellate marking of the center and the absence of minute processes next the border. The older specific names of Ehrenberg given above under the now-abandoned genus Symbolophora take precedence over those of Grunow and Roper. I have selected *S. pentas*, published simultaneously with *S. microtrias* and *S. tetras*, because I have found the five-parted star at the center to be more common than the rest and because Ehrenberg's illustration cited above is quite satisfactory.

Found at stations 2807, 2848, 2859, 2860, 2919, 3346, 3361H, 3603, 3604, 3604H, 3671, 4029H, Galapagos Islands, off Alaska peninsula, off British Columbia to southern California and Bering Sea.

Coscinodiscus pustulatus Mann, sp. nov. PLATE XLVIII, FIGURE 3.

Valve strongly and evenly convex, covered with large conical (not hemispherical) beads, symmetrically arranged in decussating rows, as in *C. symmetricus* Grev., the largest at the center and regularly decreasing to the border, but terminating just within the border in a single row of increased size; border broad, stout, and hyaline. The heavy cone-shaped beads give a remarkable brilliancy to the diatom.

Diameter of valve, 0.1 mm.

Type in the U. S. National Museum, No. 590156, from station 3565H, Bering Sea, July 6, 1895; 1,866 fathoms, bottom of blue mud ooze.

It should be here noted that what resembles a pseudonodule near the border in the photograph herewith reproduced is, together with three flecks near the center, due to defects in the negative.

Coscinodiscus radiatus Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1839:** 148. *pl. 3. f. 10–c* (not *d.*). 1841; Mikrog. *pl. 19. f. 1, pl. 22. f. 3, pl. 33. XIII. f. 2* (not *2**), *pl. 33. XVI. f. 6, pl. 35A. XVII. f. 6* (doubtful=*pl. 20. I. f. 27, pl. 21. f. 1*). 1854. Pritch. Hist. Infus. ed. 4. 830. *pl. 11. f. 39, 40.* 1861. Schmidt, Atlas *pl. 60. f. 5, 6, 9, 10, pl. 61. f. 13* (undetermined). 1878; *pl. 65. f. 8* (no name). 1881; *pl. 113. f. 8, 15* (no name). *21.* 1888. Schmidt, Jahresb. Komm. Deut. Meere **2:** 94. *pl. 3. f. 34.* 1874. Grun. Denkschr. Akad. Wien **48²:** 71. *pl. 3. f. 1–4, 7.* 1884. Cleve & Möll. types no. 57, 114, 155, 164, 207, 211, 215, 257. Van Heur. Synop. *pl. 129. f. 1.* 1881. Castr. Rep. Voy. Chall. Bot. **2:** 165. *pl. 29. f. 2, 11, 15.* 1886. Ratt. Proc. Roy. Soc. Edinb. **16:** 514. 1889. De Toni, Syll. Alg. **2:** 1244. 1894. (exclude here *C. radiatus* Bail. Am. Journ. Sci. **42:** 95. *pl. 2. f. 14.* 1842; also *C. radiatus* Weisse, Bull. Acad. St. Petersb. **12:** 122. *pl. 1. f. 25.* 1868).

Coscinodiscus caspius Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1872:** 394. *pl. 12. I. f. 14.* 1873.

Coscinodiscus borealis Ehrenb. Monatsber. Akad. Wiss. Berl. **1861:** 294. 1862, not *C. borealis* Bail. Am. Journ. Sci. **22:** 3. 1856.

Coscinodiscus derius Schmidt, Atlas *pl. 60. f. 1–4.* 1878. Van Heur. Synop. *pl. 130. f. 3.* 1881. Cleve & Möll. type no. 150.

Coscinodiscus fallax Schum. Schrift. Phys. Ökon. Gesell. Konigsb. **8:** 62. *pl. 3. f. 76.* 1867 (cf. Castr. Rep. Voy. Chall. Bot. **2:** 165. *pl. 29. f. 2, 11, 15.* 1886).

Rattray includes under the above category several references,[a] which are omitted here.

Found at stations 2807, 3604, 2835, Galapagos Islands, off Lower California and Bering Sea.

Coscinodiscus robustus Grev. Trans. Micr. Soc. Lond. n. s. **14:** 3. *pl. 1. f. 8.* 1866. Moeb. Diat.-taf. *pl. 70. f. 8.* 1890. Jan. Diat. Gaz. Exped. *pl. 4. f. 10–11.* Schmidt, Atlas *pl. 62. f. 16, 17* (not *f. 1–6*). 1878. Grun. Denkschr. Akad. Wien **48²:** 72. 1884. Ratt. Proc. Roy. Soc. Edinb. **16:** 511. 1889. De Toni, Syll. Alg. **2:** 1243. 1894. PLATE XLVIII, FIGURE 4.

Coscinodiscus subrelatus Grun.: Schmidt, Atlas *pl. 65. f. 9.* 1881.

Coscinodiscus marginatus Ehrenb. var. Grun. Denkschr. Akad. Wien **48²:** 72. 1884.

Coscinodiscus kinkerianus Truan & Witt, Diat. Hayti 13. *pl. 3. f. 1.* 1888.

Greville's figure and its reproduction cited above by Moebius are, as Rattray points out, somewhat idealized. A variety was found at station 3399H corresponding to the one that Schmidt[b] considers doubtful. *C. subrelatus* Grun. is also a rather too divergent variety, while *C. kinkerianus* Truan & Witt is either a variety with unusually narrow margin or a type form with margin wanting. The confusion between this species and *C. marginatus* Ehrenb. has been discussed under that heading.

Found at stations 3346, 3361H, 3399H, 3604, 3663H, 3693H, 3784, 3785, 4023H, 4025H, off Washington, Bering Sea and Okhotsk Sea.

In Rattray's revision[c] occurs this paragraph: "In a Santa Monica form, 13 mm. in diameter, discovered by Doctor Rae, the usual striated border was surrounded by a second more sharply defined but narrower band, with a slightly convex surface, and bearing delicate striae, 8 to 10 in 0.01 mm. At one place this band is interrupted and somewhat more convex on the two sides of the break. This gives it the appearance of an elastic spring enveloping the valve." Specimens of this structure are not infrequent at station 3361H, which is in Bering Sea northwest from Pribilof Islands. At station 4025H, a little north of the Aleutian Islands, it is decidedly abundant. Nor is such a band confined to this species. Brun[d] figures precisely this condition on a specimen of *C. crassus* Bail. It would be interesting to know the precise physiological signification of this feature, its only occasional presence in the different species implying that it has such signification. Figures of this form and a morphological discussion of the interrupted diatom girdle have been published by Palmer & Keeley.[e] The form found at station 4025H is represented in the accompanying figure.

Coscinodiscus simbirskianus Grun. Denkschr. Akad. Wien **48²:** 81. 1884. Schmidt, Atlas *pl. 113. f. 11–12.* 1888. Ratt. Proc. Roy. Soc. Edinb. **16:** 489. 1889. De Toni, Syll. Alg. **2:** 1228. 1894.

My specimen is a typical example of this unusual species. As the sounding in which it occurred was made off the coast of Alaska, and as the only places heretofore

[a] Ehrenb. Mikrog. *pl. 33. XIII. f. 2*.* Schmidt, Atlas *pl. 62. f. 18.* 1878. H. L. Smith. Sp. Diat. Typ. no. 99. This last is probably an error. No. 99 is marked *C. scintillans* Grev., and contains no example of *C. radiatus*. No. 98 is marked *C. radiatus* Ehrenb., but is wrong. It is *C. nodulifer* Schmidt.

[b] Schmidt, Atlas *pl. 62. f. 1. 1878.*

[c] Proc. Roy. Soc. Edinb. **16:** 512. 1889.

[d] Mem. Soc. Phys. et Hist. Nat. Geneva **31¹:** *pl. 20. f. 3.* 1891.

[e] Proc. Acad. Phila. **1900:** 465 479. *pl. 15–16.* 1900.

reported where it has been found are in Russia (i. e. Simbrisk, Ananino, and Archangelsk-kurojedowo), it would be interesting to know the geological outcrop that furnished this specimen.

Found at station 3361H, Bering Sea.

Coscinodiscus subtilis Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 412. *pl. 1, III. f. 18, pl. 3. VII. f. 4.* 1843; Mikrog. *pl. 18. f. 35, pl. 33. XIII. f. 4, pl. 33. XVI. f. 7, pl. 34. VII. f. 6, pl. 35. XVII. f. 5, pl. 35. XVIII. f. 5.* 1854. Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 438. *pl. 1. III. f. 18.* 1843. Grev. Quart. Journ. Micr. Sci. **7:** 81. 1859. Pritch. Hist. Infus. ed. 4. 830. 1861. Jan. Abh. Schl. Ges. Vaterl. Cult. **1862**[2]: 4. *pl. 1.1. f. 2.* 1862. Jan. Diat. Gaz. Exped. *pl. 2. f. 8.* Schmidt, Atlas *pl. 57. f. 11–16.* 1878. H. L. Smith, Sp. Diat. Typ. no. 100. Ratt. Proc. Roy. Soc. Edinb. **16:** 494. 1889. De Toni, Syll. Alg. **2:** 1232. 1894 (exclude Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 443. *pl. 3. VII. f. 4.* 1843. Grun. Denkschr. Akad. Wien **48**[2]: 81. *pl. 3. f. 26.* 1884. Ehrenb. Mikrog. *pl. 22. f. 4.* 1854).

Rattray has included here several references which are very questionable.[a] The two varieties described by him[b] are very unsatisfactory and uncertain examples of this species. Its boundaries are unquestionably misty. It approaches *C. normanni* Greg., *C. odontophorus* Grun., *C. rothii* Grun., *C. symmetricus* Grev., *C. fasciculatus* Schmidt, *C. denarius* Schmidt. H. L. Smith's type no. 100 is truly typical. Compare synonymy of *C. normanni* Greg.

Found at stations 2844, 3526, 3604H, 3607, 3635H, Aleutian Islands and Bering Sea.

Coscinodiscus undulosus Mann, sp. nov. PLATE XLIX, FIGURE 1.

Frustules small and very delicate; valves slightly and evenly convex; markings of oval beads elongated in the radial line, all of one size very small, arranged in radiating rows, but so spaced in the rows as to produce a uniform delicate wavy appearance over the entire valve; border moderately broad, perfectly smooth. A fragile and handsome species, found only in the following dredging, there quite abundant.

Diameter of valve, 0.125 to 0.136 mm.

Type in the U. S. National Museum, No. 590121, from station 3526, Bering Sea, August 5, 1893; 49 fathoms, bottom of fine sand and dark mud.

Coscinodiscus verecundus Mann, sp. nov. PLATE L, FIGURE 1.

Valve nearly flat; central area very minute or wanting, marking of minute beads, the largest at the center and regularly decreasing to the border; arranged in indistinct fascicles, 12 to 14 in number, irregular in width, showing the watch-milling effect of an Actinocyclus; border of two distinct portions equal in width, namely, each about one-twentieth the radius; the inner portion a smooth band ornamented with evenly set, large but dim beads in a single circle; the outer portion strongly marked with transverse (radial) striae, slightly wider on the outer side. The entire valve most delicate and pellucid.

Diameter of valve, 0.078 mm.

Type in the U. S. National Museum, No. 590122 from station 3688H, Okhotsk Sea, August 27, 1896; 1,562 fathoms, bottom of brown mud and fine sand.

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[a] Jan. Diat. Gaz. Exped. *pl. 4. f. 1–2* (named *C. lentiginosus* Jan.), *pl. 5. f. 7, pl. 6. f. 1, 5, pl. 20. f. 5.* Schmidt, Atlas *pl. 57. f. 28–29* (no name), *pl. 58. f. 37* (no name). 1878. Van Heur. Synop. 218. *pl. 131. f. 1.* 1881–1885 (as *C. subtilis* Ehrenb.? in text and *C. normannicus* Greg. in plate).

[b] Proc. Roy. Soc. Edinb. **16:** 497. *pl. 1. f. 16, pl. 3. f. 6.* 1889.

Coscinodiscus woodwardii Eulen. Diat. Sp. Typ. no. 116. 1868. Schmidt, Atlas *pl. 60. f. 8, pl. 61. f. 3.* 1878; *pl. 65. f. 2.* 1881.

I do not find satisfactory reason for placing this diatom under *C. apiculatus* Ehrenb. as is done by Rattray[a] and copied in De Toni.[b] Although our knowledge of the latter species is most obscure, yet so far as the form is now represented it has only a remote resemblance to the above. Its typical structure is with beaded valves, while the above is covered with a fine network; and although the transition from beads to hexagons by the enlargement of the beading and their subsequent lateral pressure is an easily understood one, I think the form is then so far from the type as to have passed over into another species. Rattray has, I think, suggested a more important affinity than the one above by his remark[c] that *C. apiculatus* "when its markings are polygonal and in contact is distinguished from *C. radiatus* Ehrenb. by the presence of a central space." This is very nearly the structure represented by *C. woodwardii*, which I would therefore prefer to place as a variety of *C. radiatus* rather than to unite it with *C. apiculatus*, as I look upon the minute and irregular central area of this species as less significant than the striking structural contrast between it and *C. apiculatus*. But for the present at least it is better to keep this species independent, as is done by Grunow, Schmidt, and others. Habirshaw makes this name synonymous with *C. argus* Ehrenb., an identification quite out of the question.

Found at station 2694II, off California.

ACTINOCYCLUS Ehrenb.

Actinocyclus Ehrenb. Ber. Akad. Wiss. Berl. **1837:** 61. 1838; Infus. 171. 1838; Ber. Akad. Wiss. Berl. **1840:** 202–204. 1841,

Pyxidicula Ehrenb. in part; Ber. Akad. Wiss. Berl. **1844:** 85. 1845.

Eupodiscus Ehrenb. in part; W. Smith, Synop. Brit. Diat. **1:** 21. *pl. 4. f. 41.* 1853. Breb. Journ. Quek. Micr. Club **2:** 71. 1870. Greg. Trans. Roy. Soc. Edinb. **21:** 501. 1857.

Actinoptychus Ehrenb. in part; Ehrenb. Mikrog. *pl. 18. f. 12.* 1854. Kütz. Bacill. 134. 1844. Bright. Quart. Journ. Micr. Sci. **8:** 94. 1860.

Auliscus Ehrenb. in part; Rabh. Fl. Eur. Alg. **1:** 320. 1864.

Hyalodiscus Ehrenb. in part; H. L. Smith, Amer. Journ. Micr. **2:** 100. 1877.

Stictodiscus Grev. in part; Grun.; Van Heur. Synop. *pl. 118. f. 4.* 1881.

Podosira Ehrenb. in part; Grun.; Van Heur. Synop. *pl. 118. f. 5.* 1881.

Micropodiscus Grun.; Van Heur. Synop. *pl. 118. f. 5.* 1881.

Roperia Grun.; Grun in Van Heur. Synop. *pl. 118. f. 6.* note. 1881. Ratt. Journ. Roy. Micr. Soc. **8**[2]**:** 917. 1888.

Coscinodiscus Ehrenb. in part; Grun. Denkschr. Akad. Wien **48**[2]**:** 83. 1884. Norm. Trans. Micr. Soc. Lond. n. s. **9:** 7. 1861. Grove, Proc. Roy. Soc. Edinb. **17:** 449. 1890.

This genus is one of extreme difficulty—first, because of the remarkable confusion between it and other genera, especially in the earlier writers; the result being that such actinocycloid forms as are treated by them are difficult to find. This is especially the case in regard to this genus and Actinoptychus Ehrenb., on the part of Ehrenberg, Kützing, Greville, Brightwell, and others, a condition growing out of the fact that when Ehrenberg first constituted the genus Actinocyclus it made no distinction between these and the Actinoptychus forms, which, though so dissimilar, were not separated until 1840, when Ehrenberg created the genus Actinoptychus for that pur-

[a] Proc. Roy. Soc. Edinb. **16:** 571. 1889.
[b] De Toni, Syll. Alg. **2:** 1283. 1894.
[c] Op. cit. 570.

pose. Kützing, Greville, and Brightwell, however, ignored this latter genus, and so perpetuated the error. In addition to the confusion between the above-mentioned genera, there is a second reason for the difficulty here encountered, and one that partly explains the other; the inconstant and rather trivial generic distinction between this and Coscinodiscus Ehrenb. The general structure and markings are those of the latter genus, and the one striking distinguishing feature, the "pseudonodule" of Actinocyclus, is unquestionably very inconstant. Some species, like *A. pyrotechnicus* Deby, seem fairly well marked and stable: but many others differ from well-known species of Coscinodiscus only in the presence of this pseudonodule, and it is not unusual to find specimens both with and without this structure in the same gathering. Thus *C. curvatulus* Grun., is *A. curvatulus* Jan., without its pseudonodule; so also *C. subtilis* Ehrenb. and *A. subtilis* Greg., *C. fuscus* Norm., and *A. ralfsii* (W. Smith) Ralfs, *C. tuberculatus* Grev., and *A. sparsus* (Greg.) Ratt.: while in H. L. Smith's type slide no. 12 the form he calls "*Actinocyclus interpunctatus* Bright.," is uniformly lacking in the pseudonodule and agrees exactly with his type slide no. 421, marked "*Podosira marina* Grun." There might be mentioned a third reason for the difficult character of this genus, namely, the lack of good literature on the subject and especially of good figures of the species. Rattray's revision of Actinocyclus[a] contains some excellent work, but it leaves much to be desired. Too many old specific names have been disturbed; the illustrations are scanty and too small, and the analytical key is most difficult to use. Schmidt's Atlas has so far practically ignored this much needed subject, an undertaking of far more importance to the science than the wearisome reillustration of species already repeatedly figured in its plates.

Actinocyclus alienus Grun.: Van Heur. Synop. *pl. 125. f. 10, 12.* 1881. Ratt. Journ. Quek. Micr. Club II. **4:** 144. 1890. Wolle, Diat. N. A. *pl. 85. f. 14.* 1890. De Toni, Syll. Alg. **2:** 1165. 1894.

The specimens found by me agree with what Grunow calls variety *californica*,[b] which is the type of the species.

Found at station 3361H, off the coast of Alaska.

Actinocyclus crassus (W. Smith) Van Heur. Synop. *pl. 124. f. 6, 8.* 1881. De Toni, Syll. Alg. **2:** 1169. 1894.

Eupodiscus crassus W. Smith, Synop. Brit. Diat. **1:** 24. *pl. 4. f. 41.* 1853.
Actinocyclus suberassus Ratt. Journ. Quek. Micr. Club II. **4:** 154. 1890.
Actinocyclus circumdatus Pant. Bacill. Ung. **1:** 66. *pl. 3. f. 28.* 1887.

Van Heurck's figure is hardly typical, as the beading is radially arranged in the type. Rattray's proposition to make a new species of the nonradial forms is, however, not to be commended. They should be looked upon as varieties of the above.

Found at station 3346, off the coast of Washington.

Actinocyclus curvatulus Jan.; Schmidt, Atlas *pl. 57. f. 31.* 1878. Wolle, Diat. N. A. *pl. 94. f. 14.* 1890.

Coscinodiscus curvatulus subocellatus Grun. Denkschr. Akad. Wien **48**[2]: 83. *pl. 4. f. 15.* 1884.

Actinocyclus subocellatus Ratt. Journ. Quek. Micr. Club II. **4:** 145. 1890.

The above differs merely in its pseudonodule from *Coscinodiscus curvatulus* Grun.,[c] a difficulty that Grunow tries to avoid by making this species a form as variety *subocellatus* of that species.

Found at station 2807, Galapagos Islands.

[a] Journ. Quek. Micr. Club II. **4:** 137–212. *pl. 11.* 1890.
[b] Van Heur. Synop. 125. *pl. 25. f. 10.*
[c] Schmidt, Atlas 57. *f. 33.* 1878.

Actinocyclus (?) **elongatus** Grun.; Van Heur. Synop. *pl. 125. f. 15, 17.* 1881.

I am in harmony with Van Heurck in doubting the correctness of calling this an Actinocyclus. Not only the extreme contrast of this elongated form with any known Actinocyclus (my specimen is twenty times as long as wide), but the absence of any true pseudonodule makes this classification unsatisfactory. In my specimen at least, the dot which Grunow considers a pseudonodule is only an enlarged bead on the upper surface of the valve, and lacks the shimmering appearance of the true pseudonodule. In my form also, as in Van Heurck's figures, there are two such, located at short distances from the two ends. Rattray[a] states that the pseudonodule is genuine in a *Tuscarora* valve, but doubts its genuineness in another subspecies which Grunow for that reason names *A. elongatus dubia.*[b] The fact is, we have here another illustration of the difficulty of considering Actinocyclus anything more than a subgenus of Coscinodiscus. Compare the figures of Van Heurck[b] with that of *Coscinodiscus elongatus* Grun. in figure 14 of the same plate.

Found at station 2919, off the coast of southern California.

Actinocyclus interpunctatus (Bright.) Ralfs in Pritch. Hist. Infus. ed. 4. 835. 1861. Ratt. Journ. Quek. Micr. Club II. **4:** 203. 1890. (Not H. L. Smith typ. no. 12.)

Actinoptychus interpunctatus Bright. Quart. Journ. Micr. Sci. **8:** 94. *pl. 6. f. 17.* 1860.

Hyalodiscus stelliger Bail. err. det. Möll. Amer. Journ. Micr. **2:** 100. 1877.

Eupodiscus (*Actinoptychus*) *interpunctatus* Bright.; Grun. Amer. Journ. Micr. **8:** 101–102. 1878.

The above is perhaps a broad variety of *A. ralfsii* (W. Smith) Ralfs, and differs little from *A. sparsus* (Greg.) Ratt. The slide in H. L. Smith's type no. 12, bearing the above name and identical with his slide 421, marked "*Podosira marina* Grun.," is better considered a variety of *A. ralfsii*, that is, if that species and this one are to be kept separate. Ralfs was himself doubtful about this form being a valid species. I share this doubt. Still, as there is ground for question on this point, it is perhaps best to accept Rattray's decision and retain the above name.

Found at station 4505H.

Actinocyclus minutus Grev.; Ratt. Journ. Quek. Micr. Club II. **4:** 170. *pl. 11. f. 4.* 1890.

The original specimens came from Manila; this one from the Galapagos Islands.

Found at station 2807, Galapagos Islands.

Actinocyclus oliverianus O'Meara, Jour. Linn. Soc. Bot. **15:** 58. *pl. 1. f. 7.* 1876 (?). Castr. Rep. Voy. Chall. Bot. **2:** 145. *pl. 4. f. 7.* 1886. Ratt. Journ. Quek. Micr. Club II. **4:** 148. 1890.

Podosira oliveriana Grun.; Van Heur. Synop. *pl. 118. f. 5.* 1881.

Micropodiscus oliverianus Grun.; Van Heur. Synop. *pl. 118. f. 5.* 1881; Denkschr. Akad. Wien **48**[2]: 79. 1884.

Actinocyclus umbonatus Castr. Rep. Voy. Chall. Bot. **2:** 145. *pl. 4. f. 4.* 1886.

It is difficult to decide on the genus of this diatom. It has the shimmering pseudonodule of Actinocyclus, the watch-case milling of Podosira and the general border of Craspedodiscus. I place it as above because my form, unlike that figured by Van Heurck and the one referred to by Rattray, has a true pseudonodule, a large, hyaline, refractive globule, and not the small process of Van Heurck's and Rattray's figures. The view of Van Heurck and of Grunow, who looked on this as a species of Podosira, does not seem to me to be tenable. It may be found necessary to adopt Grunow's sug-

[a] Journ. Quek. Micr. Club II. **4:** 197. 1890.

[b] Van Heur. Synop. *pl. 125. f. 16–17.* 1881.

gestion of putting this in a new genus Micropodiscus; though the name would be bad, as some specimens have, as above stated, not a "little foot," but a very evident pseudonodule. Castracane's figure gives emphasis to contorted markings that do not occur in all cases. I do not agree with Rattray that *Actinocyclus antarticus* Castr.[a] and *A. umbonatus* Castr.[b] are synonymous with the above. The failure to find a pseudonodule in the original specimen by O'Meara is probably explained by the inconstancy of that structure.

Found at station 2859, off the coast of Alaska.

Actinocyclus ralfsii (W. Smith) Ralfs in Pritch. Hist. Infus. ed. 4. 835. *pl. 5. f. 84.* 1861. Van Heur. Synop. 215. *pl. 123. f. 6, pl. 124. f. 1–4.* 1881. O'Meara, Proc. Roy. Irish Acad. II. **2:** 268. *pl. 37. f. 1.* 1875. Ratt. Journ. Quek. Micr. Club II. **4:** 155. 1890. De Toni, Syll. Alg. **2:** 1170. 1894. Castr. Rep. Voy. Chall. Bot. **2:** 143. *pl. 30. f. 1.* 1886. Eng. & Pr. Pflanzenfam. **1[b]:** 78. *f. 119B.* 1896. Blake, Trans. Wisc. Acad. **14:** 108. *pl. 3–4.* 1903.

Eupodiscus ralfsii W. Smith, Synop. Brit. Diat. **2:** 86. 1856. Moeb. Diat.-taf. *pl. 5. f. 11.* 1890.

Eupodiscus sparsus Greg. Trans. Micr. Soc. Lond. n. s. **5:** 81. *pl. 1. f. 47.* 1857.

Coscinodiscus fuscus Norm. Trans. Micr. Soc. Lond. n. s. **9:** 7. *pl. 2. f. 3.* 1861.

Actinocyclus fuscus H. L. Smith, Sp. Diat. Typ. no. 11. 1874.

The specimens found at station 3611 are a small and coarse variety similar to the figure in Moebius cited above.

Found at stations 3361H and 3611, off the coast of Alaska.

Actinocyclus sparsus (Greg.) Ratt. Journ. Quek. Micr. Club II. **4:** 156, 170. 1890. De Toni, Syll. Alg. **2:** 1177. 1894.

Eupodiscus sparsus Greg. Trans. Micr. Soc. Lond. n. s. **5:** 81. *pl. 1. f. 47.* 1857. Moeb. Diat.-taf. *pl. 12. f. 47.* 1890.

Actinocyclus ralfsii sparsus Ralfs, Pritch. Hist. Infus. ed. 4. 835. 1861. Cleve & Möll. type no. 115. 1878.

Actinocyclus fasciculatus Castr. Rep. Voy. Chall. Bot. **2:** *pl. 4. f. 8–8bis.* 1886.

As Rattray points out,[c] it is a matter of doubt if this form is not to be looked upon as a variety of *A. ralfsii*, thus agreeing with Ralfs's opinion[d] in Pritch. Hist. Infus. above. But, like Rattray, I feel that this union is questionable enough to warrant the separation, at least for the present. As has been pointed out in the discussion of the genus, the above differs from *Coscinodiscus tuberculatus* Grev., only in the presence of a pseudonodule.[e]

Found at station 3346, off the coast of Washington.

Actinocyclus subtilis (Greg.) Ralfs in Pritch. Hist. Infus. ed. 4. 835. 1861. Ratt. Journ. Quek. Micr. Club II. **4:** 188. 1890. H. L. Smith, Am. Journ. Micr. **2:** 101. 1877. H. L. Smith, Sp. Diat. Typ. 14. 1874. Van Heur. Synop. 216. *pl. 124, f. 7.* 1881. De Toni, Syll. Alg. **2:** 1183. 1894.

Eupodiscus subtilis Greg. Trans. Roy. Soc. Edinb. **21:** 501. *pl. 11. f. 50.* 1857, not Ehrenb. 1855, nom. nud.

Eupodiscus gregorianus Breb. Journ. Quek. Micr. Club **2:** 41. 1870.

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[a] Rep. Voy. Chall. Bot. **2:** 145. 1886.

[b] Loc. cit. *pl. 4. fig. 4.*

[c] Journ. Quek. Micr. Club II. **4:** 156. 1890.

[d] Cf. Pritch. Hist. Infus. ed. 4. 835. 1861.

[e] See Greville's original figure in Trans. Micr. Soc. Lond. n. s. **9:** 42. *pl. 4. f. 6.* 1861, or Moeb. Diat.-taf. *pl. 37. f. 6.* 1890.

The name "*Eupodiscus ? subtilis*" Ehrenberg[a] ought to be dropped out of consideration, as there is no indication of the character of the diatom the author had in mind. Ralfs's species, however, differs in no respect, except in its pseudonodule, from *Coscinodiscus subtilis* Ehrenb.[b] and especially from the figures in Schmidt's Atlas *pl. 57. f. 11–16.*

Found at stations 3669H, Kuril Islands, and 3688 H, Sea of Okhotsk.

Actinocyclus tesselatus (Roper) Ralfs in Pritch. Hist. Infus. ed. 4. 835. 1861.

Eupodiscus tesselatus Roper, Quart. Journ. Micr. Sci. **6**: 19. *pl. 3. f. 1–1.* 1858. Moeb. Diat.-taf. *pl. 13. f. 1–1b.* 1890.

Roperia tesselata Grun.; Van Heur. Synop. *pl. 118. f. 6–7.* 1881. Ratt. Journ. Roy. Micr. Soc. **8**[2]: 57. 1888. De Toni, Syll. Alg. **2**: 1087. 1894.

As has been pointed out in the discussion of the genus, the sole difference between Actinocyclus and Coscinodiscus is the presence in the former of the pseudonodule. Although this species contrasts strongly with others of the genus because of its reticulated marking, it does not differ in that respect from Coscinodiscus, where such markings are the dominant ones. I see, therefore, no reason to place this in a new genus. The pseudonodule is less dense and convex than in most Actinocycli, though there are exceptions even to this; but there can be no question that it is the homologue of that structure.

Found at stations 2680H, 2690H, between San Francisco and Hawaii.

CRASPEDODISCUS Ehrenb.

Craspedodiscus Ehrenb. Ber. Akad. Wiss. Berl. **1844**: 200. 1845; Mikrog. *pl. 18. f. 108.* Pritch. Hist. Infus. ed. 4. 831, 939. 1861. De Toni, Syll. Alg. **2**: 1198. 1894 Griff. & Henf. Micr. Dict. ed. 3. 203. *pl. 43. f. 21.* 1875. Bright. Quart. Journ. Micr. Sci. **8**: 95. *pl. 5. f. 6, pl. 6. f. 12.* Moeb. Diat.-taf. *pl. 29. f. 12.* 1890.

Coscinodiscus Ehrenb. in part; Kütz. Sp. Alg. 126. 1849.

Pyxidicula Ehrenb. Ber. Akad. Wiss. Berl. **1844**: 85. 1845, in part.

Porodiscus Grev. in part; Grun.; Schmidt, Atlas *pl. 66. f. 6.* 1888.

Hyalodiscus Ehrenb. Ber. Akad. Wiss. Berl. **1853**: 526. 1854, in part; Mikrog. *pl. 35A. xviii. f. 6a–b.* 1854.

Although this genus is of questionable validity it is not possible at this time to distribute its members among the two or three genera which it most nearly resembles. It stands closest to Coscinodiscus, as is evident by such examples of *Craspedodiscus coscinodiscus* Ehrenb. as that figured in Schmidt.[c] On the other hand, it leads over imperceptibly into Porodiscus Grev., as in the case of Schmidt's figure,[d] which Grunow calls *Craspedodiscus oblongus*, but which Rattray[e] looks upon, and rightly, as *Porodiscus oblongus* Grev. Nor is it surprising that in such cases of Brightwellia as have a very minute ring of beads separating the central portion from the outer band of the valve, this ring should be looked upon as essentially the same as the suture that usually separates these two portions in Craspedodiscus.[f] It is, however, best to hold this genus distinct; and accordingly the union of it with Coscinodiscus by Kützing[g] has been generally disregarded.

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[a] Ehrenb. Ber. Akad. Wiss. Berl. **1855**: 302. 1856.

[b] Phys. Abh. Akad. Wiss. Berl. **1841**: 412. *pl. 1. III. f. 18.* 1843.

[c] Schmidt, Atlas *pl. 66. f. 3.* 1881.

[d] Op. cit. *f. 7–9.*

[e] Proc. Roy. Soc. Edinb. **16**: 674. 1889.

[f] Cf. Bright. Quart. Journ. Micr. Sci. **8**: 95. *pl. 5. f. 6.* 1860.

[g] Kütz. Sp. Alg. 126. 1849.

Craspedodiscus coscinodiscus Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 266. 1845; Mikrog. *pl. 18. f. 108, pl. 33. XV. f. 8, pl. 33. XVI. f. 8.* 1854. Pritch. Hist. Infus. ed. 4. 832. *pl. 5. f. 80.* 1861. O'Meara, Proc. Roy. Irish Acad. II. **2:** 266. *pl. 26. f. 26.* 1874. Schmidt, Atlas *pl. 66. f. 3 5.* 1881; *pl. 184. f. 4.* 1893. Bright. Quart. Journ. Micr. Sci. **8:** 95, 139. *pl. 5. f. 4.* 1860, correction. Grun. in Fenzl, Reise Novara Bot. **1:** 26, 194. 1870. Ratt. Proc. Roy. Soc. Edinb. **16:** 600. 1889. De Toni, Syll. Alg. **2:** 1199. 1894. Wolle, Diat. N. A. *pl. 86. f. 3, 8.* 1890.

Pyxidicula coscinodiscus Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 85. 1845.

Craspedodiscus microdiscus Ehrenb. Mikrog. *pl. 33. XVII. f. 4.* 1854.

Craspedodiscus pyxidicula Bright. Quart. Journ. Micr. Sci. **8:** 95. *pl. 5. f. 4.* 1860. Moeb. Diat.-taf. *pl. 28. f. 4.* 1890.

Coscinodiscus pyxidicula Kütz. Sp. Alg. 126. 1849. Griff. & Henf. Micr. Dict. ed. 3. *pl. 43. f. 21.* 1875.

Found at station 2919, off southern California.

CYCLOTELLA Breb.

Cyclotella[a] Breb. in Breb. & God. Consid. Diat. 20. 1838. Kütz. Bacill. 50. 1844. Arnott, Quart. Journ. Micr. Sci. **8:** 241. 1860. Van Heur. Synop. 213. Pritch. Hist. Infus. ed. 4. 811. 1861. Castr. Rep. Voy. Chall. Bot. **2:** 140. 1886. De Toni, Syll. Alg. **2:** 1351. 1894.

Cymbella C. Ag. Consp. Diat. 11. 1830, in part.

Pyxidicula Ehrenb. Infus. *pl. 10. f. 1.* 1838, in part.

Discoplea Ehrenb. Ber. Akad. Wiss. Berl. **1847:** 484. 1848; Mikrog. *pl. 6. II. f. 1–4, pl. 39. II. f. 29.* 1854.

In many instances single valves of this genus are identical in general build with those of Melosira C. Ag. They never, however, grow in connected chains or filaments, as do those of the latter genus. Their sculpturing is also usually sui generis. The genus is universally recognized as distinct, a decided advantage in classification, in view of the size of Melosira. Although Cyclotella represents much smaller forms than those comprising the genus Coscinodiscus, the general shape and the mode of growth of the two are closely similar, and certain members of each genus are difficult to distinguish.

Cyclotella regina Mann, sp. nov. PLATE L, FIGURE 2.

Valve circular; consisting of a large central area, three-fourths the diameter of the valve and a rim one-fourth the diameter; the former nearly hyaline, but having a few scattered beads near the slightly elevated center and a narrow fringe of fine radiating lines next to the rim; rim nearly flat, showing different markings on its under and upper sides; the under (section *a* in the figure) ornamented with delicate and close transverse striae; the upper (section *b* in the figure) finely beaded on the inner half, the outer half hyaline; a fine but evident line near to and parallel with the margin.

Diameter of valve 0.088 mm.

The general appearance of this species is somewhat like *C. transylvanica* Pant.[b] Specimens are scarce at station 2807, at the Galapagos Islands, and only a single valve was found at station 2823 just inside the mouth of the Gulf of California, opposite the town of La Pax.

Type in the U. S. National Museum, No. 590123, from station 2807; also from station 2823, Galapagos Islands and Gulf of California.

Cyclotella striata (Kütz.) Grun. in Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 119 1880. Van Heur. Synop. 213. *pl. 92. f. 6 10, 12 15.* 1881. Schmidt, Atlas *pl. 223. f. 9 14.* 1896. De Toni, Syll. Alg. **2:** 1352. 1894.

Coscinodiscus striatus Kütz. Bacill. 131. *pl. 1. f. 8.* 1844.

[a] As a subgenus by Kützing. Linnaea **8:** 535. 1833.

[b] Schmidt, Atlas *pl. 223. f. 21 27.* 1896.

Discoplea sinensis Ehrenb. Mikrog. *pl. 39. I. f. 16, pl. 39. II. f. 30.* 1854.
Discoplea atlantica Ehrenb. Mikrog. *pl. 39. II. f. 29.* 1854.
Cyclotella dallasiana W. Smith, Synop. Brit. Diat. **2**: 87. 1856. Rabh. Fl. Eur. Alg. **1**: 33. 1864 (not H. L. Smith. Sp. Diat. Typ. no. 102. 1874).
Cyclotella sinensis Ralfs in Pritch. Hist. Infus. ed. 4. 812. *pl. 15. f. 4.* 1861.
Cyclotella atlantica Ralfs in Pritch. Hist. Infus. ed. 4. 812. *pl. 15. f. 3.* 1861.
Cyclotella ambigua Grun. in Cleve. & Grun. Sv. Vet. Akad. Handl. **17**^{2}: 119. *pl. 7. f. 133.* 1880. De Toni, Syll. Alg. **2**: 1352. 1894.

Though there is similarity between this and *C. stylorum* Bright., I do not think it is sufficient to necessitate uniting them, as is done by De Toni.[a] They are held as separate by Ralfs, Schmidt, and Van Heurck. There is no doubt about *C. sinensis* (Ehrenb.) Ralfs being this species; though *Discoplea sinensis* Ehrenb., on which Ralfs bases his name, is somewhat questionable. The same is true of *C. dallasiana* W. Smith, which from the meager description and the absence of any illustration is rather indefinite. H. L. Smith's type no. 102 is a typical *C. stylorum* Bright., to which, therefore, if the two are to be held separate, it should be referred.

Found at stations 2688H, 4516H, off California and in Gulf of California.

Cyclotella stylorum Bright. Quart. Journ. Micr. Sci. **8**: 96. *pl. 6. f. 16.* 1860. Van Heur. Synop. *pl. 92. f. 2-5.* 1881 Schmidt, Atlas *pl. 223. f. 6 8.* 1896. Pritch Hist. Infus. ed. 4. 813. 1861. Moeb. Diat.-taf. *pl. 29. f. 16.* 1890.
Cyclotella dallasiana W. Smith, err. det. H. L. Smith, Sp. Diat. Typ. no. 102. 1874.

As only a single valve was found the identification is somewhat doubtful, for without a complete frustule it is nearly impossible to decide between the above species and similarly constructed valves of Melosira, as, for example, those of *M. subornata* Schmidt.

Found at station 3263H, south of Aleutian Islands.

HEMIPTYCHUS Ehrenb.

Hemiptychus Ehrenb. Ber. Akad. Wiss. Berl. **1848**: 7. 1849.
Arachnodiscus Bail. Ber. Akad. Wiss. Berl. **1849**: 64. 1850: in Wilkes U. S. Explor. Exped. **17**: 174. 1874. De Toni, Syll. Alg. **2**: 1311. 1894.
Arachnoidiscus Deane; Pritch. Hist. Animale. ed. 2. 318. 1852; Hist. Infus. ed. 4. 841. *pl. 15. f. 18–21.* 1861. H. L. Smith, The Lens **1**: 19, 93. 1872.
Arachnoidiscus Bail.; W. Smith. Synop. Brit. Diat. **1**: 25. *pl. 31. f. 256.* 1853. Deane, Quart. Journ. Micr. Sci. **6**: 188. 1858.

The above name must take precedence over Arachnodiscus, which was first published in 1850, Ehrenberg crediting the name to J. W. Bailey, who probably communicated the name in a letter to Ehrenberg, as no trace of it can be found in Bailey's earlier writings. In 1850 Ehrenberg discards the earlier name, in consequence of its prior application to a genus of insects, and adopts the very appropriate and descriptive name of Arachnodiscus, which was first used in England by H. Deane (spelling it, however, as it is now generally spelled, Arachnoidiscus) in an unpublished paper read before the Microscopical Society of London on March 17, 1847.[b]

Ehrenberg's excuse for abandoning his earlier name, Hemiptychus, is not valid. I think it is both unnecessary and unwise to duplicate names in botany and zoology, and especially so where the forms are, as with the diatoms, close to the dividing line between the two kingdoms. But in this instance there is no duplication; the hemipterous name previously established by Germar in 1833[c] being Hemiptycha, not

[a] De Toni, Syll. Alg. **2**: 1352. 1894.
[b] Quart. Journ. Micr. Sci. **6**: 188. 1858.
[c] Silb. Rev. Ent. 1833.

Hemiptychus. This latter was looked upon by Le Conte as sufficiently distinct to be given to a genus of Coleoptera in 1865.[a] As this first name of Ehrenberg's is valid and as his diagnosis is clear and his type species well defined, namely, *H. ornatus*, it must replace the better known and far more descriptive name invented by Deane.

Hemiptychus ehrenbergii (Bail.) Mann.

Arachnodiscus ehrenbergii Bail. Ber. Akad. Wiss. Berl. **1849:** 63. 1850; Wilkes U. S. Explor. Exped. **17:** 174. 1874. W. Smith. Synop. Brit. Diat. **1:** 26. *pl. 31. f. 256.* 1853. Schmidt, Atlas *pl. 68. f. 3–4.* Jan. Abh. Schles. Ges. Vaterl. Cult. **1862**[2]**:** 158. *pl. 2A. f. 3. 11.* 1862. Pant. Beitr. Bacill. Ung. **1:** 69. *pl. 19. f. 169.* 1886. Truan & Witt, Diat. Hayti. *pl. 2. f. 8.* 1888.

Arachnoidiscus japonicus Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1872:** 198. 1873 (not *A. japonicus* Shadb. which is *A. ornatus* Ehrenb.). Carp. Micro. ed. 8. 612. *pl. 12.* 1901.

The specimens found at station 3604 are the variety called *californica* Grun.[b]

Found at stations 2287H, 2844, 2848, 2860, 3604, 3635H, 3691H, 3693H, 3694H, 3712H, 3784H, 4013H, 4019H, 4023H, 4025H, 4029H, Bering Sea, Aleutian Islands, off British Columbia, Okhotsk Sea, and off Honshu Island, Japan.

Hemiptychus indicus (Ehrenb.) Mann.

Arachnoidiscus indicus Ehrenb. Ber. Akad. Wiss. Berl. **1854:** 165. 1855; Mikrog. *pl. 36. f. 34.* 1854. Witt. Verh. Russ. Min. Gesell. II. **22:** 153. *pl. 8. f. 4.* 1886. Pant. Beitr. Bacill. Ung. **1:** 69. *pl. 19. f. 171.* 1886. Schmidt, Atlas *pl. 68. f. 6–8.* 1881; *pl. 73. f. 2.* 1882; *pl. 201. f. 2–6.* 1896. De Toni. Syll. Alg. **2:** 1312. 1894.

This species approaches by close gradations to *H. ehrenbergii.*

Found at station 3635H, Bering Sea, between Pribilof and Aleutian Islands.

Hemiptychus ornatus Ehrenb. Ber. Akad. Wiss. Berl. **1848:** 7. 1849.

Arachnoidiscus ornatus Ehrenb. Ber. Akad. Wiss. Berl. **1849:** 64. 1850. Pritch. Hist. Infus. ed. 3. 842. *pl. 15. f. 18–21.* 1861. Schmidt, Atlas *pl. 73. f. 4–10.* 1882. Truan & Witt, Diat. Hayti 11. *pl. 2. f. 15.* 1888. Jan. Abh. Schles. Ges. Vaterl. Cult. **1862**[2]**:** 22. *pl. 1A. f. 3. pl. 1B. f. 5.* 1862. De Toni, Syll. Alg. **2:** 1311. 1894. H. L. Smith, Sp. Diat. Typ. 45. 1874. Eng. & Pr. Pflanzenfam. **1**[1b]**:** 69. *f. 95.* 1896.

Arachnoidiscus japonicus Shadb. Trans. Micr. Soc. Lond. **3:** 319. *pl. 24. f. 18–21.* 1852 (not *A. japonicus* Ehrenb., which is *A. ehrenbergii* Bail.).

Arachnoidiscus nicobaricus Ehrenb. Ber. Akad. Wiss. Berl. **1854:** 165. 1855; Mikrog. *pl. 30. f. 35.* 1854.

Found at station 3698, off Honshu Island, Japan.

STICTODISCUS Grev.

Stictodiscus Grev. Trans. Micr. Soc. Lond. n. s. **9:** 39. *pl. 4, f. 1–4.* 1861. Truan & Witt, Diat. Hayti 18. *pl. 5.* 1888. De Toni, Syll. Alg. **2:** 1313. 1874. Castr. Rep. Voy. Chall. Bot. **2:** 112–116. 1886. Van Heur. Treat. Diat. 506. *f. 254.* 1896.

Cyclotella Kütz. Sp. Alg. 20. 1849, in part.

Triceratium Ehrenb. in part; Grev. Trans. Micr. Soc. Lond. n. s. **9:** 76. *pl. 9. f. 9.* 1861; **13:** 104. *pl. 8. f. 14.* 1865.

Discoplea Ehrenb. Mikrog. *pl. 35A. XVII. f. 6.* 1854, in part.

Actinoptychus Ehrenb. Mikrog. *pl. 19. f. 12.* 1854, in part.

Nothoceratium De Toni, Syll. Alg. **2:** 915. 1894, in part.

All specimens of this genus having polygonal instead of circular form were put by Greville and others in that unscientific complex, the genus Triceratium of Ehrenberg.

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[a] Proc. Acad. Phila. 239. 1865.

[b] Schmidt, Atlas *pl. 68. f. 3.* 1881.

The matter of this confusion has been so extensively treated by Castracane[a] that no attempt to add to what is there said is necessary here. The subject will be referred to in this report under the genus Trigonium. The present genus is in some instances so close to Hemiptychus Ehrenb. that good definitions are hard to formulate.[b] Nevertheless the utility of the two genera is considerable, and their approach is not close enough to merge this genus into that of Ehrenberg.

Stictodiscus buryanus Grev. Trans. Micr. Soc. Lond. n. s. **9**: 40. *pl. 4. f. 1 2.* 1861. Moeb. Diat.-taf. *pl. 37. f. 1-2.* 1890. Schmidt, Atlas *pl. 131. f. 3.* 1888. Truan & Witt, Diat. Hayti 19. *pl. 5. f. 1 3, 5 6, 15.* 1888. De Toni, Syll. Alg. **2**: 1313. 1894.

Stictodiscus hüttlingerianus Truan & Witt, Diat. Hayti 19. *pl. 5. f. 11.* 1888.

It is a question whether or not *S. johnsonianus* Grev. should be placed here as a synonym. The chief distinction is the single lines of radiating beads in *S. johnsonianus* and the multiple lines of beading, especially near the border, in *S. buryanus*. This difference, as seen in Greville's original figures and in plate 5 of Luard and Witt is hardly adequate to keep these apart. There is even less excuse for making a new species of *S. hüttlingerianus* on the trivial ground that the shadow lines at the center of the valve do not anastomose.

Found at stations 2807, 3784, Galapagos Islands, and north of Aleutian Islands.

Stictodiscus gelidus Mann, sp. nov. PLATE L, FIGURE 5.

Valves circular, almost flat; marked with very large flat disks, which, like the interspaces, are smooth and shining; the largest, four to five in number, arranged about the center of the valve in a ring, each disk being one-eighth the diameter of the valve in width or fully 0.01 mm. wide, thence decreasing in size to the border of the valve, where they are one-third as large; 12 to 18 radiating but irregular lines proceeding from the border toward the center, but not reaching it, as is common in this genus; at the center one smaller disk invariably perforated by a vermiform central pore, larger above and narrowing inward to a fine point; rim narrow and hyaline.

Diameter of valve, 0.058 to 0.105 mm.

Type in the U. S. National Museum, No. 590124, from station 4029H, Bering Sea, June 27, 1900; 913 fathoms, bottom of gray sand and clay.

Stictodiscus johnsonianus Grev. Trans. Micr. Soc. Lond. n. s. **9**: 41. *pl. 4. f. 3.* 1861. De Toni, Syll. Alg. **2**: 1314. 1894. Truan & Witt, Diat. Hayti 20. *pl. 5. f. 4. 9, pl. 6. f. 16.* 1888. Moeb. Diat.-taf. *pl. 37. f. 3.* 1890.

Stictodiscus jeremianus Castr. Rep. Voy. Chall. Bot. **2**: 116. 1886. Truan & Witt, Diat. Hayti 20. *pl. 5. f. 10, pl. 6. f. 2.* 1888. Schmidt, Atlas *pl. 131. f. 1.* 1888. De Toni, Syll. Alg. **2**: 1320. 1884.

Triceratium jeremianum Schmidt, Atlas *pl. 75. f. 2–2a.* 1882.

Stictodiscus truani Witt, in Truan & Witt, Diat. Hayti 19. *pl. 4. f. 23–24.* 1888. Schmidt, Atlas *pl. 131. f. 2.* 1888. De Toni, Syll. Alg. **2**: 1317. 1894.

Stictodiscus caraibicus Truan & Witt, Diat. Hayti 20. *pl. 5. f. 14.* 1888. De Toni, Syll. Alg. **2**: 1319. 1894.

Stictodiscus radiatus Castr. Rep. Voy. Chall. Bot. **2**: 117. *pl. 1. f. 1.* 1886. De Toni, Syll. Alg. **2**: 1316. 1894.

In admitting a specific difference between this diatom and *S. buryanus*, chiefly on the basis of the multiple character of the radial rows of beading in the latter and

[a] Castr. Rep. Voy. Chall. Bot. **2**: 112–116. 1886.

[b] Cf. *Arachnoidiscus barbadensis* Schmidt, Atlas *pl. 68. f. 11*, with *Stictodiscus hardmanianus* Grev. *pl. 74. f. 8*, and these two with *Stictodiscus grovei* Schmidt, *pl. 147. f. 5–7.*

incidentally on the anastomosing of the shadow lines near its center, we certainly recognize a difference as small as is consistent with any distinction at all. There is excuse for this in the fact that all members of this genus are closely allied and differences may be recognized to divide up the large number of its forms which elsewhere would hardly serve that purpose. But having made this admission, there is nothing left on which to base a distinction between Greville's *S. johnsonianus* and those quoted above as synonyms. *Tricratium jeremianum* is simply a polygonal instead of a circular specimen of the same diatom,[a] and this divergence, being a most common one in the genus, counts for nothing. So *S. caraibicus* has a few more beads than the triangular examples of *S. johnsonianus* on the same plate. The "spiral arrangement" of the beads in *S. truani*, its only distinction, is difficult to detect and of no worth when detected. The figure of *S. radiatus* is almost as fine a copy of Greville's original figure of *S. johnsonianus* as could be asked for. Other forms might be added to the above list, as their differences are of somewhat questionable weight; as *S. pulchellus* Truan & Witt,[b] *S. granowii* Truan & Witt,[c] *S. affinis* Castr.,[d] *S. trigonus* Castr.,[e] *S. margaritaceus* Castr.[f] A little further removed, solely by the character of the border, is *S. californicus* Grev., together with a number of its synonyms.[g]

I have united a large number of circular and triangular specimens under this species, mounted specimens of which accompany this report.

Found at stations 2807, 2808, 2920II, 3008II, 3604, 4029II, Galapagos Islands, Hawaiian Islands.

Stictodiscus kittonianus Grev. Trans. Micr. Soc. Lond. n. s. **9:** 77. *pl. 10. f. 2-3.* 1861. Moeb. Diat.-taf. *pl. 4. f. 2 3.* Schmidt, Atlas *pl. 74. f. 16–18.* 1882. De Toni, Syll. Alg. **2:** 1315. 1894.

This delicate form, not infrequent in the fossil deposits of Maryland and Virginia, has been found on the Pacific slope only in the fossil beds of Monterey, California. The specimen discovered by me came from Bering Sea, north of the Aleutian Islands.

Found at station 4029II. Bering Sea.

ACTINOPTYCHUS Ehrenb.

Actinoptychus Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 400, 409. *pl. 1. I. f. 27. III. 22.* 1843; Am. Journ. Sci. **46:** 300. 1844.

Actinocyctus Ehrenb. in part; Bail. Am. Journ. Sci. **45:** *pl. 2. f. 11.* 1842.

Omphalopelta Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 270. 1845, in part. Castr. Rep. Voy. Chall. Bot. **2:** 129. *pl. 7. f. 2,* 131. *pl. 18. f. 9.* 1886, in toto.

Heliopelta Ehrenb. Mikrog. *pl. 33. XVIII. f. 5.* 1854. Johnst. Quart. Journ. Micr. Sci. **8:** 13, 18. 1860. Ralfs in Pritch. Hist. Infus. ed. 4. 840. 1861.

Halionyx Ehrenb. Mikrog. *pl. 35A. XXI. f. 12.* 1854. Jan. Abh. Schl. Ges. Vaterl. Cult. **1861**[2]: *pl. 1. f. 1.* 1861; **1862**[2]: *pl. 1a. f. 6.* 1862.

Actinophaenia Shadb. Trans. Micr. Soc. Lond. n. s. 16. 1854; Quart. Journ. Micr. Sci. **8:** 94. *pl 6. f. 18.* 1860.

Schuettia De Toni, Syll. Alg. **2:** 1395–96. 1894.

Closely allied to the above genus are Debya Pant., Anthodiscus Gr. & St., Lepidodiscus Witt, Actinodictyon Pant., Wittia Pant. They fall into H. L. Smith's family

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[a] Cf. Truan & Witt, Diat. Hayti *pl. 5. f. 9.* 1888.
[b] Truan & Witt, Diat. Hayti 20. *pl. 6. f. 5.* 1888.
[c] Op. cit. *pl. 4. f. 25, pl. 5. f. 8, pl. 6. f. 31.*
[d] Castr. Rep. Voy. Chall. Bot. **2:** 119. *pl. 1. f. 4.* 1886.
[e] Op. cit. 122. *pl. 31. f. 1.*
[f] Op. cit. 120. *pl. 17. f. 12.*
[g] Trans. Micr. Soc. Lond. n. s. **9:** 79. *pl. 10. f. 1.* 1861.

grouping Heliopelteae,[a] in which is also included Polymyxus Bail., a genus which I think has closer affinity with Aulacodiscus (Ehrenb.) Ralf.

The original union of Actinoptychus and Actinocyclus by Ehrenberg and the subsequent separation of the former by the creation of that genus in 1839 has been discussed under Actinocyclus. It may be well to quote here the original Ehrenberg distinction between the two as it is given by J. W. Bailey.[b] "Under the new genus Actinoptychus are now placed those species of the old genus Actinocyclus which possess internal partitions or folds, while under the old name are retained those in which the external rays are not connected with internal folds."

Actinoptychus alternans Mann, sp. nov. PLATE XLV, FIGURE 1.

Valves circular; divided into 16 alternating segments, 8 of which bear each a minute rounded process close to the margin, its base not surrounded by a hyaline area; these segments evenly marked with minute rows of beads, parallel to the central row or rows; that is, not radially arranged; number of rows per segment, 14 or 15; the 8 segments alternating with these without processes, marked with much larger beads regularly placed in diagonal parallel rows; inner ends of these segments proceeding slightly farther toward the center than those bearing processes, and hence giving a stellate appearance to the hyaline median area; the external ends of these segments showing a narrow hyaline band next to the rim; rim narrow, hyaline.

Diameter of valve, 0.0357 to 0.0450 mm.

The general aspect is similar to minute forms of *A. vulgaris* Schmidt and to *A. laevigatus* Grun., forma *para*.[c] It is also apparently like the rather obscure unnamed figure[d] which Grove rightly considers to be different from *A. elegans* Ralfs.

Type in the U. S. National Museum, No. 590125, from station 4516H, Gulf of California, December 22, 1904; 1,627 fathoms, bottom of volcanic sand, obsidian, and fragments of Globigerina.

Also a variety of the above, in which the segments bearing processes are underlain with secondary markings of coarse, bead-like dots irregularly disposed.

Found at stations 2690H, between California and the Hawaiian Islands, and 4516H in the South Pacific.

Actinoptychus grundleri Schmidt, Atlas *pl. 1. f. 22.* 1875; *pl. 90. f. 7, pl. 100. f. 3–4,* 1886. Pant. Beitr. Bacill. Ung. **1**: *pl. 12. f. 106.* 1887.

My specimen differs from the type in that the hyaline spaces between the outer extremities of the segments are not united by thin hyaline bands parallel to the margin.

Found at station 2835, off Lower California.

Actinoptychus janischii Grun.; Van Heur. Synop. *pl. 122. f. 6.* 1881. Schmidt, Atlas *pl. 153. f. 8-10.* 21. 1890. Pant. Beitr. Bacill. Ung. **1**: *pl. 16. f. 143.* 1887. De Toni, Syll. Alg. **2**: 1388. 1894.

Halionyx vicenarius Jan. Abh. Schles Ges. Vaterl. Cult. **1862**[2]: 10. *pl. 1. f. 2.* 1862.

The above specific name of Janisch, though older than *A. janischii*, was preempted by *Actinoptychus vicenarius* Ehrenb.,[e] a decidedly different diatom, without processes and having no hyaline lines bisecting the segments.

Found at station 2823.

[a] The Lens **1**: 8, 17. 1872.

[b] Am. Journ. Sci. **46**: 300. 1844.

[c] Schmidt, Atlas *pl. 132. f. 15.* 1890.

[d] Schmidt, Atlas, *pl. 153. f. 4.* 1890.

[e] Phys. Abh. Akad. Wiss. Berl. **1841**: 410. 1843. Ehrenb. Mikrog. *pl. 18. f. 28.* 1854.

Actinoptychus mölleri Grun.; Schmidt, Atlas *pl. 132. f. 8–9.* 1888; *pl. 154. f. 5.* 1890.

In our specimens the central area is formed into a strong hyaline star by the extension of the ends of the undulating segments.

Found at station 2807, Galapagos Islands.

Actinoptychus planus Mann, sp. nov. PLATE XLV, FIGURE 2.

Valves circular, divided into six segments of equal size and identical markings, their surfaces lying nearly in one plane; three bearing each a minute globular process, set on the extreme outer margin of the valve, the alternating three showing obscure rudiments of such processes; markings of minute beading closely placed, not in perfect rows, but so arranged as to give a faintly blotched or wavy appearance to the surface; no hyaline bands at the outer margins of the segments, but their outer corners separated by small triangular hyaline areas, the extremities of the six lines of division; central area unusually small, circular, hyaline; rim a mere line, apparently smooth.

Diameter of valve, 0.0525 mm.

Type in the U. S. National Museum, No. 590126, from station 4029H, Bering Sea, June 27, 1900; 913 fathoms, bottom of gray sand and clay.

Actinoptychus punctulatus Pant. Beitr. Bacill. Ung. **1:** 62. *pl. 8. f. 60.* 1887. De Toni, Notarisia **3:** 608. 1888; Syll. Alg. **2:** 1374. 1894.

Actinoptychus intermedius Schmidt, Atlas *pl. 91. f. 3* (not *f. 2*), *pl. 109. f. 12.* 1886.

As is pointed out by De Toni[a], Schmidt has included under his name *intermedius* two quite distinct forms. That represented by figure 2 in plate 91 should be taken as type; the other (fig. 3), agreeing with Pantocsek's species, should be placed here.

Found at stations 2807, Galapagos Islands, and 2920H and 3013H, between California and Hawaii.

Actinoptychus radulus Mann, sp. nov. PLATE XLV, FIGURE 3.

Valve circular; divided into 6 equal segments, each bearing a stout, rounded process, arising close to the rim and protruding slightly beyond it, its base surrounded by a small oval or cuneiform, hyaline space which narrows inward to a thin line running to the center of the valve, thus bisecting the segment; markings of minute beads regularly arranged in diagonal cross lines; each segment slightly wider at the outer margin than its length radially, thereby leaving an unusually large hyaline central area; rim narrow, finely crossed with lines and bearing blunt, stout teeth closely set, giving to the outer edge a serrate appearance; the segments alternately slightly concave and convex, as in many other species.

Diameter of valve, 0.078 mm.

Type in the U. S. National Museum, No. 590127, from station 2920H, between California and Hawaii, November 21, 1891; 570 fathoms, bottom of brown mud and fine sand.

Actinoptychus splendens (Shadb.) Ralfs in Pritch. Hist. Infus. ed. 4. 840. 1861. Van Heur. Synop. *pl. 119. f. 1–2, 4.* 1881. Pant. Beitr. Bacill. Ung. **1:** 63. *pl. 16. f. 140.* 1887. De Toni, Syll. Alg. **2:** 1385. 1894. Schmidt, Atlas *pl. 153. f. 3, 16–17.*

Actinophaenia splendens Shadb.[b] in Bright. Quart. Journ. Micr. Sci. **8:** 94. *pl. 6. f. 18.* 1860. Moeb. Diat.-taf. *pl. 29. f. 18.* 1890.

Halionyx undenarius Ehrenb. and *H. bisenarius* Ehrenb. Abh. Schles. Ges. Vaterl. Cult. **1861**[2]: *pl. 1. f. 1.* 1861; **1862**[2]: *pl. 1A. f. 6.* 1862.

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[a] Syll. Alg. **2:** 1374. 1894.

[b] This name was originally published by Shadbolt in Trans. Micr. Soc. Lond. n. s. **2:** 16. 1854. The description is insufficient for a determination, but Brightwell's identification may be correct, inasmuch as he was a contemporary worker and may have seen authentic material.

Actinoptychus hationys Grun. in Fenzl, Reise Novara Bot. **1**: 25. 1870.

Actinoptychus glabratus Grun.; Van Heur. Synop. *pl. 120. f. 6.* 1881. Pritch. Hist. Infus. ed. 4. 140. 1861. De Toni, Syll. Alg. **2**: 1387. 1894. Schmidt, Atlas *pl. 153. f. 7. 12, pl. 154. f. 2–4.* 1890.

Found at stations 2851, off the coast of Alaska; 2885, off the coast of Oregon, and 2920H, between California and Hawaii.

Actinoptychus undulatus (Bail.) Ralfs in Pritch. Hist. Infus. ed. 4. 839. *pl. 5. f. 88.* 1861. Schmidt, Jahresb. Komm. Deut. Meere *pl. 3. f. 29–30.* 1874. Schmidt, Atlas *pl. 1. f. 1–6.* 1875. Van Heur. Synop. *pl. 22bis. f. 14, pl. 122. f. 1–4.* 1881. Pant. Beitr. Bacill. Ung. **2**: 109. 1889. De Toni, Syll. Alg. **2**: 1372. 1894.

Actinocyclus undulatus Bail. Amer. Journ. Sci. **42**: *pl. 2. f. 11.* 1842. Kütz. Bacill. 132. *pl. 1. f. 24.* 1844.

Omphalopelta areolata Ehrenb. Ber. Akad. Wiss. Berl. **1844**: 270. 1845; Mikrog. *pl. 35A. XVIII. f. 2, pl. 43. XIII. f. 17.* 1854. Pritch Hist. Infus. ed. 4. 841. *pl. 8. f. 15.* 1861. Griff. & Henf. Mier. Diet. ed. 3. *pl. 43. f. 53.* 1875.

Actinoptychus omphalopelta Grun. in Fenzl, Reise Novara Bot. **1**: 25. 1870.

Actinoptychus biternarius Ehrenb. Ber. Akad. Wiss. Berl. **1843**: 166. 1844; Mikrog. *pl. 33A. XVI. f. 1, pl. 18. f. 20.* 1854.

There is some doubt about the identification of many forms in Ehrenberg's works, especially in his Mikrogeologie, bearing a close resemblance to this species. It seems to me unwise to load the synonymy with names assigned by him to forms the exact character of which it is now impossible to discover. Those given above are probably specimens of this species. It is a question whether *A. senarius* Ehrenb.[a] and *A. sedenarius* Ehrenb.[b] belong here or under *A. splendens* (Shadb.) Ralfs. If their character could be clearly determined their assignment to either of these species would call for a change of the specific name. I look upon the question as far too obscure to warrant such a change.

Many wide varieties of this species were found in these investigations. Those from station 2823 have the marginal processes on alternating segments, and so protruded beyond the usual marginal curve as to give the valve an angular form. A variety from station 2807 approaches close to *A. trifurcatus* Temp. & Br.[c]

Found at stations 2807, 2823, 2835, 2848, 2851, 2859, 2860, 2882, 3346, 3603, 3604, 3671, 3691H, 3694H, 3712H, 4013H, 4014H, 4029H, 4585H, Galapagos Islands to Bering Sea, and off Honshu Island, Japan.

At station 3604 in the Bering Sea occurs the variety called "*monterey*" by Schmidt.[d]

ASTEROLAMPRA Ehrenb.

Asterolampra Ehrenb., Ber. Akad. Wiss. Berl. **1844**: 73, 76. 1845. Grev. Trans. Mier. Soc. Lond. n. s. **8**: 108. 1860. Ratt. Proc. Roy. Soc. Edinb. **16**: 641. 1889. De Toni, Syll. Alg. **2**: 1397. 1894.

Asteromphalus Ehrenb. in part; Wall. Trans. Mier. Soc. Lond. n. s. **8**: 47. *pl. 2. f. 13.* 1860. Grev. Trans. Mier. Soc. Lond. **8**: 121. *pl. 4. f. 19.* 1860.

Craspedodiscus Ehrenb. in part; Bright. Quart. Journ. Mier. Sci. **8**: 95. *pl. 5. f. 7.* 1860. Ralfs in Pritch. Hist. Infus. ed. 4. 832. 1861.

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[a] Ehrenb. Infus. *pl. 21. f. 6.* 1838; Phys. Abh. Akad. Wiss. Berlin **1839**: *pl. 4. f. 1a–e.* 1841.

[b] Phys. Abh. Akad. Wiss. Berlin **1839**: *pl. 4. f. 2.* 1841; Mikrog. *pl. 33. XV. f. 4. 4.* 1854.

[c] Mem. Soc. Phys. et Hist. Nat. Geneva **30**[3]: *pl. 7. f. 2.* 1889.

[d] Atlas *pl. 1. f. 6.* 1875.

This genus and the next, Asteromphalus, form together a group sharply defined from all other disciform diatoms. The two genera are easily distinguished from each other by the fact that in Asteromphalus one of the radiating limbs is not symmetrical with the rest, but much narrower, and at its inner extremity, where it goes to make up the central rosette of segments, it is generally not as the rest are, i. e., wedge-shaped and terminating at the center, but is either club-shaped and extended beyond the center or rectangular and not reaching the center, or if it happen to be wedge-shaped it is smaller and narrower than the other segments. Although this asymmetry of one radiating limb in Asteromphalus is very constant in its many species, it is a rather inadequate basis for separating into two genera forms that are otherwise so much alike and are so different from all other diatoms. But for convenience of classification it is certainly advantageous to leave them as they are. The genera Rylandsia Grev., Truania Pant., Bergonia Brun, Stelladiscus Ratt., and Asterodiscus Johnst. are the nearest forms to the two above-named genera.

Asterolampra marylandica Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 76. *f. 10.* 1845. Bail. Amer. Journ. Sci. **48:** *pl. 4. f. B.* 1845. Bright. Quart. Journ. Micr. Sci. **8:** 94. *pl. 5. f. 3.* 1860. Wallich, Trans. Micr. Soc. Lond. n. s. **8:** 47. *pl. 2. f. 14–15.* 1860. Ralfs in Pritch. Hist. Infus. ed. 4. 836. *pl. 11. f. 33.* 1861. Moeb. Diat.-taf. *pl. 32. f. 1–4.* 1890. Griff. & Henf. Micr. Dict. ed. 3. *pl. 19. f. 5.* 1875. Grev. Trans. Micr. Soc. Lond. n. s. **8:** 108. *pl. 3. f. 1–4.* 1860; **10:** 44. *pl. 7. f. 1–3.* 1862. Ratt. Proc. Roy. Soc. Edinb. **16:** 193. 1889.

Asterolampra septenarius Johns. Amer. Journ. Sci. II. **13:** 33. 1852.

Asterolampra impar Shadb. Trans. Micr. Soc. Lond. n. s. **2:** 17. *pl. 1. f. 14.* 1854.

Asterolampra hexactis Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1872:** 392. *pl. 9. f. 1–2.* 1873.

Asterolampra pelagica Ehrenb. Ber. Akad. Wiss. Berl. **1854:** 238. 1855?; Phys. Abh. Akad. Wiss. Berl. **1841:** 232. *pl. 6. f. 4.* 1843.

Found at stations 2807, 2920H, 2923, Galapagos Islands, Hawaiian Islands, and off southern California.

ASTEROMPHALUS Ehrenb.

Asteromphalus Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 198, 200. 1845; Mikrog. *pl. 35A. XVI. f. 3.* 1854. Ratt. Proc. Roy. Soc. Edinb. **16:** 206. 1889. De Toni, Syll. Alg. **2:** 1409. 1894.

Spatangidium Breb. Bull. Soc. Linn. Norm. **2:** 294–7. *pl. 3. f. 3.* 1857.

Actinogramma Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1872:** 255, 392. *pl. 9. f. 3–6.* 1873.

Mesasterias Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1872:** 392. *pl. 9. f. 7.* 1873.

Asterolampra Ehrenb. in part; Grev. Trans. Micr. Soc. Lond. n. s. **8:** 117–119. *pl. 4. f. 15–18.* 1860.

The genera nearest to this are the same as are enumerated under Asterolampra, where also the close similarity of these two genera is discussed. Greville misplaced nearly all his examples of this genus in Asterolampra.

Asteromphalus arachne (Breb.) Ralfs in Pritch. Hist. Infus. ed. 4. 837. *pl. 5. f. 66.* 1861. Schmidt, Atlas *pl. 38. f. 3–4.* 1876. Jan. Abh. Schles. Ges. Vaterl. Cult. **1862**[2]: 14, *pl. 1A. f. 13, pl. 2B. f. 16.* 1862. Ratt. Proc. Roy. Soc. Edinb. **16:** 665. 1889. De Toni, Syll. Alg. **2:** 1417. 1894.

Spatangidium arachne Breb. Bull. Soc. Linn. Norm. **2:** 296. *pl. 3. f. 1.* 1857.

Asterolampra arachne Grev. Trans. Micr. Soc. Lond. n. s. **8:** 123. 1860.

Asteromphalus malleus Wall. Trans. Micr. Soc. Lond. n. s. **8:** 47. *pl. 2. f. 11.* 1860.

Asteromphalus malleiformis Wall. Trans. Micr. Soc. Lond. n. s. **8:** *pl. 2. f. 11.* expl. 1860.

There is a close resemblance between the above and *A. wallichianus* (Grev.) Ralfs,[a] which has been figured as *Asterolampra wallichiana* Grev.[b]

Found at station 2807, Galapagos Islands.

Asteromphalus beaumontii Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 200. 1845. Jan.; Schmidt, Atlas *pl. 38. f. 6–7.* (not *f. 5*). 1876. Griff. & Henf. Micr. Dict. ed. 3. *pl. 18. f. 15.* 1875. Ratt. Proc. Roy. Soc. Edinb. **16:** 658. 1889. De Toni, Syll. Alg. **2:** 1412. 1894.

Asteromphalus ralfsianus Grun. err. det. Schmidt, Atlas *pl. 38. f. 6–7* (not *f. 5*). 1876.

Much confusion exists between this species and *A. heptactis* (Breb.) Ralfs. The latter, under its synonymous name *A. ralfsianus* (Norm.) Grun., is figured by Schmidt[c] and united with figures 6 and 7 of the same plate, which should be assigned to this species. Janisch, in a note to these figures, points out this fact. De Toni[d] groups all these figures of Schmidt under *A. heptactis* (Breb.) Ralfs. The specimens found at station 2860 approach varieties of *A. hookeri* Ehrenb. as figured under its synonym *A. humboldtii* Ehrenb.,[e] and also *A. variabilis* (Grev.) Ratt. as figured under its synonym *Asterolampra variabilis* Grev.[f] and are, further, rather close to what Brun & Tempére have named *A. senectus.*[g]

Found at stations 2859, 2860, 3346, 3607, 4029II, off Washington to Bering Sea.

Asteromphalus brookei Bail. Am. Journ. Sci. II. **22:** 2. *pl. 1. f. 2.* 1856; Schmidt, Atlas *pl. 38. f. 21–23.* 1876. Pritch. Hist. Infus. ed. 4. 837. *pl. 5. f. 79.* 1861. Cleve, Bih. Sv. Vet. Akad. Handl. **1**[11]**:** 10. 1873. De Toni, Syll. Alg. **2:** 1412. 1894.

Asterolampra brookei Grev. Trans. Micr. Soc. Lond. n. s. **8:** 119. *pl. 4. f. 18.* 1860. Moeb. Diat.-taf. *pl. 33. f. 18.* 1890.

Actinogramma brookei Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1872:** 257. 1873.

Found at stations 3361, 3604, 3607, 3635II, 3693II, 4029II, off Panama and in Bering and Okhotsk seas. At station 3604 this species is remarkably abundant.

Asteromphalus elegans Grev. Quart. Journ. Micr. Sci. **7:** 161. *pl. 7. f. 6.* 1859. Pritch. Hist. Infus. ed. 4. 837. *pl. 5. f. 87.* 1861. Schmidt, Atlas *pl. 38. f. 1–2.* 1876. Ratt. Proc. Roy. Soc. Edinb. **16:** 212. 1889. De Toni, Syll. Alg. **2:** 1413. 1894.

Asterolampra elegans Grev. Trans. Micr. Soc. Lond. n. s. **8:** 118. *pl. 4. f. 16.* 1860. Moeb. Diat.-taf. *pl. 33. f. 16.* 1890.

Actinogramma jupiter Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1872:** 392. *pl. 9. f. 3.* 1873.

Actinogramma venus Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1872:** 392. *pl. 9. f. 4.* 1873.

Actinogramma saturnus Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1872:** 392. *pl. 9. f. 5.* 1873.

Actinogramma sol Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1872:** 392. *pl. 9. f. 6.* 1873.

Asteromphalus wyvillii Castr. Rep. Voy. Chall. Bot. **2: 134.** *pl. 5. f. 6.* 1886. De Toni, Syll. Alg. **2:** 1418. 1894.

Schmidt incorrectly attributes this name to Ralfs.

Found at station 2807, Galapagos Islands.

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[a] Pritch. Hist. Infus. ed. 4. 837. 1861.

[b] Trans. Micr. Soc. Lond. n. s. **8:** *pl. 4. f. 11.* 1860. Moeb. Diat.-taf. *pl. 33. f. 11.* 1890.

[c] Atlas *pl. 38. f. 5.* 1876.

[d] Syll. Alg. **2:** 1416. 1894.

[e] Mikrog. *pl. 35A. XXI. f. 3.* 1854.

[f] Trans. Micr. Soc. Lond. n. s. **8:** *pl. 3. f. 6–8.* 1860.

[g] Mem. Soc. Phys. et Hist. Nat. Geneva **30**[9]**:** 17. *pl. 3. f. 2.* 1889 (cf. Schmidt, Atlas *pl. 202. f. 17.* 1896.)

Asteromphalus flabellatus (Breb.) Grev. Quart. Journ. Micr. Sci. **7:** 160 *pl. 7. f. 4–5.* 1859. Moeb. Diat.-taf. *pl. 21. f. 4–5.* 1890. Schmidt, Atlas *pl. 38. f. 10–12.* 1876. Van Heur. Synop. *pl. 127. f. 5–6.* 1881. Jan. Abh. Schles. Ges. Vaterl. Cult. **1862[2]:** 13. *pl. 2B. f. 23.* 1862. Ratt. Proc. Roy. Soc. Edinb. **16:** 622. 1889. De Toni, Syll. Alg. **2:** 1414. 1894.

Spatangidium flabellatum Breb. Bull. Soc. Linn. Norm. **2:** 297. *pl. 3. f. 3.* 1857.

Spatangidium peltatum Breb. Bull. Soc. Linn. Norm. **2:** 298. *pl. 3. f. 4.* 1857.

Asterolampra flabellata Grev. Trans. Micr. Soc. Lond. n. s. **8:** 116. 1860.

Found at stations 2807, 3698, Galapagos Islands and off Honshuh Island, Japan.

Asteromphalus heptactis (Breb.) Ralfs in Pritch. Hist. Infus. ed. 4. 838. *pl. 8. f. 21.* 1861. Ratt. Proc. Roy. Soc. Edinb. **16:** 664. 1889. De Toni, Syll. Alg. **2:** 1416. 1894.

Spatangidium heptactis Breb. Bull. Soc. Linn. Norm. **2:** 296. *pl. 3. f. 2.* 1857.

Spatangidium ralfsianum Norm. Quart. Journ. Micr. Sci. **7:** 161. *pl. 7. f. 7–8.* 1859. Moeb. Diat.-taf. *pl. 21. f. 7–8.* 1890.

Asterolampra heptactis Grev. Trans. Micr. Soc. Lond. n. s. **8:** 122. 1860.

Asteromphalus ralfsianus Grun. in Schmidt, Atlas *pl. 38. f. 5* (not *f. 6–8*). 1876.

As is stated under *A. baumontii* Ehrenb., much confusion exists between these two forms. A variety is found abundantly at stations 4505H and 4516H, having the valves rather oval than circular, similar to Ralfs's figure cited above, but with the part bisected by the narrow limb flattened to nearly a straight line and showing a fold in the valve on the left of this limb. This contorted phase is perfectly uniform in these gatherings.

Found at stations 2807, 2923, 3604, 4505H, 4516H, Galapagos Islands to Bering Sea.

Asteromphalus hiltonianus (Grev.) Ralfs in Pritch. Hist. Infus. ed. 4. 837. 1861. Ratt. Proc. Roy. Soc. Edinb. **16:** 661. 1889. De Toni, Syll. Alg. **2:** 1414. 1894.

Asterolampra hiltoniana Grev. Trans. Micr. Soc. Lond. n. s. **8:** 117. *pl. 4. f. 15.* 1860. Moeb. Diat.-taf. *pl. 33. f. 15.* 1890. H. L. Smith, Sp. Diat. Typ. no. 491. 1878.

I have not placed the above as a synonym of *A. elegans* Grev., but the two are enough alike to raise the question of uniting them. I find both in some abundance in the same dredging, station 2807, and the distinguishing between the two has been a rather arbitrary one on my part. It may be found best to place this species under the older one, *A. elegans*.

Found at station 2807, Galapagos Island.

Asteromphalus hookerii Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 200. *f. 3.* 1845; Mikrog. *pl. 35A. XXI. f. 2.* 1854. Pritch. Hist. Infus. ed. 4. 836. *pl. 11. f. 34.* 1861. Ratt. Proc. Roy. Soc. Edinb. **16:** 656. 1889. De Toni, Syll. Alg. **2:** 1410. 1894. Griff. & Henf. Micr. Dict. ed. 3. 81. *pl. 19. f. 2.* 1875.

Asteromphalus buchii Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 200. *f. 4.* 1845.

Asteromphalus cuvierii Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 200. *f. 7.* 1845; Mikrog. *pl. 35A. XXI. f. 1.* 1854. Jan. Abh. Schles. Ges. Vaterl. Cult. **1862[2]:** 160. *pl. 2B. f. 21.* 1862.

Asteromphalus humboldtii Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 200. *f. 6.* 1845; Mikrog. *pl. 35A. XXI. f. 3.* 1854. Jan. & Rabh. in Rabh. Beitr. **1:** [4. *pl. 3. f. 11*] 1863. Schmidt, Atlas *pl. 38. f. 18–20.* 1876.

Asterolampra hookerii Grev. Trans. Micr. Soc. Lond. n. s. **8:** 114. 1860.

Ehrenberg's habit of giving separate names to specimens of the same species differing in the number of arms or divisions is responsible for the three synonyms cited above, *A. hookerii* having six rays, *A. buchii* seven rays, *A. humboldtii* eight rays, and *A. cuvierii* nine rays.

Found at station 3635H, Bering Sea.

Asteromphalus nanus Mann, sp. nov. PLATE XLV, FIGURE 4.

Valves circular, the central hyaline area or rosette unequally divided into five wedge-shaped segments by straight or slightly curved partitions, having neither forks nor angular breaks, the focus of the five segments being not in the center of the valve, but slightly nearer the side bearing the narrow limb; the wedge-shaped segment of the narrow limb smallest, constituting about 12 per cent of the central area, the two on either side larger, each about 20 per cent of the area and the remaining two largest, about 24 per cent; narrow limb sharply bent to the left, dividing the beaded compartments on either side of it into two unequal portions; of the four remaining limbs one or two slightly curved; all four stout, expanded at the ends and bearing a minute circular process at the extremity; all five limbs reaching to within one row of beading of the margin; beading fine, decreasing toward the margin; approximately regular, the slight deviation from regularity being repeated exactly in each of the pairs of compartments to the right and left of the narrow limb. The species is very abundant in the one sounding where it was discovered and is constant to its type.

Diameter of valve 0.04 to 0.06 mm.; rows of beading 13 to 15 in 0.1 mm.

Type in the U. S. National Museum, No. 590128, from station 4029H, Bering Sea, June 27, 1900; 913 fathoms, bottom of gray sand and clay.

The nearest form to this is *A. debyi* Pant.[a] It differs from the latter in the character of the beading and in the absence of septae joining the dividing lines of the wedge-shaped segments of the central rosette.

Asteromphalus roperianus (Grev.) Ralfs. in Pritch. Hist. Infus. ed. 4, 838, 1861. Schmidt, Atlas *pl. 38, f. 15*. 1876. Ratt. Proc. Roy. Soc. Edinb. **16**: 657. 1889. Castr. Rep. Voy. Chall. Bot. **2**: 133. *pl. 5, f. 3*. 1886. Schultze, Bull. Torr. Club **14**: 96. 1887. De Toni, Syll. Alg. **2**: 1411. 1894.

Asterolampra roperiana Grev. Trans. Micr. Soc. Lond. n. s. **8**: 119. *pl. 4, f. 14*. 1860. Moeb. Diat.-taf. *pl. 33, f. 14*. 1890.

Mesasterias abyssi Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1872**: 392. *pl. 9, f. 7*. 1873.

Found at station 2807, Galapagos Islands.

Asteromphalus shadboltianus (Grev.) Ralfs in Pritch. Hist. Infus. ed. 4, 838, 1861. Schmidt, Atlas *pl. 38, f. 17*. 1876; *pl. 137, f. 26*. 1889. Ratt. Proc. Roy. Soc. Edinb. **16**: 656. 1889. De Toni, Syll. Alg. **2**: 1411. 1894.

Asterolampra shadboltiana Grev. Trans. Micr. Soc. Lond. n. s. **8**: 121. *pl. 4, f. 19*. 1860. Moeb. Diat.-taf. *pl. 33, f. 19*. 1890.

Found at stations 2919, 2920H, 3688H, near Hawaiian Islands and in Okhotsk Sea.

Asteromphalus van heurckii Mann, sp. nov. PLATE XLV, FIGURE 5.

Valve circular, scarcely convex, extremely delicate and translucent; radiating limbs 12; central hyaline area or rosette large, divided somewhat unequally into 12 wedge-shaped segments by tortuous partitions, the segment belonging to the narrow limb alone reaching the center of the valve and narrower than the rest; limbs straight, slender, terminating at the margin of the valve in suddenly enlarged extremities, bearing a minute process; margin narrow but evidently striated; markings of the 12 external wedge-shaped compartments very delicate, appearing under magnifications of 200 to 250 diameters to consist of delicate parallel lines concentric with the periphery of the valve, but under the highest magnification resolved into fine moniliform striae, those nearest the periphery alone parallel to it, those nearer the center becoming curved in the opposite direction—that is, with the convexity inward—the striae slightly wider apart than the width of the beading; the beading next to the limbs separating the compartments and bordering the internal convex ends of the compartments double the size of the rest of the beading, forming a single row of large

[a] Beitr. Bacill. Ung. **3**: *pl. 21, f. 305*. 1893.

beads around the outer edge of each compartment. Under low magnifications these bordering rows are alone visible, the rest of the compartments appearing to be hyaline.

Diameter of valve 0.088 mm.; striae 112 to 119 in 0.1 mm.

Type in the U. S. National Museum, No. 590129, from station 2923, off southern California, January 19, 1889; 822 fathoms, bottom of green mud.

I have named this fine species as above, not only because of my high regard for Dr. Henri Van Heurck, but also on account of its general resemblance to *Asterolampra van heurckii* Brun.[a]

Asteromphalus variabilis (Grev.) Ratt. Proc. Roy. Soc. Edinb. **16**: 655. 1889. De Toni, Syll. Alg. **2**: 1410. 1894.

Asterolampra variabilis Grev. Trans. Mier. Soc. Lond. n. s. **8**: 111. *pl. 3. f. 6–8.* 1860.

My specimen is a rather doubtful example of the above species, and, it should be added, the species itself is open to some question. The figures of Greville in the above citation are too incomplete as to the nature of the limbs and especially as to the character of the markings to make it certain that figures 7 and 8 are not both generically and specifically different from figure 6, their general aspect being that of Asterolampra, as Greville has of course named them. There is no question about figure 6 being an Asteromphalus; and Rattray is probably justified in putting this variable diatom under the above name. My form lends confirmation to this view, the segment of the central area belonging to the narrow limb, being, as in figure 6, wedge-shaped and the valve having all the characteristics of this genus. Its size, also, and the fineness of its striation correspond exactly with those data as given by Rattray.

Diameter of valve 0.113 mm.; striae 5 to 8 in 0.01 mm.

Found at station 4029H, Bering Sea.

TRIPODISCUS Ehrenb.

Tripodiscus Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1839**: 130, 159. *pl. 3. f. 6a–c.* 1841.

Tetrapodiscus Ehrenb. Ber. Akad. Wiss Berl. **1843**: 166. 1844. Kütz. Bacill. 136. *pl. 1. f. 6.* 1844.

Pentapodiscus Ehrenb. Ber. Akad. Wiss. Berl. **1843**: 166. 1844.

Podiscus Bail. Am. Journ. Sci. **46**: 137. *pl. 3. f. 1 2.* 1844.

Eupodiscus Ehrenb. Ber. Akad. Wiss. Berl. **1844**: 73. 1845, in part.

Aulacodiscus Ehrenb. Ber. Akad. Wiss. Berl. **1844**: 73. 1845; Mikrog. *pl. 18. f. 47.* 1854. Pritch. Hist. Infus. ed. 4. 843. *pl. 6. f. 4–5.* 1861. Char. Emend. Ratt. Journ. Roy. Mier. Soc. **8**: 337. 1888. De Toni, Syll. Alg. **2**: 1091. 1891.

The name Tripodiscus is clearly prior to the generally accepted name Aulacodiscus. It is an unfortunate name, as it applies strictly to only those specimens that have the accidental number of three processes, whereas nine-tenths of the members of the genus have from four to twenty processes. But the descriptive exactness of a name can be no criterion of its claim in taxonomy. It is, however, genuinely unfortunate that this inapt name must, according to existing rules, supplant the better and generally known name Aulacodiscus. Tripodiscus is clearly defined as a genus[b] and its type species, *T. argus*,[c] is equally definite and is unmistakably figured. On the plate it is called *T. germanicus*, but the reference to it on page 159 gives preference to *T. argus*. Bailey's name, Podiscus, is better than either of the foregoing, so far as aptness is concerned. The species *T. argus*, generally known as *Eupodiscus argus* Ehrenb., is hardly characteristic of the genus, as on account of its imperfectly radiating areolation and its double markings it represents, together with *T.* (*Aulacodiscus*) *rogersii*

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[a] Mem. Soc. Phys. et Hist. Nat. Geneva **31**[1]: 19. *pl. 14. f. 1.* 1891.

[b] Phys. Abh. Akad. Wiss. Berl. **1839**: 130. 1841.

[c] Op. cit. 159. *pl. 3. f. 6a–c.*

Bail., and *T.* (*Aulacodiscus*) *thumii* Schmidt, a somewhat aberrant phase of the genus, for most members of the genus have simple beading for markings, radially arranged, with a more or less pronounced hyaline central area from which hyaline lines run to the bases of the intermarginal processes. Indeed, Eupodiscus of Ehrenb. (not of Ratt.) came to represent just the aberrant phase of *T. argus*. But the differences are neither constant nor striking enough to warrant a separate genus, and Rattray, Schmidt, and others, have done rightly in uniting these with those generally called Aulacodiscus. Rattray has unwisely retained the name Eupodiscus for a group of diatoms having none of the characteristics of Ehrenberg's forms, nor containing a single species so named by him, namely, species with from one to four processes that are not protuberant horns, but more of the nature of the "ocelli" in the genus Auliscus or of the pseudonodule in Actinocyclus. The genus so framed is of doubtful value, and if it be needed, those of its members which can not be referred to Auliscus (where most of them belong) would be better placed under an entirely new generic title, rather than under the misleading name Eupodiscus. Eupodiscus Ratt. (not Ehrenb.) is therefore left out of the above synonymy.[a]

Tripodiscus affinis (Grun.) Mann.

Aulacodiscus affinis Grun.; Schmidt, Atlas *pl. 1. 34. f. 9–10.* 1876. Ratt. Journ. Roy. Micr. Soc. **8**[1]: 359. De Toni, Syll. Alg. **2:** 1110. 1894.

Aulacodiscus chasei Pant. Beitr. Bacill. Ung. **1:** 57. *pl. 29. f. 294.* 1886.

Aulacodiscus oregonus sparsius-punctata Grun.; Schmidt, Atlas *pl. 107. f. 6, 7* (figure unnamed). 1886.

Rattray includes in this species the unnamed figure of Schmidt's noted in the last synonym as well as Grunow's subspecies of *A. oregonus* Bail. I think this union is justified. But there seems to me more uncertainty about placing here the type and varieties of *A. lunyaeskii* Pant.[b] However, there is a similarity between these and the above, and indeed between all these and *A. oregonus* Bail.

Found at Station 3604H, off British Columbia.

Tripodiscus beringensis Mann. PLATE L, FIGURE 6.

Valve circular, strongly marked with coarse beads, becoming smaller only near the margin; processes nine, submarginal; from the base of each a hyaline rectangular space, two rows of beads wide, extending radially inward for about one-fifth the radius, from this point a single row of beads running to the small circular central area, this inclosed by a ring formed of the nine terminal beads of these rows; the segments subtended by these nine radial rows set with beads of equal size in parallel lines, only the central one in each segment being, therefore, radial.

Diameter of valve 0.063 mm.; beads 64 in 0.1 mm.

Type in the U. S. National Museum, No. 590130, from Station 4029H, Bering Sea, June 27, 1900; 913 fathoms, bottom of gray sand and clay.

Tripodiscus concentricus Mann, sp. nov. PLATE LIV, FIGURES 1, 2.

Valve circular, nearly flat for one-half the radius, thence moderately and evenly convex to the margin; marking of large beads, of uniform size until within one-fifth a radius length of the margin, then of smaller beading, so placed as to form a single spiral about the minute hyaline center, thence passing into a series of strictly concentric circles and the component beads of each circle so arranged as to form with those in the other circles perfectly radial rows, the beads set slightly closer in the concentric circles than in the radiating rows; at the distance of one-half a radius from the center, where the valve becomes convex to the margin, the two concentric circles of beads a trifle

[a] Cf. Journ. Roy. Micr. Soc. **8**[4]: 900. 1888.

[b] Pant. Beitr. Bacill. Ung. **1**: 59, *pl. 1, f. 2, pl. 2. f. 9-10, pl. 25. f. 225–229.* 1886.

farther apart than elsewhere, giving to the interspace the appearance of a bright narrow ring; processes two or three, stout, spherical, placed at about one-sixth a radius from the margin; the base of each surrounded by a small hyaline area, from which an obscure hyaline line extends to the center; border very narrow, minutely beaded.

Diameter of valve 0.065 to 0.133 mm.

Type in the U. S. National Museum, No. 590131, from station 4505H, Santa Cruz Light-house, Monterey Bay, Cal., 1904; 10 fathoms.

The concentric beading of this species reminds one of *A. brownii* Norm., though it is much more pronounced here. The species differs from *A. brownii* in the convexity of the valve, the character of the processes, the border, etc. The latter is also a much more delicate species than this massive one.

Although Rattray has used the above specific name for an Actinocyclus, I have applied it here because it is so aptly descriptive of this diatom's most striking characteristic.

Tripodiscus cosmiodiscus Mann, sp. nov. PLATE LIV, FIGURE 4.

Valve circular, nearly flat, beaded; beading minute, closely and evenly set in radiating lines, except where these lines are slightly bowed around the twelve somewhat protuberant portions of the valve bearing the twelve processes; no hyaline central area; margin obscure; each of the twelve processes consisting of a prolongation of a single row of beads, this within one-sixth a radius of the margin becoming a narrow hyaline ridge crowning the twelve slightly protuberant portions of the valve and terminating in an exceedingly small but evidently spherical process. Aspect of the valve somewhat like Greville's *Cosmiodiscus barbadensis*.[a]

Diameter of valve, 0.095 mm.; beads 130 to 135 in 0.1 mm.

Type in the U. S. National Museum, No. 590132, from station 4029H, Bering Sea, June 27, 1900; 913 fathoms, bottom of gray sand and clay.

Tripodiscus kinkeri (Schmidt) Mann.

Aulacodiscus kinkeri Schmidt, Atlas *pl. 106, f. 4, 5*. 1886.

Aulacodiscus margaritaceus kinkeri Ratt. Journ. Roy. Micr. Soc. **8**[1]: 352. 1888.

The dominant form of the present genus is probably to be seen in *A. margaritaceus* Ralfs; and under that specific name Rattray has grouped a host of forms considered as separate species by other authors.[b] This condensation was much needed, and has been well done. But in a few instances it seems to have been carried too far. The above case is an example. Schmidt's species has a strong general resemblance to both *A. margaritaceus* Ralfs and *A. crux* Ehrenb.; but I think to make it a variety is hardly justified. Schmidt's form is a far flatter specimen than Ralfs's species. As the difference between varieties and species is practically a thing of personal opinion, the recognition of Schmidt's species is simply an expression of the fact that I look upon it as a justified expedient for distinguishing between this form and others that are called *A. margaritaceus* Ralfs. It may not be out of place here to add that the multiplication of named varieties is, I think, to be avoided wherever possible. As a rule if a new form is so different from an already existing species as to require taxonomic recognition, it is safe to look upon it as a new species. The gradations of the diatoms are almost limitless, and named varieties can be multiplied ad libitum. In this work I have omitted these whenever possible and have added none to the list myself. The remarks on this subject by Rev. William Smith[c] are worthy of consideration.

Found at station 3696, off Honshu Island, Japan.

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[a] Trans. Micr. Soc. Lond. n. s. **14**: 79. *pl. 8, f. 12*. 1866.

[b] Journ. Roy. Micr. Soc. **8**[1]: 351. 1888.

[c] Quart. Journ. Micr. Sci. **3**: 130 135. 1855.

Tripodiscus laxus Mann, sp. nov. PLATE LIV, FIGURE 3.

Valve circular; barely concave to the bases of the processes, thence rapidly convex to the border; processes five, auriculate, placed one-sixth of a radius from the border, their bases surrounded by evident hyaline areas; central area circular, slightly rugose, one-tenth of a radius in diameter; beading all of one size: that is, not decreasing toward the border; the rows radial and straight except at the bases of the processes, where one row on each side is curved about the base; both primary and secondary rows set wide apart with large interspaces, at least the width of two beads, generally of four beads, giving a loose and open appearance to the valve; border narrow, closely set with delicate beads.

Diameter of valve, 0.076 mm.; beads 45 in 0.1 mm.

Type in the U. S. National Museum, No. 590133, from station 4029H, Bering Sea, June 27, 1900; 913 fathoms, bottom of gray sand and clay.

The nearest approach to the above is the unnamed figure of Schmidt's,[a] which may be a variety of this species. Both bear some resemblance to *A. kilkellyanus* Grev.,[b] but the processes, the border, and the radially decreasing beading of Greville's diatom clearly distinguish it from this.

Tripodiscus margaritaceus (Ralfs) Mann.

Aulacodiscus margaritaceus Ralfs in Pritch. Hist. Infus. ed. 4. 844. 1861. Schmidt, Atlas *pl. 37. f. 4–7.* 1876; *pl. 92. f. 12.* 1886; *pl. 104. f. 6–8, pl. 105. f. 1–2, 4.* 1886. Ratt. Journ. Roy. Micr. Soc. **8**[1]: 351–353. *pl. 6. f. 3.* 1888. De Toni, Syll. Alg. **2**: 1101. 1894.

Aulacodiscus crux Ehrenb. Mikrog. *pl. 35 A. XVI. f. 2.* 1854, in part. Grun. Denkschr. Akad. Wien **48**[2]: 69. 1884. Schmidt, Atlas *pl. 33. f. 1 2.* 1876; *pl. 102. f. 4.* 1886.

Aulacodiscus möllèri Grun.; Schmidt, Atlas *pl. 33. f. 14, pl. 35. f. 6, pl. 37. f. 8, pl. 41. f. 12.* 1876; *pl. 102. f. 1–2, 13.* 1886.

Aulacodiscus debyi Pant. Beitr. Bacill. Ung. **1**: 58. *pl. 25. f. 226.* 1886.

Aulacodiscus n. sp.? Schmidt, Atlas *pl. 37. f. 1 3.* 1876.

Rattray[b] has named many varieties of this species. The one he calls variety *elongata* Schmidt thinks should be a separate species. (See last synonym above.) Rattray's view is to be preferred.

Found at station 2823, Gulf of California.

Tripodiscus oregonus (Harv. & Bail.) Mann.

Aulacodiscus oregonus Harv. & Bail. Proc. Acad. Phila. **6**: 430. 1854. Pritch. Hist. Infus. ed. 4. 845. *pl. 6. f. 4.* 1861. Grev. Quart. Journ. Micr. Sci. **7**: 156. *pl. 7. f. 2.* 1859. Moeb. Diat.-taf. *pl. 21. f. 2.* 1890. Schmidt, Atlas *pl. 34. f. 4–6.* 1876; *pl. 107. f. 6–7.* 1886. Ratt. Journ. Roy. Micr. Soc. **8**[1]: 358. 1888. De Toni, Syll. Alg. **2**: 1109. 1894.

Aulacodiscus oregonensis Bail. & Harv. in Wilkes U. S. Explor. Exped. **17**: 176. 1874.

Found at station 2835, off Lower California.

Tripodiscus orientalis (Grev.) Mann.

Aulacodiscus orientalis Grev. Trans. Micr. Soc. Lond. n. s. **12**: 12. *pl. 2. f. 6.* 1864. Schmidt, Atlas *pl. 34. f. 1 3.* 1876. Grun. in Fenzl. Reise Novara Bot. **1**: 103. 1870. Ratt. Journ. Roy. Micr. Soc. **8**[1]: 361. 1888. De Toni, Syll. Alg. **2**: 1111. 1894.

Found at station 3688, Paumotu Islands.

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[a] Schmidt, Atlas *pl. 105. f. 8.* 1886.

[b] Trans. Micr. Soc. Lond. n. s. **11**: 70. *pl. 4. f. 14.* 1863.

Tripodiscus radiosus (Gr. & St.) Mann.

Aulacodiscus radiosus Gr. & St. Journ. Quek. Micr. Club II. **3:** 140. *pl. 12. f. 33.* 1887. Schmidt, Atlas *pl. 157. f. 1.* 1890. Ratt. Journ. Roy. Micr. Soc. **8**[1]**:** 350. 1888. De Toni, Syll. Alg. **2:** 1101. 1894. De Toni, Notarisia 466. 1888.

The original figure cited above is so bad as to mislead identification; but the description is clear; it agrees well with Schmidt's illustration. It is a diatom of exceptional beauty.

Found at station 2808, Galapagos Islands.

Tripodiscus rogersii (Bail.) Mann.

Podiscus rogersii Bail. Am. Journ. Sci. **46:** 137. *pl. 3. f. 1–2.* 1844. Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 81. 1845.

Eupodiscus rogersii Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 81. 1845. Schmidt, Atlas *pl. 92. f. 5–6.* 1886.

Eupodiscus baileyi Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 81. 1845.

Aulacodiscus rogersii Schmidt, Atlas *pl. 107. f. 3.* 1886. Ratt. Journ. Roy. Micr. Soc. **8**[1]**:** 372. 1888. De Toni, Syll. Alg. **2:** 1121. 1894.

Aulacodiscus areolatus O'Meara, Quart. Journ. Micr. Sci. n. s. **18:** 104. 1878.

Aulacodiscus thumii Schmidt, Atlas *pl. 102. f. 8.* 1886. Ratt. Journ. Roy. Micr. Soc. **8**[1]**:** 374. 1888.

The above enumerated diatoms are close to *T. argus*, and form with it a group somewhat distinct from other members of the genus, especially in the matter of the double marked areolation.

Found at stations 2823, 2835, Gulf of California and off Lower California.

Tripodiscus scaber (Ralfs) Mann.

Aulacodiscus scaber Ralfs in Pritch. Hist. Infus. ed. 4. 844. 1861. Schmidt, Atlas *pl. 33. f. 4–8.* 1876. Ratt. Journ. Roy. Micr. Soc. **8**[1]**:** 353. 1888.

Aulacodiscus crux Ehrenb. in part; Hab. Cat. 57. 1877. Jan. Abh. Schles. Ges. Vaterl. Cult. **1861**[2]**:** 161. *pl. 2. f. 1 3.* 1861; **1862**[2]**:** *pl. 1A. f. 12.* 1862.

Aulacodiscus ternatus Jan. Abh. Schles. Ges. Vaterl. Cult. **1861**[2]**:** 161. *pl. 2. f. 4.* 1861.

Aulacodiscus beeveriae Johnst.? Pritch. Hist. Infus. ed. 4. 844. *pl. 6. f. 5.* 1861. Schmidt, Atlas *pl. 36. f. 12.* 1876.

There is a possible doubt about the last-named synonym, though I do not see how it can be maintained as the name of a separate species. Strictly type forms of the present species occur in the latter of the two stations following.

Found at stations 2807, 2835, Galapagos Islands and off Lower California.

Tripodiscus tripartitus (Br. & Temp.) Mann.

Aulacodiscus tripartitus Br. & Temp. Mem. Soc. Phys. et Hist. Nat. Geneva **30**[2]**:** 21. *pl. 4. f. 3.* 1889. Schmidt, Atlas *pl. 169. f. 8, 9.* 1892. De Toni, Syll. Alg. **2:** 1106. 1894.

I assign my specimen to this species with considerable doubt. It agrees well with Schmidt's figures, but these and my form are somewhat different from the type as described and figured by its authors, especially in the absence of the inner triangular line of spines or granulations connecting the bases of the three processes.

Found at station 4029H, Bering Sea.

AULISCUS Ehrenb.

Auliscus Ehrenb. Ber. Akad. Wiss. Berl. **1843:** 270. 1844. Bail. Smithson. Contr. Knowl. **7:** 4. 1854. Ratt. Journ. Roy. Micr. Soc. **8**[2]**:** 861–900. 1888. De Toni, Syll. Alg. **2:** 1025. 1894.

Mastodiscus Bail. Smithson. Contr. Knowl. **7:** 4. 1854, no species given.

Coscinodiscus Ehrenb. Ber. Akad. Wiss. Berl. **1843:** 271. 1844, in part.

Eupodiscus Ehrenb. in part; W. Smith, Synop. Brit. Diat. **1**: 25. *pl. 4. f. 39.* 1853. Bright. Quart. Journ. Micr. Sci. **8**: 94. *pl. 5. f. 3.* 1860.

Pseudoauliscus Loud.-Fort. in part; Grev. Trans. Mic. Soc. Lond. n. s. **11**: 74. *pl. 5. f. 23.* 1863.

Cerataulus Ehrenb. in part; Jan. Abh. Schles. Ges. Vaterl. Cult. **1861**[2]: 15. *pl. 1. f. 6.* 1861.

Auliscus caelatus Bail. Smithson. Contr. Knowl. **7**: 6. *pl. 1. f. 3 4.* 1854. Grev. Trans. Micr. Soc. Lond. n. s. **11**: 44. *pl. 2. f. 4 7.* 1863. Moeb. Diat.-taf. *pl. 50. f. 4-7.* 1890. Schmidt, Atlas *pl. 32. f. 12 20, 23–26.* 1875; *pl. 67. f. 11–13.* 1881; *pl. 204. f. 21.* 1896. Pant. Beitr. Bacill. Ung. **1**: 57. *pl. 19. f. 173; pl. 28. f. 279.* 1886. Ratt. Journ. Roy. Micr. Soc. **8**[2]: 885-888. *pl. 15. f. 5 9, pl. 16. f. 3, 6.* 1888. Pritch. Hist. Infus. ed. 4. 845. 1861. Loud.-Fort. Mem. Soc. Emul. St. Brieuc 63. *pl. 7. f. 68.* 1879. Wolle, Diat. N. A. *pl. 89. f. 6, 9–10.* 1890. H. L. Smith, Sp. Diat. Typ. 54. 1874. De Toni, Syll. Alg. **2**: 1049. 1894.

Auliscus smithii Jan. Abh. Schles. Ges. Vaterl. Cult. **1861**[2]: 163. *pl. 2. f. 9.* 1861.

Auliscus gregorii Jan. Abh. Schles. Ges. Vaterl. Cult. **1861**[2]: 163. *pl. 2. f. 12.* 1861.

Auliscus sculptus Ralfs, in part; Loud.-Fort. Mem. Soc. Emul. St. Brieuc *pl. 7. f. 66–67.* 1879.

This species exhibits more variability in its markings than most other members of Auliscus, a genus which I think shows a greater elasticity in this respect than any other. This has created a strong temptation to multiply named and accredited varieties, so that the species is quite confused with them. De Toni[a] enumerates fifteen such, of which Rattray is the author of eight. Did the present writer favor this method of extending nomenclature he could greatly enlarge this list out of the large mass of individuals of this species afforded by these investigations. Thus a number of very striking varieties, with feathery instead of anastomosing lines, were found at stations 2920II and 3712II—the variety called *strigillata* at station 2807 and that called *latecostata* at station 2835 and others. The fact is that Bailey's type form is not at all typical of the diatoms at present assigned to this species, but represents a rather extreme and severe phase of ornamentation only rarely met with. The significance of the specific name, *caelatus*, meaning carved, is therefore not particularly applicable, however well it applied to the original specimens. Although *A. pruinosus* Bail. is typically a very different diatom from this species, the two have come closely to approach each other by reason of the varieties assigned to them; and on the other side this species passes imperceptibly into *A. sculptus* (W. Smith) Ralfs.

Found at stations 2807, 2835, 2920II, 3712II, Galapagos Islands, to Lower California, Hawaiian Islands, and Okhotsk Sea.

Auliscus hardmanianus Grev. Trans. Micr. Soc. Lond. n. s. **14**: 6. *pl. 2. f. 17.* 1866. Moeb. Diat.-taf. *pl. 71. f. 17.* 1890. Schmidt, Atlas *pl. 67. f. 1.* 1881; *pl. 108. f. 1.* 1886. Truan & Witt, Diat. Hayti, 12. *pl. 2. f. 4.* 1888. Ratt. Journ. Roy. Micr. Soc. **8**[2]: 17–18. 1888. De Toni, Syll. Alg. **2**: 1041. 1894.

Auliscus joynsonii Schmidt, Atlas *pl. 67. f. 2.* 1881.

Rattray gives also four named varieties. The *A. joynsonii* of Schmidt is an unimportant variety.

Found at station 2807, Galapagos Islands.

Auliscus insignis Cleve, Sv. Vet. Akad. Handl. **18**[3]: 22. *pl. 5. f. 64a b.* 1881. Schmidt, Atlas *pl. 89. f. 1.* 1886. Ratt. Journ. Roy. Micr. Soc. **8**[2]: 15. 1888. De Toni, Syll. Alg. **2**: 1039. 1894.

Both the above illustrations are very poor. Cleve's material, like my own, was from the Galapagos Islands.

Found at station 2807, Galapagos Islands.

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[a] Syll. Alg. **2**: 1049. 1894.

Auliscus pruinosus Bail. Smithson. Contr. Knowl. **7:** 5. *pl. 1. f. 5–8.* 1854. Grev. Trans. Micr. Soc. Lond. n. s. **11:** 48. *pl. 3. f. 13.* 1863. H. L. Smith, Sp. Diat. Typ. 706. 1874. Pritch. Hist. Infus. ed. 4. 845. *pl. 6. f. 1.* 1861. Schmidt, Atlas *pl. 31. f. 6–7, 11, 13–15, pl. 32. f. 5.* 1875; *pl. 108. f. 10.* 1886. Ratt. Journ. Roy. Micr. Soc. **8**[2]**:** 22. 1888. De Toni, Syll. Alg. **2:** 1045. 1894. Moeb. Diat.-taf. *pl. 51. f. 13.* 1890.

Auliscus punctatus Bail. Smithson. Contr. Knowl. **7:** 5. *pl. 1. f. 9.* 1854. Grev. Trans. Micr. Soc. Lond. n. s. **11:** 49. *pl. 3. f. 15.* 1863. Moeb. Diat.-taf. *pl. 51. f. 15.* 1890. Schmidt, Atlas *pl. 31. f. 8.* 1875; *pl. 67. f. 7–8.* 1881; *pl. 89. f. 14–17 pl. 108. f. 10.* 1886. Ratt. Journ. Roy. Micr. Soc. **8**[2]**:** 9. 1888. De Toni, Syll. Alg. **2:** 1033. 1894.

There is great confusion between these two species of Bailey. The original type forms, as can be seen by comparing the figures of Bailey or those of Greville, show considerable contrast; but at the present time one might as well assign a newly found example to one species as to the other. Rattray has retained the two species, though placing examples of *A. pruinosus*[a] under *A. punctatus*. The two species have no distinct boundary. In the single dredging in which these forms were found they are very abundant and supply every gradation between the two. It is to be noted, also, that Bailey was in considerable doubt over the separateness of these species, and it seems to me they are much better united. Nothing can better illustrate the uselessness of trying to assign specimens to one as against the other than a comparison of the two figures lying side by side in Schmidt's Atlas, plate 31, figures 7 and 8, named, despite their identity, "*pruinosus*" and "*punctatus*," respectively. No wonder that two such capable diatomists as Grunow and Witt should call the one *pruinosus* and the other *punctatus*, the diatom represented by plate 108, figure 10, of Schmidt's Atlas.

Found at station 2807, Galapagos Islands.

Auliscus stockhardtii Jan. Abh. Schles. Ges. Vaterl. Cult. **1861**[2]**:** 163. *pl. 1. f. 4.* 1861. Schmidt, Atlas *pl. 30. f. 11–13.* 1875; *pl. 67. f. 6.* 1881. Ratt. Journ. Roy. Micr. Soc. **8**[2]**:** 7. 1888. De Toni, Syll. Alg. **2:** 1031. 1894.

Auliscus constellatus Mills, Journ. Roy. Micr. Soc. II. **1:** 867. *pl. 11, f. 2–3.* 1881.

Auliscus racemosus Ralfs, Trans. Micr. Soc. Lond. n. s. **11:** 46. *pl. 2. f. 9.* 1863. Schmidt, Atlas *pl. 67. f. 6.* note. 1881. Moeb. Diat.-taf. *pl. 50. f. 9.* 1890.

I am in doubt as to making *A. racemosus* Ralfs a synonym of the above as Schmidt and Rattray have done. At least, a comparison of the original figure of Janisch with that of Ralfs in the citations given above will show enough divergence to make the matter questionable. Certain varieties of *A. pruinosus* Bail. approach this species.

Found at station 2807, Galapagos Islands.

RHIZOSOLENIA Ehrenb.

Rhizosolenia Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841**; 329, 422. 1843; Ber. Akad. Wiss. Berl. **1844:** 204. 1845. Kütz. Bacill. 51. 1844; Sp. Alg. 24. 1849. Bright. Quart. Journ. Micr. Sci. **6:** 93. *pl. 5.* 1858, char. emend. Pritch. Hist. Infus. ed. 4. 865. 1861. Van Heur. Synop. 194. *pl. 78 79.* 1881; Treat. Diat. 413. *f. 133.* 1896. Griff. & Henf. Micr. Dict. ed. 4. 657. *pl. 51. f. 25.* 1883. De Toni, Syll. Alg. **2:** 823. 1894. Eng. & Pr. Pflanzenfam. **1**[1b] 84. *f. 139 140.* 1896. Perag. Le Diatomiste **1:** 108. *pl. 1 5.* 1892.

Encampia Stolter, Journ. Roy. Micr. Soc. **2:** 835. *f. a d.* 1879, not Ehrenb.

Attheya West, Trans. Micr. Soc. Lond. n. s. **8:** 152. *pl. 7. f. 15.* 1860. De Toni, Syll. Alg. **2:** 770, 822. 1892–94. Perag. Le Diatomiste **1:** 105. *pl. 1. f. 14.* 1892. Van Heur. Treat. Diat. 420. *f. 138.* 1896. Eng. & Pr. Pflanzenfam. **1**[1b]**:** 88. *f. 145.* 1896.

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[a] Schmidt, Atlas *pl. 31. f. 6–9.* 1875.

Lauderia Cleve, Bih. Sv. Vet. Akad. **1**[11]: 8. *pl. 1. f. 7.* 1873. Van Heur. Treat. Diat. 418. *f. 136.* 1896. De Toni, Syll. Alg. **2:** 771. 1892. Castr. Rep. Voy. Chall. Bot. **2:** 89. *pl. 9. f. 4, 8.* 1886.

Guinardia Perag. Le Diatomiste **1:** 107. *pl. 1. f. 1–5.* 1892. Van Heur. Treat. Diat. 417. *f. 135.* 1896. De Toni, Syll. Alg. **2:** 822. 1894.

Leptocylindricus (?) Cleve, Diat. Kattegat. 2. 1889. Perag. Le Diatomiste **1:** 104. 1892. De Toni, Syll. Alg. **2:** 822. 1891. Eng. & Pr. Pflanzenfam. **1**[1b]: 84. 1896.

Dactyliosolen Castr. Rep. Voy. Chall. Bot. **2:** 75. *pl. 9. f. 7.* 1886. Perag. Le Diatomiste **1:** 104. *pl. 1. f. 6-7.* 1892. De Toni, Syll. Alg. **2:** 821. 1891. Eng. & Pr. Pflanzenfam. **1**[1b]: 83. *f. 136.* 1896.

Ehrenberg's conception of this genus was so vague that, aside from the name, its founding is mainly due to Brightwell; and the name itself loses all meaning if we remove from it the forms represented by Cleve's Lauderia. Its members are pelagic, as a class subtropical, and, with the exception of H. L. Smith's *R. criensis*, marine. Their terminal valves, bearing one to many setae, are widely separated by a tubular zone built up of either very narrow bands or wedge-shaped pieces imbricated into a tube. The frustules thus constructed are delicate, elastic, and not densely silicified. Yet with this strong generic harmony there are differences of absorbing interest from the fact that here more than in any other genus we find variations that stand as intermediate plan structures between it and several other distinct genera. This peculiarity of Rhizosolenia has given occasion for the creation of various questionable genera enumerated above. Their affinities are most striking. The form called by West *Attheya decora* leads to the genus Chaetoceros; Guinardia, with its rudimentary mucronate scar, is close to that doubtful example of the genus Biddulphia, which Peragallo calls *Cerataulus bergonii*;[a] the species included in the invalid genus Lauderia have valves like Stephanopyxis and girdles like Striatella; those called Dactyliosolen are very suggestive of Melosira; while in *Peragallia meridiana* Schutt we have a probable species of Chaetoceros with the zonal view of Rhizosolenia; and finally *R. stolterforthii* Perag. is amazingly like that delicate but genuine example of the genus Eucampia which Cleve has miscalled *Möllería cornuta.*[b] It will help to make evident the impossibility of bounding these newer genera in any way that will dis-distinguish them generically if we carefully compare specimens of the species enumerated, or, in the absence of these, if we contrast in plate I of Peragallo's Monographe the following figures: *Rhizosolenia murrayana* Castr. (f. 20), and *R. stolterforthii* (f. 17) with *Guinardia flaccida* (Castr.) Perag. (f. 4); this latter (as shown in f. 3), noting the small mucronate scar, with *Cerataulus* (*Cerataulina*) *bergonii* Perag. (f. 16; again, *G. flaccida* (f. 4) with the lower frustule of *Lauderia delicatula* Perag. (f. 13). The fact is, if stress is put solely on the setae and other appendices of the terminal valves we shall have the various genera above enumerated; but if we take the entire frustule we shall have strikingly distinct but valid species of Rhizosolenia, with much more in common structurally than the differences that distinguish them.

Rhizosolenia hebetata Bail. Am. Journ. Sci. II. **22:** 5. *pl. 1. f. 18–19.* 1856. Bright. Quart. Journ. Micr. Sci. **6:** 94. *pl. 5. f. 4.* 1858. Pritch. Hist. Infus. ed. 4. 866. 1861. Cleve, in Nordensk. Vega Exped. **3:** 486. *pl. 38. f. 69a-f.* 1883. H. L. Smith, Sp. Diat. Typ. no. 448. 1874. Grun. Denkschr. Akad. Wien **48**[2]: 96. *pl. 5. f. 48-50.* 1884. De Toni, Syll. Alg. **2:** 829. 1894. Perag. Le Diatomiste **1:** 114. *pl. 5. f. 10.* 1892. Moeb. Diat.-taf. *pl. 14. f. 4.* 1890.

This may be considered the type diatom of Bering Strait and the adjacent arctic waters. Bailey's original specimens came from Kamchatka, Grunow's also, and

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[a] Le Diatomiste **1:** *pl. 1. f. 3, 16.* 1892.

[b] Van Heur. Treat. Diat. 461. *f. 192.* 1896.

[c] Le Diatomiste **1:** *pl. 1.* 1892.

nearly every one of the following long list of dredgings and soundings were taken along the coasts of Alaska and Kamchatka. At stations 3569H and 3671H it is the commonest of all forms, and in the latter it makes up 5 to 10 per cent of the diatomaceous mass. It is important here to notice that of the thirty-three gatherings found to contain this diatom twenty-nine were hydrographic soundings and only four dredgings. It is evident that the method of taking the hydrographic soundings as contrasted with that of the regular dredgings explains why these exceedingly light and buoyant forms are abundant in one class of gatherings and not in the other. The four dredgings were taken in Arctic waters and yet contained very few specimens, while many dredgings made where this species is shown to be abundant show no trace of them. It is a clear illustration of the necessity of employing more careful methods for collecting diatoms in connection with the other marine work of the United States Fish Commission, a subject discussed in the introduction to this report.

Found at stations 2287H, 3267H, 3361H, 3390H, 3565H, 3568H, 3569H, 3603, 3604H, 3607, 3611, 3635H, 3663H, 3669H, 3671H, 3683H, 3684H, 3691H, 3692H, 3693H, 3699H, 3704H, 3784, 3786H, 4013H, 4014H, 4019H, 4022H, 4023H, 4024H, 4025H, 4027H, 4028H. Bering Sea and Okhotsk Sea to Honshu Island, Japan.

Rhizosolenia robusta Norm.; Pritch. Hist. Infus. ed. 4. 866. *pl. 8. f. 42.* 1861. De Toni, Syll. Alg. **2:** 824. 1894. Perag. Le Diatomiste **1:** 109. *pl. 2. f. 1 1a, pl. 3. f. 1–3.* 1892. Castr. Rep. Voy. Chall. Bot. **2:** 73. *pl. 24. f. 5.* 1886. Cleve, Bih. Sv. Vet. Akad. Handl. **11**: 11. 1873. Brun & Temp. Mem. Soc. Phys. et Hist. Nat. Geneva **30**: 73. 1889. Van Heur. Treat. Diat. 414. *pl. 33. f. 883.* 1896.

Though the beautiful iridescent ends are abundant in the following dredgings, no complete frustule was found and very rarely a trace of the disintegrated bands composing the tube. Although large, this pellucid diatom if badly described by its specific name, *robusta*.

Found at stations 2919, 2923, 2929, 3611, 4516H. Bering Sea and off southern and Lower California.

CHAETOCEROS Ehrenb.

Chaetoceros Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 198. 1845. Van Heur. Synop. 195. *pl. 81–82.* 1881–5. Rabh. Fl. Alg. Eur. **1:** 31, 321. *f. 91.* 1864. Pritch. Hist. Infus. ed. 4. 861. 1861. Bright. Quart. Journ. Micr. Sci. **4:** 105. *pl. 7.* 1856.

Bacteriastrum Shadb. Trans. Micr. Soc. Lond. n. s. **2:** 14. 1854. Pritch. Hist. Infus. ed. 4. 863. 1861.

Hercotheca Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 262, 269. 1845; Mikrog. *pl. 33. XVIII. f. 7.* 1845.

Periptera Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 270. 1845; Mikrog. *pl. 33. XVIII. f. 9.* 1854. Pritch. Hist. Infus. ed. 4. 865. 1861.

Actiniscus Ehrenb. Ber. Akad. Wiss. Berl. **1854:** 237. 1855, in part.

Goniotheeium Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 82. 1845.

Dicladia Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 73, 79. 1845.

Syndendrium Ehrenb. Ber. Akad. Wiss. Berl. **1845:** 73, 155. 1846.

Skeletonema Grun. Van Heur. Synop. *pl. 83ter f. 5.* 1881, not Grev. 1865.

Peragallia Schütt, Ber. Deut. Bot. Ges. **13:** 48. *pl. 5. f. 28a–b.* 1895?.

This genus has occasioned great confusion in the nomenclature of the Diatomaceae by reason of the peculiar mode of its growth. It is a mainly or perhaps wholly pelagic form and is found in both the living and fossil state. It grows in long filaments, the single frustules of which often vary widely, especially in respect to the character of the processes or setae that adorn them. These may be, in some few instances, wholly lacking, may proceed from opposite sides of the zonal portions, or may encircle the same. The terminal valves are generally ornamented with processes quite different from those on the intermediate frustules. Still further to complicate the matter,

the separate valves contain internal secondary cases, round or oval in contour, with both valves alike or different, in some instances hyaline and in others variously sculptured, without processes or variously ornamented with spines and otherwise. These internal cases have as a class thicker siliceous walls than the external valves and girdles which inclose them, and consequently are frequently met with in sea dredgings, and especially in fossil deposits where all traces of the external walls that gave form to the complete filaments have been lost. As these various parts have been successively found they have received separate generic and specific names, and we therefore have to deal with a tangle of nomenclature unusual even among the Diatomaceae. The generic name first to be constituted and (subsequently) applied to these forms is Actiniscus. Because of its priority Grunow[a] gives it to the form known elsewhere as *Bacteriastrum varians* Laud. This name, however, was not originally applied to a diatom, but to a stellate silicious spicule, which Ehrenberg called *Dictyocha* (*Actiniscus*) *sirius*,[b] and was not used for the diatoms until 1855[c] (*A. quinarius* Ehremb.[d] being indeterminate, but probably also a spicule). It is therefore not available for the Diatomaceae, but must give place to Chaetoceros, 1845. In this connection I wish to call attention to a quotation from Van Heurck's Synopsis given below under *Chaetoceros furcatus*. In the above list of synonyms "in part" we find Dicladia and Goniothecium, bestowed like Chaetoceros and preceding it in that volume. I am, however, opposed to accepting any of these names for the following reasons: (1) They represent what are not necessarily structural parts of the plants, Castracane,[e] holding them to be sporangial encasements; (2) we are not even able to affirm that these spicules are confined to what we know as the Chaetoceraе; (3) both the above generic names were based on fossil fragments from which we can build no conception of the forms to which they belong, and in using them we should, therefore, be constituting a genus without any fixed idea of its structure. Dicladia was found in African guano and Goniothecium in diatomaceous earth from Richmond, Virginia.[f]

I can not follow Castracane in maintaining the separateness of Chaetoceros and Bacteriastrum, as his grounds of distinction[g] appear to be trivial. They are (1) that the valves of Bacteriastrum are round and of Chaetoceros generally oval; (2) that the former have more awns or setae than the latter; (3) that these are in Bacteriastrum arranged around the valve, but in Chaetoceros on opposite sides; (4) that these awns in Chaetoceros interlace. Anyone who will examine a gathering of *Bacteriastrum varians* Laud. will see that these characters are in different parts of the same filament too inconstant to form a generic concept. Thus, in H. L. Smith's type no. 57, both round and oval valves are seen in the same filament and bearing precisely the same kind of setae. Again, the terminal valves often have two setae, while those below them may have more; and in the case of Lauder's figures of this species[h] we find terminal valves with eight setae and the intermediate ones with many more. As to the interlacing of the setae, it is by no means constant, many specimens examined showing no such tendency. In fact, that condition is hardly to be discovered in Castracane's own figure.[i]

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[a] Van Heur. Synop. *pl. 82bis. f. 10.* 1881.

[b] Phys. Abh. Akad. Wiss. Berl. **1839:** 149-150. 1841. Cf. Mikrog. *pl. 18. f. 59–60.*

[c] Ber. Akad. Wiss. Berl. **1854:** 237. 1855.

[d] Ber. Akad. Wiss. Berl. **1844:** 76. 1845. cf. also Griff. & Henf. Micr. Dict. ed. 3. *pl. 43. f. 1–6.* 1875.

[e] Castr. Rep. Voy. Chall. Bot. **2:** 81. 1886.

[f] Cf. article by Brightwell in Quart. Journ. Micr. Sci. **4:** 106. 1856.

[g] Castr. op. cit. 82.

[h] Trans. Micr. Soc. Lond. n. s. **12:** *pl. 3.* 1864.

[i] Castr. op. cit. *pl. 19. f. 8.*

The interesting form constituting the genus Peragallia Schütt, does, as its author says, hint of transition between the present genus and Rhizosolenia Ehrenb., as its valves are true Chaetoceros type, while the zonal part shows the plicate bands of Rhizosolenia. But this latter portion, the zone, is liable to show various changes in many genera[a] and is hardly of enough importance to separate this otherwise normal Chaetoceros from the genus.[b]

The following genera I have not included in the above. Some of them are plainly distinct from it, as Skeletonema Grev. (not Grun.) and Stangulonema Grev. Others, like Syringidium and Pterotheca, though showing considerable resemblance to the internal cases of Chaetoceros, are as yet too imperfectly understood to warrant any safe conclusion. See Syringidium Ehrenb.,[c] Omphalotheca Ehrenb.,[d] Pyxilla Grev.,[e] Pterotheca Grun.,[f] Stephanogonia Ehrenb.,[g] Skeletonema Grev.,[h] Strangulonema Grev.,[i] Xanthiopyxis Ehrenb.,[j] and Corethron Castr.[k]

Chaetoceros coarctatus Laud. Trans. Micr. Soc. Lond. n. s. **12:** 79. *pl. 8. f. 6.* 1864. Cleve, Bih. Sv. Vet. Akad. Handl. **1**[11]: 9. *pl. 2. f. 10.* 1873. De Toni, Syll. Alg. **2:** 996. 1894.

This is variously spelled *coarctatus* by De Toni, *coarctata* by Lauder, *coarctatum* by Cleve. The first is correct.

Found at station 4029H, Bering Sea.

Chaetoceros didymus Ehrenb. Ber. Akad. Wiss. Berl. **1845:** 75. 1846; Mikrog. *pl. 35A. XVII. f. 5, pl. 18. f. 4.* 1854. Bright. Quart. Journ. Micr. Sci. **4:** 107. *pl. 7. f. 3–7.* 1856. Jan. Abh. Schles Ges. Vaterl. Cult. **1862:** *pl. 1A. f. 21, 30, 32.* 1862. Pritch. Hist. Infus. ed. 4. 862. 1861. Griff. & Henf. Micr. Dict. ed. 3. *pl. 41, f. 47.* 1875.

My specimen is a somewhat doubtful example of the above, the setae being abnormal.

Found at station 4029H, Bering Sea.

Chaetoceros furcatus (Shadb.) Mann.

Bacteriastrum furcatum Shadb. Trans. Micr. Soc. Lond. n. s. **2:** 14. *pl. 1. f. 1.* 1854. Moeb. Diat.-taf. *pl. 3. f. 1.* 1890. Pritch. Hist. Infus. ed. 4. 863. *pl. 6. f. 26.* 1861.

Bacteriastrum curvatum Shadb. Trans. Micr. Soc. Lond. n. s. **2:** 14. *pl. 1. f. 2.* 1854. Moeb. Diat.-taf. *pl. 3. f. 2.* 1890. Griff. & Henf. Micr. Dict. ed. 3. *pl. 43. f. 18.* 1875.

Actiniscus sexfurcatus Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1854:** 237. 1855; Mikrog. *pl. 35B, IV. f. 15.* 1854.

Bacteriastrum varians Laud. Trans. Micr. Soc. Lond. n. s. **12:** 8. *pl. 3. f. 1–6.* 1864. H. L. Smith, Sp. Diat. Typ. no. 57. 1874; Jour. Quek. Micr. Club II. **3:** 42. *pl. 4. f. 2.* 1887. Van Heur. Synop. *pl. 80. f. 3–5.* 1881. Moeb. Diat.-taf. *pl. 56. f. 1–6.* 1890. Castr. Rep. Voy. Chall. Bot. **2:** 82, 84. *pl. 14. f. 2, pl. 19. f. 8, pl. 23. f. 1.* 1886.

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[a] Cf. Palmer & Kelley, Proc. Acad. Phila. **1900:** 465–479. 1900.

[b] Cf. Van Heurck, Treat. Diat. 419. *f. 137.* 1896.

[c] Ber. Akad. Wiss. Berl. **1845:** 357, 365. 1846; Mikrog. *pl. 35A, IX. f. 11.* 1854.

[d] Ehrenb. Mikrog. 126. *pl. 35A, IX. f. 4.* 1854.

[e] Trans. Micr. Soc. Lond. n. s. **13:** 1. *pl. 1. f. 5.* 1865.

[f] Van Heur. Synop. *pl. 83 bis. f. 10–11.* 1881.

[g] Ber. Akad. Wiss. Berl. **1844:** 264, 271. 1845.

[h] Trans. Micr. Soc. Lond. n. s. **13:** 43. *pl. 5. f. 1.* 1865.

[i] Trans. Micr. Soc. Lond. n. s. **13:** 43. *pl. 5. f. 2.* 1865.

[j] Ber. Akad. Wiss. Berl. **1844:** 264, 273. 1845; Mikrog. *pl. 33. XVII. f. 17.*

[k] Castr. Rep. Voy. Chall. Bot. **2:** 85. *pl. 21. f. 3–6, 12, 14–15.* 1886.

Actiniscus curvatus Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1872:** 390. *pl. 6. II. f. 12.* 1873.

Actiniscus vicenarius Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1872:** 390. *pl. 6. II. f. 11*(?). 1873.

Chaetoceros varians Van Heur. Synop. 195. 1885. De Toni, Syll. Alg. **2:** 998. 1894.

Bacteriastrum spirillum Castr. Rep. Voy. Chall. Bot. **2:** 83. *pl. 19. f. 2, pl. 29. f. 1.* 1886.

Bacteriastrum brevispinum Castr. Rep. Voy. Chall. Bot. **2:** 83. *pl. 15. f. 6, 8.* 1886.

The very appropriate specific name of Lauder must give place to that of Shadbolt. Castracane builds the specific character of his *spirillum* on the spirally wound setae, a quality not possessed, he says, by the above. This is quite contrary to the facts. His own figures of *B. varians* Laud.,[a] show this spiral quality. Or if his contention is that these are simply undulate, while his form has setae with a spirally wound thickening, this also is incorrect. *C. furcatus* shows this in many specimens most plainly. It may be added that exact duplicates of his *B. brevispinum* are found at station 3698, both having and destitute of the spiral ornamentation of the setae.

As this is the species to which belong most or all of the forms named generically Actiniscus by Ehrenberg, it may be well to here add to the reasons advanced by me under the present genus caption for rejecting Ehrenberg's name a quotation from Van Heurck[b] bearing on this point. He says: "NOTE. Les formes pour lesquelles Ehrenberg a constitué le genre Actiniscus, n'étaient pas des Diatomées et les auteurs subséquents qui ont écrit sur ces formes n'auraient pas dû les admettre dans leur classification. Ehrenberg a rapporté le genre Bacteriastrum à son genre Actiniscus mais sans avoir aucune raison plausible et il a continué à agir ainsi jusque dans son dernier ouvrage, Fortsetzung der Mikr. Studien, 1875. Toutes les formes de Bacteriastrum doivent être ramenées au genre Chaetoceros."

Found at stations 2860, 3091, 3346, 3698, 3712H, off British Columbia to Oregon and Kurile chain to Honshu Island, Japan.

Chaetoceros sp.?

Dicladia manniltana L. W. Bailey, Bost. Jour. Nat. Hist. **7:** 339. *pl. 7. f. 41–45.* 1862.

My specimens agree with figure 44 in the above, being what Bailey calls var. B.

Found at stations 4013H, 4516H, off Honshu Island, Japan, and Lower California.

Chaetoceros sp. ?

Goniothecium odontella Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 82. 1845; Mikrog. *pl. 18. f. 94, pl. 33. XIII. f. 13 14, pl. 33. XV. f. 16.* 1854. Pritch. Hist. Infus. ed. 4. 864. *pl. 6. f. 29.* 1861. Bright. Quart. Journ. Micr. Sci. **4:** 106. *pl. 7. f. 47 48.* 1856. Moeb. Diat.-taf. *pl. 8. f. 47–48.* 1890. De Toni, Syll. Alg. **2:** 1009. 1894. Witt, Verh. Russ. Min. Gesell. II. **22:** 25. *pl. 7. f. 7 8.* 1886. Van Heur. Synop. *pl. 105. f. 11 12.* 1881.

Ehrenberg found this form, together with eight others named by him, in the fossil deposit of Richmond, Virginia. Although this particular one has not so far been met with in a living state, six of the other eight have been so observed. It is therefore reasonable to assume that these peculiar structures are inner casings of certain Chaetoceros valves, the outer spine-bearing valves of which have fallen away. But it should be remembered that quite dissimilar specimens of Goniothecium may be eventually found to belong to the same species of Chaetoceros. These forms are so frequently met with and are so widely illustrated in diatom literature that I have thought it advantageous to give the above citations.

Found at station 4029H, Bering Sea.

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[a] Castr. op. cit. *pl. 14. f. 2, pl. 29. f. 3.*

[b] Van Heur. Synop. 195. 1885.

TRIGONIUM Cleve.

Trigonium Cleve, Ofv. Kgl. Vet. Akad. **24**: 663. 1868; Bih. Sv. Vet. Akad. Handl. **1**[13]: 8. 1873.
Triceratium Ehrenb. err. det. Bail. Smithson. Contr. Knowl. **2**[8]: 14. *f. 55–56.* 1851. Bright. Quart. Journ. Micr. Sci. **4**: 275. *pl. 17. f. 16.* 1856.
Biddulphia Gray, in part; Bright. Quart. Journ. Micr. Sci. **7**: 181. *pl. 9. f. 15.* 1859.
Zygoceros Ehrenb. in part; Bail. Smithson. Contr. Knowl. **7**: 11. *pl. 1. f. 29.* 1854.
Amphitetras Ehrenb. in part; De Toni, Syll. Alg. **2**: 900. 1894.
Amphipentas Ehrenb. in part; De Toni. Syll. Alg. **2**: 911. 1894.
Nothoceratium De Toni, Syll. Alg. **2**: 914. 1894, in part.
Cestodiscus Grev. in part; Grun. in Van Heur. Synop. *pl. 126. f. 1–2.* 1881.
Pseudotriceratium Grun. Denkschr. Akad. Wien **48**[2]: 83. 1884.

The genus Triceratium as constituted by Ehrenberg[a] included simply triangular specimens of the genus Biddulphia Gray. The striking but inconstant characteristic led him to select the very descriptive name and to word his diagnosis so as to convey this one idea. His type species, *T. favus*, agrees with this. It is, therefore, based on a wholly untenable conception and is a synonym of Biddulphia. Gradually, however, it underwent modification chiefly at the hands of Brightwell[b] and Ralfs,[c] whereby it came to include forms with more than three horns, together with a host of forms where the horns at the angles are obscure or wanting, in fact, almost anything of a polygonal character, when seen from the valval side. It thus came about that the genus grew to be a mixture of many genera, whose sole bond of union was the worthless accident of a more or less angular valve outline. Thus polygonal specimens of Stictodiscus Grev., of Ditylum Bail., of the triangular forms of Hemiaulus Ehrenb., which make up Heiberg's invalid genus Trinacria, of the triangular forms of Terpsinoe Ehrenb., which Wallich calls Hydrosera, and others found a resting place in this unscientific medley. De Toni[d] performs the useless task of restoring it to its original boundaries, except that he excludes those triangular forms represented by Greville's newer genus Entogonia. It is evident that Triceratium Ehrenb. represents nothing but a peculiar configuration of Biddulphia; nor have the attempts to reconstruct it resulted in anything but confusion. It must, therefore, be abandoned, a course adopted by Van Heurck, Boyer, and others. But in doing this some diatoms now bearing the name Triceratium remain which can not be referred to any of the before-mentioned genera. This has led to the necessity of a genus for these forms; and I have placed them in the genus created by Cleve for this purpose. He defines it as follows: "Hufvudytan triangulär, sidoytan rektangelformig utan framspringande utskott eller hörn." It is true that this is too indefinite, as it would include such triangular and quadrangular forms as we meet with in Stictodiscus, as well as the members of the genus Entogonia, a genus that Cleve recognizes as distinct; and further would exclude the occasional biangular or fusiform specimens of some species normally triangular. But that the latter are not intended to be excluded by Cleve is shown by the fact that in discussing *Trigonium arcticum* (Bright.) Cleve[e] he speaks of the biangular variety known as *Zygoceros balaena* Ehrenb. Boyer[f] refers the members of Triceratium (exclusive of those referred to other established genera, as Stictodiscus and Hemiaulus) to Biddulphia, whether the angles are surmounted by horn-like processes or not, and to a great extent Van Heurck does the same. This takes from Biddulphia its most salient characteristic and places in the genus such

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[a] Phys. Abh. Akad. Wiss. Berl. **1839**: 129, 159. 1841.
[b] Quart. Journ. Micr. Sci. **1**: 215. 1853.
[c] Pritch. Hist. Infus. ed. 4. 853. 1861.
[d] De Toni, Notarisia **5**: 912. 1890; Syll. Alg. **2**: 917. 1894.
[e] Bih. Sv. Vet. Akad. Handl. **1**[13]: 8. 1873.
[f] Proc. Acad. Phila. **1900**: 1901.

diatoms as those in the following species which are in striking contrast to the Biddulphia idea. I therefore make use of Cleve's genus, excluding those triangular forms that have definite central areas distinctly different in sculpture from the rest of the valve, represented by the genus Entogonia, and including forms having four or more angles. Nothoceratium De Toni agrees in part with this, except for the limitation of the species to those of six or more angles, an utterly impracticable provision, leading to the absurd distinction between the four-sided and the six-sided specimens of *Triceratium parallelum* Grev.,[a] the former of which he places in the genus Amphitetras and the latter in Nothoceratium.

Trigonium alternans (Bail.) Mann.

Triceratium alternans Bail. Smithson. Contr. Knowl. **2**[3]: 14. *pl. 1. f. 55–56.* 1851; **2**[8]: 40. 1851. Bright. Quart. Journ. Micr. Sci. **1**: 251. *pl. 4. f. 19a–b.* 1853. Jan. Abh. Schles. Ges. Vaterl. Cult. **1862**[2]: 15. *pl. 1.1. f. 16.* 1862. W. Smith, Synop. Brit. Diat. **1**: 26. *pl. 5. f. 45, pl. 30. f. 45.* 1853. Schmidt, Atlas *pl. 78. f. 9–18* (not *f. 19–20,* = *T. campechianum* Grun.). 1882. O'Meara, Proc. Roy. Irish. Acad. II. **2**: 278. *pl. 27. f. 11.* 1875. Van Heur. Synop. *pl. 113. f. 4–5.* 1881. Pritch. Hist. Infus. ed. 4. 854. *pl. 6. f. 21.* 1861. Moeb. Diat -taf. *pl. 1. f. 19a–b.* 1890. Wolle, Diat. N. A. *pl. 100. f. 16, 18* (not *pl. 106. f. 2*). 1890. De Toni, Syll. Alg. **2**: 941. 1894.

Biddulphia alternans Van Heur. Synop. 208. 1881. Boyer, Proc. Acad. Phila. **1900**: 719. 1901.

Triceratium variabile Bright. Quart. Journ. Micr. Sci. **4**: 275. *pl. 17. f. 19a–c.* 1856. Moeb. Diat.-taf. *pl. 9. f. 19a–c.* 1890. West, Trans. Micr. Soc. Lond. n. s. **8**: 149. *pl. 7. f. 7.* 1860. Pritch. Hist. Infus. ed. 4. 854. 1861. Leud. Fort.-Mem. Soc. Emul. St. Brieuc 60. 1879.

There is a specious resemblance here to the Biddulphia type in the slight elevation of the angles and this is intensified by their being apparently cut off from the rest of the valve by definite internal septa. This is especially so if several of the figures above cited are relied on instead of the diatoms themselves. That there are no processes at the angles can be seen by a careful examination of more than one specimen of this species. Sometimes the extremities of the angles are not raised at all above the rest of the valve and in some cases they are slightly lower. The lines usually (not always) marking off the extremities and making them resemble Biddulphia processes have no significance; for in the forms classed by Brightwell, as *T. variabile*, the valves are penetrated by numerous false septa extending inward from the margin. The angles are often beaded exactly like the rest of the valve. Altogether these angular portions are very different from the true processes of Biddulphia. It may be mentioned in this connection that the frustules are not joined by alternate angles into a zigzag chain, as is common in Biddulphia, but when united, which is rare, it is face to face; but it should also be said that too much significance should not be placed on this fact, either here or elsewhere. Schmidt, De Toni, and others do not admit this species into Biddulphia, but retain it in Triceratium.

Found at station 3696, off Honshu Island, Japan.

Trigonium articum (Bright.) Cleve, Öfv. Kgl. Vet. Akad. **24**: 663. 1868; Sv. Vet. Akad. Handl. **1**[13]: 8. 1873.

Triceratium articum Bright. Quart. Journ. Micr. Sci. **1**: 250. *pl. 4. f. 11.* 1853 Moeb. Diat.-taf. *pl. 1. f. 11.* 1890. Grun. in Fenzl, Reise Novara Bot. **1**: 24. 1870. De Toni, Syll. Alg. **2**: 920. 1894. Pritch. Hist. Infus. ed. 4. 856. 1861. Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 15, 111. 1880. Schmidt, Atlas *pl. 76. f. 29, pl. 79. f. 5–6, 8, 10–13.* 1882; *pl. 81. f. 4.* 1885. H. L. Smith, Sp. Diat. Typ. no. 596. 1874. Van Heur. Synop. *pl. 112. f. 1.* 1881.

Biddulphia artica Boyer, Proc. Acad. Phila. **1900**: 714. 1901.

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[a] Trans. Micr. Soc. Lond. n. s. **13**: 104. *pl. 9. f. 22–23.* 1865.

Biddulphia balaena Bright. Quart. Journ. Micr. Sci. **7**: 181. *pl. 9. f. 15*. 1859. Moeb. Diat.-taf. *pl. 23. f. 15*. 1890. Cleve, in Nordensk. Vega. Exped. **3**: 485. 1883. Schmidt, Atlas *pl. 121. f. 5–6*. 1888. H. L. Smith, Sp. Diat. Typ. no. 624. 1874. Boyer, Proc. Acad. Phila. **1900**: 713. 1901.

Zygoceros balaena Ehrenb. Mikrog. *pl. 35A XXXIII. f. 17*. 1854; Ber. Akad. Wiss. Berl. **1853**: 529. 1854. Roper, Trans. Micr. Soc. Lond. n. s. **7**: 20. 1859. De Toni Syll. Alg. **2**: 887. 1894.

Zygoceros radiatus Bail. Smithson. Contr. Knowl. **7**: 11. *pl. 1. f. 29*. 1854.

Amphitetras wilkesii Harv. & Bail. Proc. Acad. Phila. **6**: 430. 1854.

Triceratium formosum Bright. Quart. Journ. Micr. Sci. **4**: 274. *pl. 17. f. 8*. 1856. Moeb. Diat.-taf. *pl. 9. f. 8*. 1890.

Triceratium quadrangulare Grev. Trans. Micr. Soc. Lond. n. s. **13**: 10. *pl. 2. f. 26*. 1865. Moeb. Diat.-taf. *pl. 63. f. 26*. 1890. Schmidt, Atlas *pl. 81. f. 3*. 1885.

Amphitetras quadrangularis De Toni, Syll. Alg. **2**: 904. 1894.

Triceratium quinquelobatum Grev. Trans. Micr. Soc. Lond. n. s. **14**: 83. *pl. 9. f. 21*. 1866. Moeb. Diat.-taf. *pl. 73. f. 21*. 1890. Schmidt, Atlas *pl. 79. f. 8*. 1882. Eng. & Pr. Pflanzenfam. **1**^{1b}: 91. *f. 155B*. 1896.

Amphipentas quinquelobata De Toni, Syll. Alg. **2**: 911. 1894.

Triceratium firmum Grev. Trans. Micr. Soc. Lond. n. s. **12**: 93. *pl. 13. f. 8*. 1864. Moeb. Diat.- taf. *pl. 61. f. 8*. 1890. De Toni, Syll. Alg. **2**: 924. 1894.

Biddulphia formosa Walk. & Chase, Notes on Diatoms **1**: 2. *pl. 2. f. 9*. 1886.

This species is Cleve's type of the genus Trigonium.

Probably no species shows more variability than this in size, outline, fineness of marking, and absence or presence of central area. Nor is it possible to decide on the identity of the above names without specimens corresponding to the figures and descriptions. I have been able to do this on account of the large number of sea dredgings, widely separated from each other and containing abundant quantities of these forms that have been examined for this report. By comparison of many examples accurately agreeing with the above names I am convinced they all represent varieties of the same polymorphic species, and this conclusion agrees in the main with that of some of the authors cited above. Thus *Zygoceros balaena* Ehrenb., which is *Z. radiatus* Bail., and *Biddulphia balaena* Bright., is an oval with two instead of three rounded apices. It is frequent at station 4029H. It is also in H. L. Smith's Type no. 624 and makes up a considerable portion of type no. 596, marked *Triceratium arcticum*, in which the two-angled and three-angled varieties can be seen side by side and are so absolutely alike, except in the number of angles, that no question of their specific identity can remain. One of the slides accompanying this report contains three specimens from station 3603; the first is Grunow's variety *californica*, the second a quadrate specimen of *T. arcticum*, and the third a quadrate specimen of *T. formosum*. The variety *californica* also occurs abundantly at stations 2807, 2859, 2923, 3603, 3604, 3692H; beautiful specimens of typical *T. quadrangulare* Grev., at station 3688H; *T. quinquelobatum* Grev., at station 2808; a variety close to *T. antarcticum* Jan., at stations 2807 and 3604H; *T. firmum* Grev., at station 3688H. Regarding this last the border in my specimens are not quite so massive as in Greville's drawing; but the border varies greatly in all members of this species. It is certainly a small and stout variety of this species. My specimens of it averaged 0.065 mm. in diameter. I have not included *T. antarcticum* Jan., as the identification in my specimens is not exact. It is probably also a variety. The placing of some of the above in Triceratium, others in Amphitetras and others in Amphipentas by De Toni is unaccountable; also his uniting the five-angled *T. formosum* with the five-angled *T. favus* under Brightwell's invalid name *T. grande*.

Found at stations 2680H, 2807, 2808, 2844, 2859, 2923, 3263H, 3603, 3604, 3604H, 3683H, 3688H, 3691H, 3692H, 3698, 4025H, 4029H, 4516H, Galapagos Islands to Bering Sea and south to Honshu Island, Japan

Trigonium adspersum Mann, sp. nov. PLATE LI, FIGURE 5.

Valves triangular; slightly and evenly convex; sides inflated; angles blunt, not produced, each one having an evident but very minute spine; markings large, compound, oval or rounded beads, loosely but radially placed at the middle of the valve, leaving an indefinite central area, thence outward closely set and radially arranged, remaining the same size until within a short distance of the border, then rapidly diminishing to one-fourth size.

Width between apices, 0.065 mm.

The general markings correspond to *T. rusticum* Mann, which also has very minute spines at the angles. The two are rather wide for one species. Compare this description with that of the latter below.

Type in the U. S. National Museum, No. 590157, from station 3699H, Okhotsk Sea, September 3, 1896; 1,584 fathoms, bottom of green mud and fine sand.

Trigonium cinnamomeum (Grev.) Mann.

Triceratium cinnamomeum Grev. Quart. Journ. Micr. Sci. n. s. **3**: 232. *pl. 9. f. 12.* 1863. Moeb. Diat.-taf. *pl. 47. f. 12.* 1890. Schmidt, Atlas *pl. 151. f. 23–24.* 1890. De Toni, Syll. Alg. **2**: 974. 1894.

Cestodiscus cinnamomeum Grun.; Van. Heur. Synop. *pl. 126. f. 1–2.* 1881.

Pseudotriceratium cinnamomeum Grun. Denkschr. Akad. Wien **48**[2]: 83. 1884.

However this diatom may contrast with others by reason of the minute spines that terminate its apices, the hyaline lines leading up to these and thus bisecting the angles, and the general but not constant presence of still smaller spines along the margin, I do not recognize any reason for placing this in Cestodiscus. That genus as defined by Greville[a] is made to differ from Aulacodiscus by the absence of "furrows" or radiating lines running from the center to the submarginal processes, not in any marked difference of the processes. To confuse such processes with the minute spines of this diatom, to which "furrows" always do run, even to those occasionally present on the margin, is hardly allowable; and when we add the further character of Cestodiscus added by Castracane,[b] a submarginal band with minuter and closer granulation, any resemblance to that doubtful genus vanishes. Schmidt and others reject this classification; and Grunow subsequently proposes a new genus, Pseudotriceratium, to accommodate this species. This would be warranted, in view of the uselessness of Triceratium, did not Cleve's older genus Trigonium serve the purpose as well.

Found at stations 2807, 2920H, Galapagos and Hawaiian Islands.

Trigonium coscinoides (Gr. & St.) Mann.

Triceratium coscinoides Gr. & St. Journ. Quek. Micr. Club II. **2**: 327. *pl. 19. f. 13.* 1886. De Toni, Syll. Alg. **2**: 922. 1894.

Triceratium radioso-reticulatum Grun.; Schmidt, Atlas *pl. 151. f. 35–36* (corrected to *T. coscinoides* in Berichtigungen opposite *pl. 153*). 1890. Van Heur. Synop. *pl. 112. f. 5.* 1881.(?).

I have been able by the discovery of numerous specimens of this diatom to determine the unity of the above. The specimens agree with the Oamaru figure except in having a very minute spine at one or all of the apices, thus agreeing with the form described by Grunow. As a rule, the tiny spine is present on only one or two of the apices, thus showing on the same valve the Grunow and the Grove and Sturt forms. I add a question-mark after the citation to Van Heurck, because no specimens I have examined show any trace of the secondary marking figured and mentioned by him, nor any

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[a] Trans. Micr. Soc. Lond. n. s. **13**: 48. 1865.

[b] Castr. Rep. Voy. Chall. Bot. **2**: 122. 1886.

very evident radial arrangement of the network, and, on the other hand, there is no mention by him of the apical spines. It is probable all these are alike, in which case the name should be *Trigonium reticulo-radiatum*. It may be added that my specimens are larger than the Grove and Sturt type, which is given as 0.0022 to 0.004 inch, approximately equal to 0.0056 to 0.01 mm., while my specimens vary from 0.048 to 0.16 mm.

Found at station 4029H, Bering Sea.

Trigonium parallelum (Ehrenb.)? Mann.

Amphitetras parallela Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1839**: 143. 1841?; Mikrog. *pl. 19. f. 20a–b*. 1854.? Kütz. Bacill. 135. 1844. Pritch. Hist. Infus. ed. 4. 858. 1844. De Toni, Syll. Alg. **2**: 908. 1894.

Triceratium parallelum Ehrenb.?; Grev. Trans. Micr. Soc. Lond. n. s. **13**: 104. *pl. 9. f. 22–23*. 1865. Moeh. Diat.-taf. *pl. 69. f. 22–23*. 1890. Schmidt, Atlas *pl. 75. f. 3–5, 11–13, 30, pl. 76. f. 14–17*. 1852 (not *f. 18*); *pl. 81. f. 1–2*. 1885. Van Heur. Synop. *pl. 111. f. 2–6* (not *f. 1, 3–5*). 1881. Grun. in Fenzl, Reise Novara Bot. **1**: 24. 1870.

Triceratium obtusum Ehrenb. Ber. Akad. Wiss. Berl. **1844**: 88. 1845; Phys. Abh. Akad. Wiss. Berl. **1841**: 425. 1843; Mikrog. *pl. 18. f. 48–49*. 1854. Pritch. Hist. Infus. ed. 4. 857. 1861.

Nothoceratium? parallelum De Toni, Syll. Alg. **2**: 915. 1894.

I have adopted the above specific name, as my specimen agrees with Greville's form. Whether or not this is *A. parallelum* Ehrenb. is impossible to determine. Ehrenberg simply says,[a] under *A. antediluviana*, "Vor wenig Tagen hat sich in den griechischen Kreidemergeln noch eine zweite Art dieser Gattung gefunden, welche auf den Seitenflachen parallela Reihen von Zellen hat und die als *A. parallela* abzusondern ist." Kützing simply repeats this meager mention. Ehrenberg's figures are also inconclusive but show a very different center. All this would be simply negative except for the character of *T. obtusum*, which unmistakably is the same as Greville's *T. parallelum*, the figures of Ehrenberg, together with the diagnosis, making this plain. He there says, " * * * * angulis late rotundatis, subtilissime punctata." If, therefore, Ehrenberg has twice named the same species, the earlier name, *parallela*, holds; if not, the proper name for Greville's form and my own is *obtusum*. Though the chances are in favor of the latter view, they are not conclusive, and the better-known name should remain.

It is not impossible to consider this species as belonging to Stictodiscus, as Castracane[b] suggests. But at least the form with which I have to deal is a little too divergent to assign to that genus. I think the resemblance to Stictodiscus is largely in the anastomosing shadow lines at the center of the valve, an appearance lacking in my specimens. De Toni's placing the quadrate form in Amphitetras and the sextate in Nothoceratium is of course indefensible.

A few bad errors in naming figures should here be mentioned. Schmidt's Atlas, plate 76, figure 18, is not *T. parallelum*, but, as Grunow insists, *T. juncatense* Grun. Van Heurck's Synopis, plate 111, figure 1, has nothing to do with this form; those in Wolle[c] are so bad as to have no resemblance to this species, and his figures 11, 12 are poor copies of Schmidt's plate 75, figures 11, 12, themselves doubtful examples of this species. Van Heurck's plate 111, figures 3 (certainly), 4, 5 (probably), are *T. harrisonianum* Norm. (=*Stictodiscus*).[d]

Found at station 3013H, near Hawaiian Islands.

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[a] Phys. Abh. Akad. Wiss. Berl. **1839**: 143. 1841.

[b] Castr. Rep. Voy. Chall. Bot. **2**: 114. 1886.

[c] Wolle, Diat. N. A. *pl. 100*. 1890.

[d] Cf. Schmidt, Atlas *pl. 75. f. 15*. 1882.

Trigonium plano-concavum (Brun) Mann.

Triceratium plano-concavum Brun in Brun & Temp. Mem. Soc. Phys. et Hist. Nat. Geneva **30**[9]: 63. *pl. 6. f. 9.* 1889. Brun, Le Diatomiste **1**: 5. *pl. 1. f. 1.* 1890. De Toni, Syll. Alg. **2**: 929. 1894.

De Toni notes the resemblance of this species to *T. inelegans* Grev.,[a] *T. nicobaricum* Grun.,[b] and *T. juncalense* Grun.[c] The similarity exists but is slight, especially if examined with high magnification and slightly oblique light, by which means the remarkable pitting of the beads brought out in the fine photograph in Le Diatomiste is made plain.

Found at stations 368811, 402911, Galapagos Islands and Okhotsk Sea.

Trigonium rusticum Mann, sp. nov. PLATE LI, FIGURE 4.

Valve triangular, slightly convex; the angles extended into flat arms with slightly broadened ends; sides between the arms inflated; markings coarse, consisting of a few large scattered oval beads at the center of the valve, thence outward strictly radiating, decreasing in size to the margin, which is very narrow and most minutely beaded; a minute spine at the apex of each arm.

Width between the apices, 0.06 mm.

It resembles remotely *T. microcephalum* Grev.[d] and *T. subcapitatum* Grev.[e] but differs materially in its coarse, strongly radiating beading and especially in its flat arms destitute of the globose elevated ends found in the foregoing.

Type in the U. S. National Museum, No. 590134, from station 4029H, Bering Sea, June 27, 1900; 913 fathoms, bottom of gray sand and clay.

Trigonium sculptum (Shadb.) Mann.

Triceratium reticulum Bright. Quart. Journ. Micr. Sci. **1**: 251. *pl. 4. f. 17.* 1853 (?), not Ehrenb.

Triceratium sculptum Shadb. Trans. Micr. Soc. Lond. n. s. **4**: 15. *pl. 1. f. 4.* 1854. Moeb. Diat.-taf. *pl. 3. f.* 4. 1890. Schmidt, Atlas *pl. 76. f. 9–12, 31.* 1877, *pl. 150. f. 17.* 1890. Van Heur. Synop. *pl. 109. f. 7–8, pl. 111. f. 8.* 1881. Pritch. Hist. Infus. ed. 4. 856. 1861. Wolle, Diat. N. A. *pl. 106. f. 4–5, pl. 111. f. 4.* 1890. Petit, Fonds de la Mer **3**: 195. 1877.

Triceratium punctatum Bright. Quart. Journ. Micr. Sci. **4**: 275. *pl. 17. f. 18.* 1856. Pritch. Hist. Infus. ed. 4. 856. *pl. 6. f. 20.* 1861. De Toni, Syll. Alg. **2**: 944. 1894. H. L. Smith, Sp. Diat. Typ. no. 602. 1874. Cleve, Bih. Sv. Vet. Akad. Handl. **5**[8]: 16. 1878. Van Heur. Synop. *pl. 109. f. 6, 9–10.* 1881. Wolle, Diat. N. A. *pl. 101. f. 9, 12.* 1890. Schmidt, Atlas *pl. 76. f. 19–20.* 1882; *pl. 81. f. 6–7.* 1885; *pl. 99. f. 5.* 1886. Cleve in Nordensk. Vega Exped. **3**: 503. 1883. Petit, Fonds de la Mer **3**: 194. 1877.

Biddulphia sculpta Van Heur. Synop. 208. 1885.

Triceratium pardus Schmidt, Atlas *pl. 79. f. 15.* 1882.

Biddulphia reticulum Boyer, Proc. Acad. Phila. **1900**: 724. 1901.

This species varies greatly. It is common to find in the Pacific dredgings forms with a small curved spine in the center and an evident but delicate circular ridge, centrally placed, having a radius of one-half the distance from center to side of the valve. Schmidt *f* mentions the spine, saying there are one to three in forms from Nottingham, Maryland; but he does not mention the ridge. Shadbolt gives emphasis to three minute rings near the center. These, like the ridge and spines mentioned, are

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[a] Trans. Micr. Soc. Lond. n. s. **14**: 8. *pl. 2. f. 21.* 1866.
[b] Schmidt, Atlas *pl. 76. f. 22.* 1877.
[c] Schmidt, Atlas *pl. 76. f. 13.* 1877.
[d] Trans. Micr. Soc. Lond. n. s. **9**: 74. *pl. 9. f. 4.* 1861.
[e] Quart. Journ. Micr. Sci. n. s. **3**: 234. *pl. 10. f. 20.* 1863.
[f] Schmidt, Atlas *pl. 76. f. 26.* 1882.

inconstant. Though the union of *sculptum* and *punctatum* is desirable, the former name should be preferred to the latter, which De Toni selects. It is probable *T. reticulum* Bright. belongs here, though the miserable figure and incomplete description make this a little uncertain. But this is not *T. reticulum* Ehrenb.[a] De Toni quotes Brightwell's name but does not identify it with Ehrenberg. *T. brouneanum* Grev.[b] which Boyer adds to the above list, is not at all the same. Greville says of it "angles rounded with obscure pseudonodules." These last can not possibly be the rings of Shadbolt's form, those being at the center, but must be processes at the apices. The center of Greville's figure is clearly drawn and without trace of the rings of *T. sculptum*. I think Schmidt's plate 79, figures 14 and 16, belong here, a pentagonal specimen from Station 2920H being almost identical with figure 14 as well as with Van Heurck's Synopsis, plate 109, figure 6.

Found at stations 2920II, 3513, 3526, 3611, 3604II, 3698, 3712H, Hawaiian Islands, Honshu Island, Japan, and Okhotsk Sea.

Trigonium striolatum (Ehrenb.) Mann.

Triceratium striolatum Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1839:** 159. *pl. 4. f. 9.* 1841. Bright. Quart. Journ. Micr. Sci. n. s. **1:** 250. *pl. 4. f. 10.* 1853. Moeb. Diat.-taf. *pl. 1. f. 10.* 1890 De Toni, Syll. Alg. **2:** 943. 1894. (not Roper, Trans. Micr. Soc. Lond. n. s. **2:** 74. *pl. 6. f. 3.* 1854.)

Roper is right [c] in claiming that his idea of this diatom of Ehrenberg and Brightwell's idea are not the same. A comparison of the original figure and a reading of Ehrenberg's diagnosis will show that Brightwell is correct. There is neither mention nor sign in the figures of any horn-like processes in Ehrenberg's species. At any rate the specimens found by me are wholly destitute of such processes, though the apices are produced; and as they agree perfectly with what is given in Ehrenberg, Kützing, and Brightwell, I look upon them as well marked and distinct from Roper's form. To unite all these with *Biddulphia rhombus* (Ehrenb.) W. Smith, as is done by Van Heurck[d] is out of the question. Roper's form is probably the same as *T. membranaceum* Bright.[e]

Found at station 3361H, Bering Sea.

Trigonium tabellarium (Bright.) Mann.

Triceratium tabellarium Bright. Quart. Journ. Micr. Sci. **4:** 275. *pl. 17. f. 15.* 1856. Moeb. Diat.-taf. *pl. 9. f. 15.* 1890. Schmidt, Atlas *pl. 77. f. 1–2* (*f.* 3–5 according to Grun.). 1882. Jan. Diat. Gaz. Exped. *pl. 9. f. 7.* De Toni, Syll. Alg. **2:** 953. 1894. Pritch. Hist. Infus. ed. 4. 854. Cleve, Bih. Sv. Vet. Akad. Handl. **5**[8]: 17. *pl. 5. f. 31.* 1878.

Triceratium johnsoni Ralfs in Pritch. Hist. Infus. ed. 4. 854. 1861 ?.

Triceratium venulosum Grev. Trans. Micr. Soc. Lond. n. s. **12:** 90. *pl. 13. f. 21.* 1864. Moeb. Diat.-taf. *pl. 61. f. 21.* 1890. Schmidt, Atlas *pl. 77. f. 6–9.* 1882; *pl. 147. f. 3.* 1888 (not Gr. & St. Journ. Quek. Micr. Club II. **2:** 327. *pl. 19. f. 15–16.* 1886).

Triceratium pallidum Grev. Trans. Micr. Soc. Lond. n. s. **12:** 84. *pl. 11. f. 7.* 1864. Moeb. Diat.-taf. *pl. 59. f. 7.* 1890. De Toni, Syll. Alg. **2:** 938. 1894.

Triceratium brevinervum Grev. Trans. Micr. Soc. Lond. n. s. **13:** 101. *pl. 9. f. 26.* 1865. Moeb. Diat.-taf. *pl. 69. f. 26.* 1890.

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[a] Cf. Ber. Akad. Wiss. Berl. **1844:** 38. 1845; Mikrog. *pl. 18. f. 50, pl. 33. XVI. f. 13.* 1854.

[b] Trans. Micr. Soc. Lond. n. s. **9:** 72. *pl. 8. f. 16.* 1861.

[c] Trans. Micr. Soc. Lond. **2:** 74. 1854.

[d] Van Heur. Synop. *pl. 99. f. 1–3.* 1881.

[e] Quart. Journ. Micr. Sci. **1:** 251. *pl. 4. f. 15.* 1853. and cf. with Brightwell's figure of this species on the same plate.

Triceratium grave Schmidt, Atlas *pl. 77. f. 17.* 1882. Truan & Witt, Diat. Hayti 22. *pl. 7. f. 1, 13.* 1888. De Toni, Syll. Alg. **2:** 946. 1894.
Biddulphia tabellarium Boyer, Proc. Acad. Phila. **1900:** 718. 1901.

The form described and figured (with some doubt) as this species by Grove and Sturt is another species, as Schmidt makes it,[a] calling it *T. majus* Gr. & St. It is clearly a Biddulphia, having strongly developed processes at the angles. *T. venulosum* Grev. is simply a delicate variety of *T. tabellarium*.

Found at stations 2807, 3604, Galapagos Islands and Bering Sea.

Trigonium trinitas (Brun) Mann.

Triceratium trinitas Brun; Schmidt, Atlas *pl. 166. f. 3–4.* 1891.

The general build of this species is that of a very minute *T. arcticum;* but the beading is very different, coarse, each bead having a central dot, showing no trace of radial arrangement. The beads are similar to those of *T. luminosum* Brun & Temp., especially as figured by Schmidt.[b] But unlike the latter, they have no processes at the angles (seen best in the original figure).[c] The border is unusually massive and transversely striated. My specimen agrees best with the variety called *minima* (fig. 4 above).

Found at station 3603, Bering Sea.

Trigonium zonulatum (Grev.) Mann.

Triceratium zonulatum Grev. Trans. Micr. Soc. Lond. n. s. **13:** 102. *pl. 9. f. 17.* 1865. Moeb. Diat.-taf. *pl. 69. f. 17.* 1890. Schmidt, Atlas *pl. 77. f. 33–37.* 1882; *pl. 94. f. 9.* 1886.
Amphitetras zonulata De Toni, Syll. Alg. **2:** 900. 1894.
Biddulphia parvula Boyer, Proc. Acad. Phila. **1900:** 725. 1901, in part.

This diminutive and fine diatom is exceedingly abundant in the single hydrographic sounding below. It entirely lacks the characteristic Biddulphia (or "Amphiteras") processes at the angles. I therefore think it is inadmissible to class it as Boyer or De Toni does. It is not exactly the same as the *Amphitetras parvula* Jan. & Rabh.[d] and it is a question if that name could stand, having been published the same year, 1863, as *A. parvula* Grev., a totally different diatom. De Toni, Cleve, and others class *T. zonulatum* and *A. parvula* separately.

My specimens are remarkably uniform in size, all measuring about 0.02 mm.

Found at station 4029H, Bering Sea.

DITYLUM Bail.

Ditylum Bail. Bost. Journ. Nat. Hist. **7:** 332. *pl. 6. 10–15.* 1861. Van Heur. Synop. 196. 1885. De Toni, Syll. Alg. **2:** 1017. 1894. Boyer, Proc. Acad. Phila. **1900:** 730–731. 1901.
Triceratium Ehrenb. in part; West. Trans. Micr. Soc. Lond. n. s. **8:** 149. *pl. 8. f. 1, 5, 8.* 1860. Van Heur. Synop. *pl. 114. f. 3–9.* 1881.

The members of this genus have not the remotest likeness to forms of Triceratium Ehrenb., except in the imperfect triangular outline of the valves, and this is inconstant. Their pellucid, sparingly silicified frustules; their long and massive central spines; the peculiar topography of the valves, with a flat central area surrounded by portions sloping downward at a considerable angle, and the great breadth of the gir-

[a] Schmidt, Atlas *pl. 127. f. 1.*
[b] Schmidt, Atlas *pl. 159. f. 8.* 1890.
[c] Mem. Soc. Phys. Hist. Nat. Geneva **30**[3]: *pl. 6. f. 3.* 1889.
[d] Rabh. Beitr. **1:** 4. *pl. 1. f. 4.* 1863.

dles separating the valves make them clearly deserving of a separate generic rank. A reference is made by L. W. Bailey to these forms having been recorded by his father under the generic name Grymaia, which has never been published except as a synomym. Van Heurck spells this genus Ditylum in his text, but Ditylium in his plates. De Toni spells it Ditylium and says in a note—"Nonnulli auctores scribunt Ditylum, ex. gr. clarus Van Heurck." I prefer to retain the original spelling as above.

Ditylum sol (Van Heur.) De Toni, Syll. Alg. **2:** 1018. 1894.

Triceratium (Ditylium) sol Van Heur. Synop. *pl. 115. f. 1–2.* 1881. Schmidt, Atlas *pl. 152. f. 4–9.* 1890.

There is a close similarity in all the forms of Ditylum that gives ground for the suspicion that they may eventually be found to be varieties of one species.

Found at station 4505H, Santa Cruz Light-House, Monterey Bay, Cal.

Ditylum undulatum (Bright.) Mann.

Triceratium undulatum Bright. Quart. Journ. Micr. Sci. **6:** 154. *pl. 8. f. 1–5, 8.* 1858. Cleve, Bih. Sv. Vet. Akad. Handl. **1**[1]**:** 6. 1873. Cleve, Bih. Sv. Vet. Akad. Handl. **5**[8]**:** 17. 1878.

Triceratium undulatum Ehrenb.; Schmidt, Atlas *pl. 151. f. 41.* 1890. Pant. Beitr. Bacill. Ung. **1:** *pl. 18. f. 164.* 1886.

Triceratium undulatum W. Smith; Lewis, Proc. Acad. Phila. **1861:** 65. 1862.

Triceratium (Ditylium) ehrenbergii Grun.; Van Heur. Synop. *pl. 115. f. 7–8.* 1881. Walk. & Chase, Notes on Diat. **2:** 5. *pl. 4. f. 12.* 1887.

Triceratium intricatum West, Trans. Micr. Soc. Lond. n. s. **8:** 149. *pl. 7. f. 5a–b.* 1860. Van Heur. Synop. *pl. 114. f. 2.* 1881.

Ditylum intricatum Grun.; Van Heur. Synop. 196. 1885.

Triceratium brightwellii West, Trans. Micr. Soc. Lond. n. s. **8:** 149 (*pl. 7. f. 6.* doubtful). 1860. Van Heur. Synop. *pl. 114. f. 3–9.* 1881.

Ditylum trigonum Bail. Bost. Journ. Nat. Hist. **7:** 332. *pl. 7. f. 6, 10, 11.* 1861. H. L. Smith, Sp. Diat. Typ. no. 142. 1874.

Ditylum inaequale Bail. Bost. Journ. Nat. Hist. **7:** 332. *pl. 7. f. 12–14.* 1861.

Tuffen West in his discussion of Brightwell's forms confuses matters considerably. He divides the latter's *T. undulatum* into two species, *T. intricatum* and *T. brightwellii.* He speaks of the form he calls *T. brightwellii* as having inflated margins and refers to Brightwell's figure, which shows that characteristic; yet in his own figure 6a he fails to show that margin. Or, if by "margin" he means outline, the convexity he shows in his figure is lacking in the figure he mentions in Brightwell's plate. I take it that both of West's forms are only varieties of Brightwell's species.

Ehrenberg's *Discoplea undulata* [a] probably does not belong here; but rather is allied to *Triceratium radiatum* Bright., a species distinct from this. It is also uncertain if his specimen from the so-called "Bermuda earth," referred to [b] as *Triceratium undulatum* is this species. It more probably is his *Discoplea undulata.* This Ralfs also looks upon as distinct from the present species. He says [c] that it is probably identical with *T. crenatum* Kitt. (MSS.), and that its nearly orbicular outline and crenate margin "distinguish it from *T. brightwellii.*" On these grounds alone it could, however, hardly be so distinguished. There is no question that what Schmidt calls *T. undulatum* Ehrenb.[d] belongs here.

Found at station 4029H, Bering Sea.

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[a] Ehrenb. Mikrog. *pl. 33. XVIII. f. 3.* 1854.

[b] Ber. Akad. Wiss. Berl. **1844:** 273. 1845.

[c] Pritch. Hist. Infus. ed. 4. 939. 1861.

[d] Schmidt, Atlas *pl. 151. f. 41.* 1890.

BIDDULPHIA S. F. Gray.

Biddulphia S. F. Gray, Nat. Arr. **1**: 294. 1821. Van Heur. Synop. 203. 1885.
Odontella C. Ag. Consp. Crit. Diat. 56. 1832. Kütz. Bacill. 137. *pl. 18. f. VIII. 1–3, 6–8.* 1844.
Zygoceros Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1839:** 131, 160. *pl. 4. f. 11–12.* 1841; Mikrog. *pl. 35. A. XXIII. f. 17.* 1854. Bail. Am. Journ. Sci. **46:** 138. 1844.
Amphitetras Ehrenb. in part; Phys. Abh. Akad. Wiss. Berl. **1839:** 122. 142. 1841. Kütz. Bacill. 135. *pl. 19. f. 3.* 1844.
Cerataulus Ehrenb. in part; Ralfs in Pritch. Hist. Infus. ed. 4. 847. 1861. Cleve, Journ. Quek. Micr. Club II. **2:** 171. 1885. Pant. Beitr. Bacill. Ung. **2:** 97. 1889; **3:** *pl. 29. f. 421.* 1893.
Triceratium Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1839:** 129, 159. *pl. 4. f. 10.* 1841, in part. Roper, Quart. Journ. Micr. Sci. **2:** 283. *f. 1.* 1854. Bright. **4:** 274. *pl. 17. f. 9–12.* 1856.
Denticella Ehrenb.; Ehrenb. in Ber. Akad. Wiss. Berl. **1840:** 207. 1841. Grun. Denkschr. Akad. Wien **48**[2]**:** 59. 1884.
Odontotropis Grun.; in part, De Toni, Syll. Alg. **2:** 881. 1894.

In including the above genera, wholly or in part, in Biddulphia a generic unity is attained that is most desirable. This fact has long been appreciated by most diatomists, and the synonymy here enumerated is essentially that of Grunow, Van Heurck, Brun, Witt, Boyer, etc. A careful study of these forms convinces me that the plan adopted in De Toni's Sylloge Algarum of reestablishing Odontella, Zygoceros, Denticella, and Cerataulus as independent genera is unwise. No set of distinguishing characteristics important and constant enough to serve as generic definitions can be found for these names. Although this will become sufficiently evident in considering the separate species following, an illustration or two may be here mentioned. For example, a comparison of *Odontella obtusa* Kütz.,[a] with *Biddulphia roperiana* Grev.,[b] and of these two with *Cerataulus galapagensis* Schmidt,[c] will make it clear how futile it is to attempt to make generic distinctions between these three diatoms. The genus Zygoceros is deservedly obsolete; compare *Z. radiatus* Bail.[d] with *Biddulphia balaena* (Ehrenb.) Bright.[e] Amphitetras might be blended with that unscientific complex "Triceratium," a genus made up chiefly of evident forms of Biddulphia, but in its general structure, in the markings and processes of the valves, and in the zigzag, chain-like growth of its members it is so typical a Biddulphia that the example of Van Heurck, Boyer, and others, in classing most of its species as Biddulphia certainly deserves imitation. The genus Triceratium is chiefly made up of biddulphoid forms, which are here classed in this genus. A full discussion of the relationship between Biddulphia and Triceratium will be given under the genus Trigonium. See also remarks under the genera Aulacodiscus and Porpeia.

Biddulphia alaskiensis Mann, sp. nov. PLATE XLVI, FIGURE 1.

Valve broadly oval, nearly circular, evenly and strongly convex, the two processes barely elevated above the surface of the valve; markings of minute and purely radial beading, there being, however, a slight curvature of the lines toward the sides of the two processes; a few minute spines scattered irregularly over the surface of

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[a] Kütz. Bacill. *pl. 18. VIII. f. 1–3.* 1844; or Van Heur. Synop. *pl. 100. f. 11–14.* 1881.

[b] Van Heur. Synop. *pl. 99. f. 4–6.* 1881. Trans. Micr. Soc. Lond. n. s. **7:** *pl. 8. f. 11–13.* 1859.

[c] Schmidt, Atlas *pl. 115. f. 8.* 1888.

[d] Smithson. Contr. Knowl. **7:** *pl. 1. f. 29.* 1854.

[e] Quart. Journ. Micr. Sci. **7:** *pl. 9. f. 15.* 1859; or Van Heur. Synop. *pl. 112. f. 1.* 1887.

the beading; a single large horn, placed near the margin, one-fourth the distance between one process and the other and pointing radially outward; border narrow and hyaline.

Length of valve, 0.063 mm.; width of valve, 0.053 mm.

Type in the U. S. National Museum, No. 590135, from station 3399II, Bering Sea, August 20, 1893; 12,041 fathoms, bottom of green mud and sand.

This minute species is essentially the same as that figured by Schmidt and marked "n. s.?." It is if anything more nearly circular than Schmidt's figure. It has a slight resemblance to *B. edwardsii* Feb. in some of its broad varieties. I find it, however, impossible to assign it to that species.

Biddulphia antediluviana (Ehrenb.) Van Heur. Synop. 207. 1885.

Amphitetras antediluviana Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1839:** 142. 1841. Kütz. Bacill. 135. *pl. 19. f. 3, pl. 29. f. 86.* 1844. Rabh. Fl. Eur. Alg. **1:** 318. *f. 86.* 1864. Pritch. Hist. Infus. ed. 4. 858. *pl. 11. f. 21–22.* 1861. Ehrenb. Mikrog. *pl. 19. f. 19, pl. 21. f. 25a–c.* 1854. W. Smith, Synop. Brit. Diat. **2:** 47. *pl. 44. f. 318, pl. 44. f. 318a.* 1856. Eng. & Pr. Pflanzenfam. **1**[1b]**:** 41. *f. 53D.* 1896. De Toni, Syll. Alg. **2:** 899. 1894. Schmidt, Atlas *pl. 99. f. 1–4, 6–9.* 1886.

Triceratium antediluvianum Grun. in Fenzl, Reise Novara Bot. **1:** 24. 1870. Van Heur. Synop. *pl. 109. f. 4–5.* 1881. Eng. & Pr. Pflanzenfam. **1**[1c]**:** 50. *f. 60.* 1896.

Biddulphia vesiculosa Boyer, Proc. Acad. Phila. **1900:** 716. 1901. ?

Although this diatom is plainly a Biddulphia, it has been so long and widely referred to as *Amphitetras antediluviana* that many authors are reluctant to drop the untenable generic name. Van Heurck in his plates carries out Grunow's suggestion of making it a Triceratium; but in the text of his Synopsis, published four years later, the above name is assigned.[a] This is certainly its proper place, rather than with Triceratium; for if that genus is to be weeded out and under the name Trigonium to be so reconstructed as to scientifically denote a class of forms not at present assignable elsewhere it must be freed from such manifest Biddulphia forms as this. As there is room for some doubt, expressed by De Toni and others, of this species being identical with Agardh's *Diatoma vesiculosum*[b] or *Isthmia vesiculosa*,[c] I do not here adopt the specific name assigned by Boyer above, but follow the opinion of Van Heurck, who in this respect agrees with Ehrenberg, Kützing, Ralfs, and Grunow.

Some of the figures of this diatom, notably those by Kützing, Pritchard, and Wolle, (those of the last copied from Van Heurck),[d] are so unlike this form as to be utterly misleading.

Found at stations 2680II, 2807, 2835, off central California to Galapagos Islands.

Biddulphia aurita (Lyng.) Breb. & God. Consid. Diat. 12. 1838. W. Smith, Synop. Brit. Diat. **1:** 49. *pl. 45. f. 319.* 1853. Jan. Abh. Schles. Ges. Vaterl. Cult. **1862**[4]**:** 16. *pl. 1A. f. 9.* 1862. Rabh. Fl. Eur. Alg. **1:** 311. 1864. O'Meara, Proc. Roy. Irish Acad. II. **2:** 274. *pl. 27. f. 8.* 1875. Griff. & Henf. Micr. Dict. ed. 3. *pl. 19. f. 9.* 1875. Schmidt, Atlas *pl. 122. f. 6.* 1888. Van Heur. Synop. 205. *pl. 98. f. 4–12.* 1881–5. Wolle, Diat. N. A. *pl. 96. f. 9–11.* 1890.

Diatoma auritum Lyng. Hydro. Dan. 182. *pl. 62. f. D.* 1819.

Odontella aurita C. Ag. Consp. Diat. 56. 1830–32. Kütz. Bacill. 137. *pl. 29. f. 88.* 1844. De Toni, Syl. Alg. **2:** 862. 1894.

Denticella aurita Ehrenb. Mikrog. *pl. 35A. XXIII. f. 7.* 1854. Bail. Am. Journ. Sci. II. **22:** 1. *pl. 1. f. 26–28.* 1856.

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[a] Van Heur. Synop. 207. 1885.

[b] C. Ag. Syst. Alg. 7. 1824.

[c] C. Ag. Consp. Crit. Diat. 55. 1830–1832.

[d] Van Heur. Synop. *pl. 103. f. c.* 1881.

Denticella gracilis Ehrenb. Ber. Akad. Wiss. Berl. **1840:** 204. 1841.
Biddulphia sansibarica Schmidt, Atlas *pl. 122. f. 10–12.* 1888.
Denticella zanzibarica De Toni, Syll. Alg. **2:** 886. 1894.

This well-known and variable species is met with in large quantities at some of the stations, especially at stations 2844 and 3361H. At station 3569H it is present, but very rare. A minute and strongly divergent variety occurs at station 4029H, which is the same as that figured in Schmidt's Atlas, plate 122, figures 10 to 12, and named *B. sansibarica* Schmidt. There can be no reasonable doubt of this being *B. aurita* if a careful examination is made of its many varieties, or even if, taking Schmidt's own figures, we compare figure 2 and figure 7 with figure 12, and also figure 8 with figures 10 and 11 in plate 122. De Toni not only accepts them as specifically distinct, but assigns them to separate genera. (See the citations above.)

Found at stations 2287H, 2690H, 2844, 2848, 2859, 2882, 2920H, 3361H, 3569H, 3635H, 3671H, 3688H, 3691H, 3692H, 3694H, 3704H, 3912H, 4013H, 4014H, 4029H, off central California to Bering Sea and south to Honshu and Hawaiian islands.

Biddulphia biquadrata (Jan.) Boyer, Proc. Acad. Phila. **1900:** 717. 1901.
Triceratium biquadratum Jan.; Schmidt, Atlas *pl. 98. f. 4–6, pl. 99. f. 25–26.* 1886. Jan. Giz. Exped. *pl. 11. f. 1, 4–6.*

I include figures 25 and 26 in Schmidt's Atlas, plate 99, as they are certainly the same species as that figured in plate 98. Both come from the Gazelle Expedition. *Triceratium junctum* Schmidt[a] is very close to the above.

Found at station 2807, Galapagos Islands.

Biddulphia consimilis (Grun.) Boyer, Proc. Acad. Phila. **1900:** 709. 1901.
Triceratium consimile Grun.; Van Heur. Synop. *pl. 108. f. 2.* 1881. Schmidt, Atlas *pl. 84. f. 13–14.* 1885.

The above figures need to be taken together. Schmidt's representation of the general form is excellent, but his figure and description of the secondary markings are wrong. Grunow's own figure cited above shows that these are not a central nodule surrounded by a faint circle, but a central nodule and a row of bright bead-like puncta close to and parallel to the walls of the hexagons. The nodule and the puncta are in two planes of focus, so that when the nodule is distinct the row of puncta assumes the appearance of a ring. Hence Schmidt's mistake.

Found at station 2807, Galapagos Islands.

Biddulphia culcitella Mann, sp. nov. PLATE XLVI, FIGURE 3.

Valve rectangular, the four sides sharply concave; the four horns or processes narrow and slightly prolonged beyond the border line; markings of beading, evenly and finely distributed over the entire valve in rows radial from the center, where six or eight beads are loosely grouped to form an indistinct rosette; valve surface very slightly convex until close to the margin, where it curves rapidly downward to the ribbed border; all specimens are marked with two sets of strong hyaline ridges, one forming a circle about the center with a diameter of one-half that of the valve, the other set consisting of two parallel ridges proceeding backward from the base of each of the four processes for a short distance, about one-eighth the diameter of the valve, where they separate at right angles and end at the margin.

Diameter of valve (between two apices), 0.081 mm.

Type in the U. S. National Museum, No. 590136 from station 2807, Galapagos Islands, April 4, 1888; 812 fathoms, bottom of Globigerina ooze and coral mud.

This form is of the "Amphitetras" type, and would be classed by some authors in that genus (here united with Biddulphia) and by others in Triceratium, from which these Biddulphia forms are here removed.

[a] Schmidt, Atlas *pl. 98. f. 1–3, 19.* 1886.

Biddulphia dubia (Bright.) Cleve, in Nordensk. Vega Exped. **3**: 508. 1883. Boyer, Proc. Acad. Phila. **1900**: 707. 1901.

Odontidium punctatum Roper ?, Quart. Journ. Micr. Sci. **7**: 180. *pl. 9. f. 9.* 1859. Moeb. Diat.-taf. *pl. 23. f. 9.* 1890.[a]

Triceratium bullosum Witt, Journ. Mus. Godef. **1**: 67. *pl. 8. f. 4.* 1873.

Triceratium dubium Bright. Trans. Micr. Soc. Lond. n. s. **7**: 180. *pl. 9. f. 12.* 1859. Schmidt, Atlas *pl. 78. f. 26 30.* 1882.

Triceratium (or *Biddulphia*) *bicorne* Cleve, Bih. Sv. Vet. Akad. Handl. **5**[8]: 17. *pl. 5. f. 30.* 1878.

Amphitetras bicornis De Toni, Syll. Alg. **2**: 902. 1894.

Though this species has sometimes a rather close resemblance to minute specimens of *B. reticulata* Roper, and this led me for a time to make it a variety of the latter, a careful examination of many specimens of both forms, abundantly supplied in some of the dredgings, shows them to be essentially distinct. *B. dubia* is always small, its reticulations irregular and of unequal size, their dividing walls thick and crinkled, the border massive, and the valve outline rhombic. In *B. reticulata*, on the other hand, a larger diatom, the reticulations are quite regular, generally hexagonal, with thin dividing walls showing "knots[b]" at their points of juncture, the border is not so massive, and the valve outline is either elliptical or with convex sides approaching that figure. Both species have secondary dotted markings within the reticulations, but those of *B. reticulata* are smaller and more distinct. The general similarity of these two species has, I think, led to the naming of Schmidt's figures[b] "*B. reticulata* Roper, var.?" whereas they are certainly closer to *B. dubia*. The union of *Triceratium bicorne* Cleve, and *Triceratium bullosum* Witt, which is recognized by De Toni[c] and by Boyer,[d] is rather difficult to admit, in view of Witt's carefully drawn figure and his plain description. Yet the close similarity of Witt's form to *Triceratium dubium* Bright. is undeniable, as is also the specific identity of *T. dubium* and *T. bicorne*. In fact, we have here an illustration of how misty and indefinable our specific boundaries really are, and how subsequently discovered specimens may bridge over the wide gap that separates apparently quite unlike species. This same condition has been previously referred to under *Auliscus punctatus* and *A. pruinosus* Bail.

Found at station 2885, off Oregon.

Biddulphia edwardsii Febiger; H. L. Smith, Sp. Diat. Typ. no. 623. 1874. Boyer, Proc. Acad. Phila. **1900**: 701. 1901.

Odontella edwardsii Grun.; Van Heur. Synop. *pl. 100. f. 9–10.* 1881. Grun. Denkschr. Akad. Wien **48**[2]: 57. *pl. 4. f. 20.* 1884. De Toni, Syll. Alg. **2**: 865. 1894.

Biddulphia obtusa Ralfs, err. det. in Van Heur. Synop. *pl. 100. f. 11 14.* 1881.

Biddulphia polycanthos Brun, Mem. Soc. Phys. et Hist. Nat. Geneva **31**[1]: 12. *pl. 12. f. 8a–b.* 1891.

Odontella ? polycanthos De Toni, Syll. Alg. **2**: 865. 1894.

I find two well-marked varieties of the above polymorphic diatom. One corresponds closely to what Brun (loc. cit.) has called *B. polycanthos*, and that, too, in the forms both with and without the large spines. Brun therefore erroneously makes these spines a mark of specific distinction for his form. Nor can the difference of *B. edwardsii*, having diagonal and *B. polycanthos* vertical lines of beading on the girdle, be admitted. For in most gatherings of *B. edwardsii*, where there is considerable diversity in size, both patterns of marking can be seen in abundance. Such, for example, is the case in the H. L. Smith type-slide no. 623 in possession of the U. S. National Museum. This

[a] Cf. De Toni, Syll. Alg. **2**: 641. 1892.
[b] Schmidt, Atlas *pl. 78. f. 21 24.*
[c] De Toni, Syll. Alg. **2**: 973. 1894.
[d] Proc. Acad. Phila. **1900**: 707. 1901.

species of Brun must, therefore, be ranked as a variety of the above. The second variety, found at station 2807, is the form called *Odontella obtusa* (Kütz.) Ralfs.[a] It is clearly a small variety of this species, exact examples being easily found in most large gatherings, as in the above-mentioned type-slide of H. L. Smith. But it is doubtful if this is the genuine *Odontella obtusa* Kütz., which seems to have a much closer resemblance to *B. roperiana* Grev.[b] Thus Kützing[c] figures it as a smoother diatom than *B. edwardsii*, as does also Ralfs,[d] and under its synonymous name of *O. biddulphioides* Wigand[e] it also differs greatly. I therefore have not included this in the above synonymy. *B. primordialis* Brun[f] is also omitted as a synonym. The figures of the two species are often quite close. But typical specimens of *B. primordialis* are frequent in gatherings made at stations 2844 and 3263H and when these are compared with examples of *B. edwardsii* the difference is seen to be far too wide to admit of their union. It is perhaps a comparison of the figures of these two diatoms, rather than the specimens themselves, that has led Grove to unite them.[g] De Toni[h] notes the similarity of the two, but gives Brun's form separate rank. I can not agree with H. L. Smith[i] in considering this species as "a hirsute variety of *B. roperiana* Grev."

The specimens found by me were mostly large forms, ranging from 0.095 mm. in station 3604 (Bering Sea) to 0.14 mm. in station 2848, south of Alaska peninsula.

Found at stations 2287H, 2807, 2848, 3604, 3693H, 4013H, off Alaska peninsula, to Bering Sea and south to Honshu Island, Japan.

Biddulphia extensa Mann. sp. nov. PLATE XLVII, FIGURES 1, 2.

Valve an elongated and perfectly symmetrical ellipse, about four and one-half times as long as wide, elegantly beaded with fine, round, closely set beads, radiating from a small circular hyaline central area, the lines so arranged as to form concentric ellipses on either half of the valve, these extending from the circular central area to the bases of the long vertical horns arising near the apices of the valve; of the lines radiating from the center only the two coinciding with the median transverse axis straight, the others curving in conformity with the two ellipses; two stout, straight, and long spines set on opposite sides of the central area, half way between the valve's longitudinal and transverse axes, and spread upward and outward; in zonal view the valve showing the two horns to be long, tapering, and vertical, and broadened into a flat-topped apex, this a little higher than the much elevated central area; the base of the valve joined to the girdle by a curved line; approximate valves of adjoining frustules united by the tips of the horns and further connected by a pellucid film-like silicious membrane at the center, parting and narrowing toward the apices; the two central areas almost touching, and the four long spines arising from these interlocked, the two from each valve being on opposite sides of the other valve.

In the single dredging in which this species was found it is abundant; but I have not been able to find any certain remains of the connecting girdle.

Length of valve, 0.130 mm; width of valve, 0.028 mm.

Type in U. S. National Museum, No. 590137, from station 4505 H, Santa Cruz lighthouse, Monterey Bay, Cal.; 10 fathoms.

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[a] Van Heur. Synop. *pl. 100. f. 11-14.* 1881.
[b] Quart. Journ. Micr. Sci. **7**: *pl. 8. f. 11 13.* 1859.
[c] Kütz. Bacill. 137. *pl. 18.* VIII. *f. 1-3, 6 8.* 1844.
[d] Pritch. Hist. Infus. ed. 4. 848. *pl. 13. f. 30 32.* 1861.
[e] Hedw. **2**: 45. *pl. 7. f. 21.* 1860.
[f] Mem. Soc. Phys. et Hist. Nat. Geneva **31**[1]: 12. *pl. 13. f. 9, pl. 14. f. 9.* 1891.
[g] Schmidt, Atlas *pl. 172. f. 4.*
[h] De Toni, Syll. Alg. **2**: 864. 1894.
[i] Am. Journ. Micr. **4**: 101. 1879.

Biddulphia favus (Ehrenb.) Van Heur. Synop. 208. 1885. Boyer, Proc. Acad. Phila. **1900:** 706. 1901.

Triceratium favus Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1839:** 159. *pl. 4. f. 10.* 1841; Mikrog. *pl. 19. f. 17.* 1854: Phys. Abh. Akad. Wiss. Berl. **1841:** 323, 443. *pl. 3. VII. f. 10.* 1843. Kütz. Bacill. 139. *pl. 18. f. 11.* 1844. W. Smith, Synop. Brit. Diat. **1:** 26. *pl. 5. f. 44, pl. 30. f. 44.* 1853. Pritch. Hist. Infus. ed. 4. 855. *pl. 11. f. 43–44.* 1861. Schmidt, Atlas *pl. 82. f. 1, 3, 4.* 1885. Jan. Abh. Schles. Ges. Vaterl. Cult. **1862**[2]: 15. *pl. 1B. f. 9.* 1862. Wolle, Diat. N. A. *pl. 99. f. 1, 2.* 1890. Van Heur. Synop. *pl. 107. f. 1–4.* 1881. H. L. Smith, Sp. Diat. Typ. no. 598. 1874. O'Meara, Proc. Roy. Irish Acad. II. **2:** 277. 1875. Rabh. Fl. Eur. Alg. **1:** 315. *f. 87.* 1864. Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1839:** 159. *pl. 4. f. 10a–b.* 1841. Griff. & Henf. Micr. Dict. ed. 3. *pl.* 13. *f. 29.* 1875. Grun. in Fenzl, Reise Novara Bot. **1:** 24. 1870. Grun. Schmidt, Atlas *pl. 136. f. 5–7.* 1888. Carp. Micro. ed. 8. 613. *f. 442.* 1901. Leud.-Fort. Mem. Soc. Emul. St. Brieuc 60. 1879. Kain, Bull. Torr. Club **14:** 29. 1887. Truan & Witt, Diat. Hayti 21. *pl. 6. f. 8, pl. 7. f. 8.* 1888. Moeb. Diat.-taf. *pl. 1. f. 6.* 1890. Named varieties: Schmidt, Atlas *pl. 82. f. 2, 11. pl. 84. f. 4.* 1885; *pl. 93. f. 4.* 1886. Bright. Quart. Journ. Micr. Sci. **4:** 274. *pl. 17. f. 7.* 1856. Moeb. Diat.-taf. *pl. 9. f. 7.* H. L. Smith, Sp. Diat. Typ. no. 599. 1874. Grun.: Van Heur. Synop. *pl. 107. f. 5.* 1881. Kütz. Sp. Alg. 140. 1849. Castr. Rep. Voy. Chall. Bot. **2:** 109. *pl. 6. f. 1, pl. 9. f. 3.* 1886. Kitt. Mo. Micr. Journ. **12:** 219. *pl. 82. f. 7 8.* 1874.

Triceratium comptum Ehrenb. Ber. Akad. Wiss. Berl. **1843:** 166. 1844. Bright. Quart. Journ. Micr. Sci. **1:** 249. *pl. 4. f. 4.* 1853. Pritch. Hist. Infus. ed. 4. 857. 1861.

Triceratium megastomum Bright. err. det. Quart. Journ. Micr. Sci. **1:** 248. *pl. 4. f. 7.* 1853. Moeb. Diat.-taf. *pl. 1. f. 7.* 1890 (not Ehrenb. Mikrog. *pl. 35A XVII. f. 14.* 1854. nor Pritch. Hist. Infus. ed. 4. 855. 1861).

Triceratium muricatum Bright. Quart. Journ. Micr. Sci. **1:** 249. *pl. 4. f. 5.* 1853. Moeb. Diat.-taf. *pl. 1. f. 5.* 1890. Pritch. Hist. Infus. ed. 4. 856. 1861. Schmidt, Atlas *pl. 83. f. 8–10.* 1885. De Toni, Syll. Alg. **2:** 923. 1894.

Triceratium scitulum Bright. Quart. Journ. Micr. Sci. **1:** 250. *pl. 4. f. 9.* 1853. Moeb. Diat.-taf. *pl. 1. f. 9.* 1890. Schmidt, Atlas *pl. 83. f. 11 16.* 1885. Grun. in Fenzl, Reise Novara Bot. **1:** 24. 1870. De Toni, Syll. Alg. **2:** 922. 1894. Pritch. Hist. Infus. ed. 4. 857. 1861.

Triceratium grande Bright. Quart. Journ. Micr. Sci. **1:** 249. *pl. 4. f. 8.* 1853. Moeb. Diat.-taf. *pl. 1. f. 8.* 1890. Schmidt, Atlas *pl. 82. f. 5.* 1885. De Toni, Notar. **3:** 626. 1888. Pant. Beitr. Bacill. Ung. **1:** 54. *pl. 4. f. 33.* 1886. Pritch. Hist. Infus. ed. 4. 856. 1861. Truan & Witt, Diat. Hayti 21. *pl. 6. f. 10. pl. 7. f. 7.* 1888. Wolle, Diat. N. A. *pl. 104. f. 1.* 1890.

Triceratium fimbriatum Wallich, Quart. Journ. Micr. Sci. **6:** 247. *pl. 13. f. 4 9.* 1858. Schmidt, Atlas *pl. 82. f. 6–7.* 1885.

Biddulphia grandis Boyer, Proc. Acad. Phila. **1900:** 706. 1901.

The necessity of classing this as a Biddulphia becomes evident as soon as we disregard the unimportant fact that it is often found in triangular form. So far as my experience goes, it is quite as abundant in sea dredgings in the quadrate form. It is the dominant species of stations 2915H to 2921H, 3008H, 3010H, 3013H, 4430H, 4502H, and 4571H, where it occurs in immense quantities and without any of the triangular varieties present. H. L. Smith's type 599 is a similar case. He marks it "Tuscarora soundings S. of Sandwich Isl. 1468 fms.," the locality, therefore, corresponding almost exactly with station 3008H. Five to 8-angled forms are frequent in all large gatherings. But whether of triangular form or not, this species, seen from the valval side, but especially from the zonal side, with its horn-like processes at the angles and its peculiar set of the valves on the girdle, is shown to be an almost typical example of Biddulphia. Like all the other members of this genus, it is either marine or fossil.

I am at present unable to include in this species some forms so classed by other writers. Thus *Triceratium orientale* Bail. & Harv.[a] is hardly close enough to *T. grande* Bright., which it most resembles, to make me certain that it can be rightly identified with that form. It is, however, so disposed of by Habirshaw,[b] and is classed by him as a synonym of *Biddulphia grandis* (Bright.) Boyer, which is in this paper united with *B. favus*. The same is true of *Triceratium cuspidatum* Jan., which Boyer unites with this species, and De Toni is disposed to class with his emended genus Amphitetras. It is figured by Schmidt and also by Janisch.[c] A question might also be raised as to the rather divergent varieties above united with this species, viz, *Triceratium muricatum* Bright. and *T. scitulum* Bright. But Schmidt says,[d] "Ob *T. muricatum* und *scitulum* mehr sind als kleine Formen von *T. favus* ist noch genauer zu untersuchen," and Ralfs[e] says of *T. scitulum*, "Except in its smaller size, we see not how this species differs from *T. favus*." The *T. scitulum* variety is abundant at station 3604, which also contains fine examples of sexangular and octangular specimens of *T. grande*.

Found at stations 2807, 2808, 2915H, 2916H, 2917H, 2918H, 2919H, 2920H, 2921H, 3008H, 3010H, 3013H, 3604, 4430H, 4571H, Galapagos Islands to Bering Sea and Hawaiian Islands.

Biddulphia gladiorum Mann, sp. nov. PLATE XLVII, FIGURE 4.

Valve elongated-oval, flat to nearly the full outline of the frustule, then bending perpendicularly downward in a broad band to the line of suture with the girdle; top and vertical sides of the valve delicately beaded with Pleurosigma-like markings; the two terminal processes, corresponding to horns in similar species, here scarcely raised above the surface of the valve, appearing as small obliquely inclined rings; five stout setae, tapering to an acute point, and occasionally imperfectly forked, set close to the margin of the flat portion of the valve, their bases broadened and extending into a low delicate hyaline comb or ridge, thus forming a connecting line between the setae; a thread-like hollow central line within the setae extending to near the tip; two of the setae next to and interior to the two processes.

Length of valve, 0.11 mm.; length of setae, 0.043 to 0.06 mm.

Type in the U. S. National Museum No. 590138, from station 4029H, Bering Sea, June 27, 1900; 813 fathoms, bottom of gray sand and clay.

This diatom finds its nearest likeness in *Biddulphia spinosa* Grev.[f] though as to the flat top of the valve when seen in zonal view, as well as the delicate Pleurosigma-like markings, it resembles *B. cornuta* Brun.[g] Its distinctness from Brun's species is due to the absence of the long-produced horns with inflated bases, to its almost perpendicular sides from the girdle to the level valve face, and to the less significant difference in the shape and number of the spines. It belongs to that group of the Biddulphiae which De Toni[h] places in the genus Denticella, in conformity with Grunow's suggestion.[i] This grouping, which I do not consider to have any generic value, would bring together many similar forms of which *Biddulphia mobiliensis* (Bail.) Grun., may be taken as the type; diatoms of relatively large size but of exceedingly delicate silica

[a] Proc. Acad. Phila. **6**: 430. 1854. Wilkes Explor. Exped. **17**: 179. *pl. 9. f. 9.* 1862.
[b] Hab. Cat. 337.
[c] Schmidt, Atlas *pl. 84. f. 2–3.* 1885. Jan. Gaz. Exped. *pl. 11. f. 14 15.*
[d] Op. cit. *pl. 83. f. 11–16.*
[e] Pritch. Hist. Infus. ed. 4. 857. 1861.
[f] Trans. Mier. Soc. Lond. n. s. **13**: 6. *pl. 1. f. 3.* 1865. Moeb. Diat.-taf. *pl. 62. f. 3.* 1890.
[g] Le Diatomiste **2**: 74. *pl. 6. f. 3.* 1894.
[h] De Toni, Syll. Alg. **2**: 882–886. 1894.
[i] Denkschr. Akad. Wien **48**[2]: 58. 1884.

walls, having two more or less produced horns at the extremities of the oval or elliptical valves, and further ornamented with from two to many long vertical and generally acuminate setae or spines.

Biddulphia granulata Roper, Trans. Micr. Soc. Lond. n. s. **7:** 13. *pl. 1. f. 10–11, pl. 2. f. 12.* 1859. Moeb. Diat.-taf. *pl.* 25. *f. 10–11, pl. 26. f. 12.* 1890. Schmidt, Atlas *pl. 122. f. 18.* 1888. Van. Heur. Synop. *pl. 99. f. 7–8; pl. 101. f. 4.* 1881. Boyer, Proc. Acad. Phila. **1900:** 702. 1901.

De Toni[a] places this as a synonym under *Denticella turgida* Ehrenb. The unfigured description of that species by Ehrenberg[b] can not afford any satisfactory grounds for uniting these two.

Found at stations 3513, 3603, Bering Sea.

Biddulphia grundleri Schmidt, Atlas *pl. 118. f. 22–24.* 1888.

Although this might easily be considered a variety of *B. pulchella* Gray, I find sufficient contrast to warrant the acceptance of Schmidt's name, at least for the present. Not only the scarcely observable marking of the rounded ends of the horns mentioned by him in the above citation, but the large, widely set, and prominent beads which mark the valves of my specimens, instead of the more thickly set beading or reticulated marking of *B. pulchella*, present too strong a contrast to favor their union.

Found at station 4013H, east coast of Honshu Island, Japan.

Biddulphia keeleyi Boyer, Proc. Acad. Phila. **1898:** 469. *pl. 24. f. 4.* 1898; **1900:** 708. 1901.

Boyer gives three localities for this diatom, the last being Monterey Bay, California, and marks it "rare." In the single sounding where it appears, also made in Monterey Bay, it is abundant.

Found at station 4505H, near Santa Cruz light-house, Monterey Bay, Cal.

Biddulphia levis Ehrenb. Ber. Akad. Wiss. Berl. **1843:** 122. 1844. Boyer, Proc. Acad. Phila. **1900:** 712. 1901.

Odontella polymorpha Kütz. Bacill. 138. *pl. 29. f. 90.* 1844.

Cerataulus levis Ralfs in Pritch. Hist. Infus. ed. 4. 847. *pl. 6. f. 7.* 1861 (not *Biddulphia levis* (Ehrenb.) Ralfs in Pritch. Hist. Infus. ed. 4. 848. 1861, which is *Denticella levis* Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 204. 1845, and *Odontella levis* Kütz. Sp. Alg. 136. 1849).—Schmidt, Atlas *pl. 116. f. 13–15.* 1886.

Cerataulus polymorphus Van Heur. Synop. *pl.* 104. *f.* 3–4. 1881.

This diatom, well deserving the specific name given by Kützing, *polymorpha*, was found in only one sounding. It was there unusually large and smooth.

Found at station 2920H, Hawaiian Islands.

Biddulphia luminosa (Brun & Temp.) Mann. PLATE XLVI, FIGURE 5.

Triceratium luminosum Brun & Temp. Mem. Soc. Phys. et Hist. Nat. Geneva **30**[2]: 62. *pl. 6. f. 3.* 1889. Schmidt, Atlas *pl. 159. f. 6.* 1890.

The authors distinguished this from the similar species, *T. africanum* Ehrenb.,[c] *T. gratum* Schmidt,[d] and *T. molleri* Pant.[e] It is, however, very close to the latter.

Two specimens were found by me, one with a length on side of 0.083 mm. and the other with a length on side of 0.153 mm. I figure this species because the drawings referred to above give in both instances emphasis to the dotted centers of the beads, an aspect entirely lacking in my specimens.

Found at stations 2694H, 4029H, off southern California and Bering Sea.

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[a] De Toni, Syll. Alg. **2:** 883. 1894.

[b] Ber. Akad. Wiss. Berl. **1840:** 207. 1841, or Pritch. Hist. Infus. ed. 4. 849. 1861.

[c] Ehrenb. Mikrog. *pl. 35A. XIVb. f. 1.* 1854.

[d] Schmidt, Atlas *pl. 77. f. 19.* 1882.

[e] Pant. Beitr. Bacill. Ung. **1:** 53. *pl. 6. f. 47.*

Biddulphia mobiliensis (Bail.) Grun.; Van Heur. Synop., *pl. 101. f. 4–6, pl. 103. f. A*. 1881. Schmidt, Atlas *pl. 122. f. 20–21*. 1888. Boyer, Proc. Acad. Phila. **1900**: 698. 1901.

Zygoceros (Denticella?) mobiliensis Bail. Smithson. Contr. Knowl. **2**[8]: 40. *pl. 2. f. 34–35*. 1851. Pritch. Hist. Infus. ed. 4. 850. *pl. 6. f. 11*. 1861.

Biddulphia baileyi W. Smith, Synop. Brit. Diat. **2**: 50. *pl. 45. f. 322, pl. 62. f. 322*. 1856. Roper, Trans. Micr. Soc. Lond. n. s. **7**: 12. *pl. 1. f. 5–9*. 1859. O'Meara, Proc. Roy. Irish Acad. II. **2**: 275. *pl. 27. f. 8*. 1875. Rabh. Fl. Eur. Alg. **1**: 311. 1864.

Denticella mobiliensis Grun. Denkschr. Akad. Wien **48**[2]: 7. 1884. De Toni, Syll. Alg. **2**: 882. 1894.

Found at stations 2923, 4505H, off southern California and near Santa Cruz Lighthouse, Monterey Bay, California.

Biddulphia ovalis (Schmidt) Boyer. Proc. Acad. Phila. **1900**: 712. 1901.

Cerataulus ovalis Schmidt, Atlas *pl. 115. f. 5–7*. 1888.

My form is drawn to a somewhat narrower oval and the processes are in the long axis. Found at station 2835, off Lower California.

Biddulphia pacifica (Grun.) Mann.

Cerataulus pacificus Grun.; Schmidt, Atlas *pl.* 115. *f. 10*. 1888.

Rattray [a] makes this a synonym of *Auliscus ralfsianus* Grev.[b] and *Eupodiscus barbadensis* Grev.,[c] giving to it the name *Pseudoauliscus ralfsianus* (Grev.) Ratt. It may be well to look upon these as the same, in which case, the genus Pseudoauliscus not being admitted, the name here would be *A. ralfsianus* Grev. My specimen is, however, clearly a broad Biddulphia of the Cerataulus variety, and I prefer to agree with Grunow's analysis, but to include here, as in all other cases, the Cerataulus forms under Biddulphia.

Found at station 2807, Galapagos Islands.

Biddulphia papillata (Gr. & St.) Mann.

Triceratium papillatum Gr. & St. Journ. Quek. Micr. Club II. **3**: 76, *pl. 6. f. 14*. 1887. Schmidt, Atlas *pl. 128. f. 16*. 1888; *pl. 167. f. 5–6, pl. 168. f. 8*. 1891. De Toni, Syll. Alg. **2**: 962. 1894; Notarisia **2**: 351. 1887.

I found five specimens of this rare and striking diatom; one triangular and four of the quadrate variety. The smallest, a single valve, measured 0.048 mm. on each side; the largest, also a single valve, measured 0.137 mm. on each side; another, a complete frustule, measured 0.087 mm. on each side and between opposite horn tips on the zonal side it measured 0.138 mm. This last specimen showed all the curious markings figured by Grove, [a] except that the central brush-like clusters of setae were broken.

It is evident that Grove and Sturt in naming this species saw it in only one position, namely, the valval view, as they state that it is "very rare" and that they were indebted to Weissflog for their specimen. Their drawing is also the valval one. It is conceivable that, seen from this side only, it might be called Triceratium; but how Grove, having subsequently seen it from the zonal side, as is shown by his drawings,[d] could have failed to reclassify it as a Biddulphia it is difficult to understand. It is a perfectly typical example of this genus.

The complete frustrule figured by Grove came from the Hawaiian Islands, as did those figured by Schmidt. My specimens came from the same locality. But as the original specimen was found in a fossil deposit at Oamaru, New Zealand, it would be

[a] Journ. Roy. Micr. Soc. **8**[2]: 43. 1888.
[b] Trans. Micr. Soc. Lond. n. s. **11**: 52. *pl. 3. f. 21*. 1863.
[c] Trans. Micr. Soc. Lond. n. s. **12**: 88. *pl. 12. f. 4*. 1864.
[d] Schmidt, Atlas *pl. 168. f. 8*. 1891.

of geological interest to know how this rare and peculiar diatom came to be present in these two localities.

Found at station 2920H, Hawaiian Islands.

Biddulphia primordialis Brun, Mem. Soc. Phys. et Hist. Nat. Geneva **31**[1]: 12. *pl. 13. f. 9, pl. 14. f. 9.* 1891. Schmidt. Atlas *pl.* 172. *f. 4.* (not *f. 5*). 1892.
Odontella primordialis De Toni, Syll. Alg. **2**: 864. 1894.

Grove has suggested [a] this being only a variety of *B. edwardsii* Febiger.[b] I have discussed the impossibility of looking on these two as the same species under the heading of *B. edwardsii* above.

I look upon figure 5 in the above citation from Schmidt's Atlas as an entirely distinct diatom.

Found at stations 2844, 3263H, off Alaska Peninsula and Aleutian Islands.

Biddulphia pulchella Gray, Nat. Arr. **1**: 294. 1821. Grev. Trans. Micr. Soc. Lond. n. s. **10**: 25. *pl. 3. f. 3–4.* 1862. W. Smith. Synop. Brit. Diat. **2**: 48. *pl. 44. f.* 321. 1856. Pritch. Hist. Infus. ed. 4. 848. *pl. 2. f. 56 60.* 1861. Schmidt, Atlas *pl. 118. f. 26–32, pl. 121. f. 1–2.* 1888. O'Meara, Proc. Roy. Irish Acad. II. **2**: 275. *pl. 27. f. 9.* 1875. Van Heur. Synop. 204. *pl. 97. f. 1–5.* 1881–1885. Rabh. Fl. Eur. Alg. **1**: 310. 1864. De Toni, Syll. Alg. **2**: 870. 1894. Eng. & Pr. Pflanzenfam. **1**[1b]: 42 *f. 54 A–C.* 1896.
Conferva biddulphiana J. E. Smith, Eng. Bot. **25**: *pl.* 1762. 1807?
Diatoma biddulphianum C. Ag. Syst. Alg. 5. 1824?
Denticella biddulphia Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841**: *pl. 2. VI. f. 19.* 1842.
Biddulphia quinquelocularis Kütz. Bacill. 138. *pl. 19. f. 1.* 1844.
Biddulphia septemlocularis Kütz. Bacill. 138. *pl. 19. f. 2.* 1844.
Biddulphia trilocularis Kütz. Bacill. 138. *pl. 29. f. 89.* 1844.
Biddulphia transversa Wigand, Hedwigia **2**: 45. *pl. 7. f. 18.* 1860.
Biddulphia unifasciata Wigand, Hedwigia **2**: 45. *pl. 7. f. 19.* 1860
Biddulphia bifasciata Wigand, Hedwigia **2**: 45. *pl. 7. f. 20.* 1860.
Biddulphia biddulphiana Boyer, Proc. Acad. Phila. **1900**: 694. 1901.

The question of the substitution of the name *Biddulphia biddulphiana* (J. E. Smith) Boyer,[c] for the above depends on whether or not the figures given by Smith[d] are identical with this species. There should be no question of such identity before a name like this one, of long standing and adopted in nearly every diatom work extant, is discarded. In this case two facts should be borne in mind, first, that this species is similar to several other species generally recognized as worthy of separate rank which are equally like the figures of J. E. Smith. Such are *Biddulphia grundleri* Schmidt,[e] which is not united with this species by either De Toni or Boyer, and *Biddulphia tridens* Ehrenb.[f] The second fact is that the figures of J. E. Smith are not those of one species. I have, therefore, not followed Boyer in making the above specific name a synonym under that of J. E. Smith's.

This widely distributed species is remarkably infrequent in the Pacific dredgings examined by me. In none of the following gatherings was it at all abundant.

Found at stations 2807, 2808, 2920H, 3604, Galapagos Islands, Hawaiian Islands, and Bering Sea.

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[a] Schmidt, Atlas *pl. 172. f. 4.* 1892.
[b] Op. cit. *pl. 167. f. 5–6.*
[c] Proc. Acad. Phila. **1900**: 694. 1901.
[d] J. E. Smith, Eng. Bot. **25**: *pl. 1762.* 1807.
[e] Schmidt, Atlas *pl. 118. f. 22–24.* 1888.
[f] Ehrenb. Mikrog. *pl. 19. f. 21, pl. 20. I. f. 53.* 1854. (*Zygoceros tuomeyi* Bail. Am. Journ. Sci. **46**: 138. *pl. 3. f. 3, 4, 8.* 1844.)

Biddulphia reticulata Roper, Trans. Micr. Soc. Lond. n. s. **7:** 14. *pl. 2. f. 13–15.* 1859. Moeb. Diat.-taf. *pl. 26. f. 13-15.* 1890. Castr. Rep. Voy. Chall. Bot. **2:** 102. *pl. 26. f. 9.* 1886. Boyer, Proc. Acad. Phila. **1900:** 708. 1901. Van Heur. Synop. *pl. 102. f. 1–2* (not *f. 3*). 1881.

Odontella? reticulata DeToni, Syll. Alg. **2:** 868. 1894.

Typical examples of this diatom are plentiful in the dredging to be cited. For a discussion of the confusion between quadrate specimens of this species and *B. dubia* (Bright.) Cleve, see under that species.

Found at station 3696, off Honshu Island, Japan.

Biddulphia robertsiana (Grev.) Boyer, Proc. Acad. Phila. **1900:** 707. 1901.

Triceratium robertsianum Grev. Quart. Journ. Micr. Sci. n. s. **3:** 231. *pl. 9. f. 9.* 1863; **6:** *pl. 2. f. 2.* 1886. Moeb. Diat.-taf. *pl. 47. f. 9, pl. 71. f. 22.* 1890. Schmidt, Atlas *pl. 83. f. 3–7* (var.). *pl. 82. f. 14–15.* 1885.

This diatom is rather close to the *Triceratium grande* form of *Biddulphia favus* (Ehrenb.) Van Heurck, both in its general shape and in the fine radiating secondary markings. Still, the fact that the processes are very obtuse and separated by a hyaline area from the reticulation and that the angles are not at all prominent, together with the general presence of large spines on the sides, give it an aspect that warrants its separate name. It is quite possible that the first of the Greville figures cited above is of "*Triceratium grande*" and his second figure that of the true type. They are very dissimilar. The second is at any rate more like the forms classified by me in the present species and agrees better with the description given by Greville, except in the matter of spines, all my specimens having two stout spines near the margin of each of the three sides. It is spoken of by Greville, Schmidt, and Boyer as very rare. In the single gathering where I found it it is fairly abundant. Boyer says: "Pacific soundings 20° 10′ N., 158° 14′ W., 2,507 fathoms." My specimens came from Pacific soundings 21° 21′ N., 157° 09′ W., and though the depth is only 570 fathoms, the location is right on the edge of a deep plain averaging 2,500 fathoms; this particular sounding being just close enough inshore to get the rise of the land from the true sea bottom. This is another one of many instances described in this work where a single species is very significant of locality on the sea bottom.

Found at station 2920H, Hawaiian Islands.

Biddulphia roperiana Grev. Trans. Micr. Soc. Lond. n. s. **7:** 163. *pl. 8. f. 11–13.* 1859. Van Heur. Synop. *pl. 99. f. 4–6.* 1881. Schmidt, Atlas *pl. 120. f. 20-24.* 1888. H. L. Smith, Diat. Sp. Typ. no. 625. 1874. Boyer, Proc. Acad. Phila. **1900:** 700. 1901. Castr. Rep. Voy. Chall. Bot. **2:** 106. *pl. 26. f. 4.* 1886.

PLATE XLVI, FIGURE 2.

Odontella roperiana De Toni, Syll. Alg. **2:** 868. 1894.

It is also possible, as suggested by Boyer,[a] that *Biddulphia* (*Odontella*) *discigera* Grun. and *Triceratium* (*Odontella discigera* var.?) *californicum* Grun.[b] might be classed as synonymous with the above; but without more light than these two figures afford I am unwilling to agree to the suggestion. As has been stated under *Biddulphia edwardsii* Febiger, I find that *B. obtusa* (Kütz.) Ralfs, as figured in Van Heurck[c] agrees better with that species than with this one, though De Toni[d] favors the idea of this species being a large form of Kützing's species. As to that matter I have much doubt about there being any close similarity between these species independent of the relation of Van Heurck's figures. De Toni follows the reference to Van Heurck's figure with the remark, "*Odontella roperiana* (Grev.) videtur forma major hujus speciei," but he gives

[a] Proc. Acad. Phila. **1900:** 700. 1901.
[b] Van Heur. Synop. *pl. 108. f. 9, 11.* 1881.
[c] Op. cit. 100. *f. 11–14.* 1881.
[d] De Toni, Syll. Alg. **2:** 863. 1894.

separate rank to Kützing's and Greville's species. Grunow[a] says, under *B. obtusa* (Kütz.) Grun.: "Hierher scheint mir als grosse Form *Bidd. roperiana* Grev. zu gehören." Grunow here incorrectly credits the inclusion of Kützing's species in Biddulphia to himself, an error repeated by Schmidt.[b] It was previously so classed by Ralfs.[c] I think it is on the whole best to do as Van Heurck and De Toni have done, notice the resemblance between Kützing's and Greville's species, but keep them separate. The same will be true of the synonym of Kützing's species, *Odontella biddulphioides* Wigand.[d] A new variety is here figured.

Found at stations 3604, 3688H, 3712H, Bering and Okhotsk seas.

Biddulphia scutellum Mann sp. nov. PLATE XLVII, FIGURE 3.

Valve an elongated oval, the surface evenly convex except for a circular central area as wide as the valve, this flat (not concave): markings of the central area, fine beading in radiating rows from two approximate foci; of the rest of the valve, of similar beading in rows running chiefly parallel with the long axis of the valve; in addition to this beading, minute pointed processes scattered evenly over the entire valve, as in valves of *B. edwardsii* Febiger; the two processes, short, broad, and circular, close to the ends of the valve.

Length of valve, 0.152 mm.; width of valve, 0.058 mm.

Type in the U. S. National Museum, No. 590139, from station 2844, off Aleutian Islands, July 28, 1888; 54 fathoms, bottom of gray sand.

The nearest species to this one is *Biddulphia obtusa* (Kütz.) Ralfs, in the doubtful figure of it given in Van Heurck,[e] which, as before stated, is somewhat nearer to *B. edwardsii* Febiger. This fact, taken in connection with the presence of fine spines scattered over my specimens similar to those on *B. edwardsii*, makes it possible that both this species and the forms figured in Van Heurck are extreme varieties of Febiger's species. On the other hand, both may be representatives of a separate species. My specimen differs from that figured by Van Heurck in having no concavity at the center, in the size of the beading, and in the central area being the full width of the valve.

Biddulphia setigera (Bail.) Mann.

Triceratium spinosum Bail. Am. Journ. Sci. **46:** 139. *pl. 3. f. 12.* 1844. Pritch. Hist. Infus. ed. 4. 853. *pl. 6. f. 19.* 1861. Schmidt, Atlas *pl. 87. f. 2–5, 7, 13–15.* 1885.

Triceratium setigerum Bail. Smithson. Contr. Knowl. **7:** 11. *f. 26.* 1854.

Triceratium armatum Roper, Quart. Journ. Micr. Sci. **2:** 283. *f. 1.* 1854; **4:** 274. *pl. 17. f. 9–12.* 1856. Moeb. Diat.-taf. *pl. 9. f. 9–12.* 1890. W. Smith, Synop. Brit. Diat. **2:** 87.1856. Cleve, Bih. Sv. Vet. Akad. Handl. **5**[8]: 15. 1878. Castr. Rep. Voy. Chall. Bot. **2:** 109. *pl. 6. f. 2.* 1886.

Triceratium serratum Wall. Quart. Journ. Micr. Sci. **6:** 243. *pl. 12. f. 1–3.* 1858. Pritch. Hist. Infus. ed. 4. 855. 1861. Moeb. Diat.-taf. *pl. 16. f. 1–3.* 1890. De Toni, Syll. Alg. **2:** 973. 1894, as synonym of Amphitetras.

Biddulphia spinosa Boyer, Proc. Acad. Phila. **1900:** 703. 1901.

From the above are excluded some forms united by other authors. The variety named *ornata* by Grove & Sturt *f* is not at all like this species, but is nearer *Triceratium ornatum* Shadb., as the authors suggest. But it possibly represents a new species.

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[a] Grun. Reise Novara Bot. **1:** 23. 1870.
[b] Schmidt, Atlas *pl. 122. f. 30.* 1888.
[c] Pritch. Hist. Infus. ed. 4. 848. 1861.
[d] Hedwigia **2:** 45. *pl. 7. f. 21.* 1860.
[e] Van Heur. Synop. *pl. 100. f. 11–14.* 1881.
[f] Journ. Quek. Micr. Club II. **2:** 329. *pl. 19. f. 20.* 1886.

Triceratium tridactylum Bright.[a] has long-attenuated processes, delicate reticulation, and a strikingly distinct border. Ralfs, De Toni, and Boyer unite it with the above, but Schmidt and others consider them distinct. I agree with this latter view. I also exclude *T. pileus* Ehrenb.,[b] which Schmidt[c] looks upon as synonymous with *T. spinosum* Bail. The resemblance is not worth considering. Grunow's claim that *T. spinosum* Bail. is only a triangular form of *Biddulphia granulata* Roper is equally untenable. The borders are very different, and the whole build of *B. granulata*, especially its reticulation, is much finer and more delicate than in *T. spinosum*.

As the name *Biddulphia spinosa* has been applied by Greville[d] to a quite different diatom and as I consider Grunow's assignment of this species of Greville's to Denticella[e] to be made on inadequate grounds, the original specific name of Bailey is preempted, and the choice lies between Bailey's *T. setigerum* and Roper's *T. armatum*. Both were published in 1854; but as Bailey's article appeared in February and Roper's somewhere near the close of the year, I have selected the name assigned by Bailey. My form is a large and elegant variety of this variable species. It shows a distinct inner triangular area symmetrical with the outer triangle, its reticulation showing no radiation; but outside of this triangle the reticulation is radial, running vertically to the edge, while a few rows of the network form broad lines running from each apex of the inner triangle to the base of each horn-like process in the angles of the outer triangle. No suture exists between these various portions of the valve, but the pattern is made very evident by the arrangement of the reticulation.

Found at station 2807, Galapagos Islands.

Biddulphia shadboltiana (Grev.) Mann.

Triceratium? gibbosum Harv. & Bail. Proc. Acad. Phila. **6**: 181. *pl. 9. f. 32.* 1853; **7**: 430. 1854. Schmidt, Atlas *pl. 80. f. 13–15, 17, 21.* 1882.

Triceratium orbiculatum Shadb. err. det. Bright. Quart. Journ. Micr. Sci. **4**: 276. *pl. 17. f. 20.* 1856.

Triceratium shadboltianum Grev. Trans. Micr. Soc. Lond. n. s. **10**: 28. 1862. Van Heur. Synop. *pl. 108. f. 5–7.* 1881. Schmidt, Atlas *pl. 80. f. 18–20.* 1882. De Toni, Syll. Alg. **2**: 954. 1894.

Triceratium elongatum Grun. in Schmidt, Atlas *pl. 80. f. 12.* 1882.

Lamprisens kittoni Schmidt, Atlas *pl. 80. f. 11.* 1882.

I think there is sufficient ground for rejecting *Triceratium orbiculatum* Shadb. in connection with this species. Greville explains with care[f] that Brightwell confused another form with the original *T. orbiculatum* of Shadbolt. This is borne out by Shadbolt's description and figure,[g] the figure being reproduced by Moebius.[h] Shadbolt mentions no spines, and they are omitted from the figure by Tuffin West, which clearly argues they were not there. It is true, as Boyer[i] has pointed out, that Brightwell's species may be with or without spines, a statement that I can confirm. But though Brightwell's species may resemble Shadbolt's in not having spines, that does not mean that Shadbolt's species resembles Brightwell's further than in this negative quality. Greville, in conferring the name *shadboltianum* on the misnamed species of Brightwell, clearly emphasizes their differences and Ralfs[j] repeats this distinction.

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[a] Quart. Journ. Micr. Sci. **1**: 248. *pl. 4. f. 3.* 1853.
[b] Ehrenb. Mikrog. *pl. 19. f. 18.* 1854.
[c] Schmidt, Atlas *pl. 87. f. 18.* 1885.
[d] Trans. Micr. Soc. Lond. n. s. **13**: 6. *pl. 1. f. 3.* 1865.
[e] Denkschr. Akad. Wien **48**[2]: 58. 1884.
[f] Trans. Micr. Soc. Lond. n. s. **10**: 28. 1862.
[g] Trans. Micr. Soc. Lond. n. s. **2**: 14. *pl. 1. f. 6.* 1854.
[h] Moeb. Diet.-taf. *pl. 3. f. 6.* 1890.
[i] Proc. Acad. Phila. **1900**: 710. 1901.
[j] Pritch. Hist. Infus. ed. 4. 853. 1861.

Certainly so capable a delineator of the Diatomaceae as Tuffen West would not figure Shadbolt's species so differently from Brightwell's, in the matter of cellulation, if they were specifically near enough to be united. We can, of course, go only by the figure and description and by the opinions of Greville and Ralfs; but in the absence of type material to examine, I consider it best to drop Shadbolt's species out of this category and unite the other forms above enumerated under the name given by Greville.

Found at station 3698, off Honshu Island, Japan.

Biddulphia subjuncta Mann, sp. nov. PLATE XLVI, FIGURE 4.

Valve square, the angles rounded and the sides slightly concave; marking of large, flat bosses, oval or subsquare, radially arranged from the center, which is without hyaline area; central portion within a circle, one-half the diameter of the valve, flat, thence the valve slightly convex to the border; the four processes set at the extremity of the rounded angles, broad, nearly sessile, with heavy investing rings and tipped to an angle of 45° to the surface of the valve; each bead punctate with a strong central dot.

Width of valve, 0.063 mm.

Type in the U. S. National Museum, No. 590140, from station 2808, Galapagos Islands April 4, 1888; 634 fathoms, bottom of coral sand.

I am compelled to name this diatom, but do so reluctantly. It is one of a variable group already including many close species, which will need eventually to be revised and condensed when subsequent intermediate forms are discovered. At such time this species should probably disappear. In general markings it is like *Triceratium biquadratum* Jan.,[a] except for the unimportant difference of a circular instead of a quadrate arrangement of the central portion of the valve, a character made prominent in the name given by Janisch. But in addition to the minor differences in marking, the processes at the angles are very broad and sessile, like those figured in *T. elegans* Grev.,[b] a phase of Greville's species in rather too wide contrast to his own representation.[c] My specimen is, on the whole, nearest to an unnamed figure of Schmidt's.[d]

Biddulphia turgida (Ehrenb.?) W. Smith, Synop. Brit. Diat. **2:** 50. *pl. 62. f. 384.* 1856. Roper, Trans. Micr. Soc. Lond. n. s. 7: 17. *pl. 2. f. 23.* 1859. Van Heur. Synop. 206. 1885. Boyer, Proc. Acad. Phila. **1900:** 711. 1901.

Denticella turgida Ehrenb. Ber. Akad. Wiss. Berl. **1840:** 207. 1841?

Cerataulus turgidus Ehrenb. Ber. Akad. Wiss. Berl. **1843:** 271. 1844. Bail. Smithson. Contr. Knowl. **2**[8]: 39. *pl. 2. f. 26–27.* 1851. Pritch. Hist. Infus. ed. 4. 846. *pl. 6. f. 9.* 1861. Schmidt, Atlas *pl. 115. f. 12–14, pl. 116. f. 1–3.* 1888. Castr. Rep. Voy. Chall. Bot. **2:** 101. *pl. 26. f. 6, 8.* 1886. Rabh. Fl. Cur. Alg. **1:** 313. 1864.

Odontella turgida Van Heur. Synop. *pl. 104. f. 1–2.* 1881. De Toni, Syll. Alg. **2:** 864. 1894.

The specimens found at station 3694H are quite small and wholly destitute of the two long spines.

Found at stations 3694H, 3712H, Okhotsk Sea.

ISTHMIA Ag.

Isthmia C. Ag. Consp. Diat. 55. 1832. Ehrenb. Infus. 208. 1838. Kütz. Bacill. 137 1844. W. Smith, Synop. Brit. Diat. **2:** 51. 1856. Cleve, Bih. Sv. Vet. Akad. Handl. **1**[3]: 10. 1873. O'Meara, Proc. Roy. Irish Acad. II. **2:** 279. 1875. Pritch. Hist. Infus. ed. 4. 851. 1861. De Toni, Syll. Alg. **2:** 833. 1891. Van Heur. Treat. Diat. 451. *f. 175.* 1896.

[a] Schmidt, Atlas *pl. 98. f. 4.* 1886.

[b] Schmidt, Atlas *pl. 99. f. 10–11.* 1886.

[c] Trans. Micr. Soc. Lond. n. s. **14:** 9. *pl. 2. f. 24.* 1866.

[d] Schmidt, Atlas *pl. 99. f. 23.* 1886.

Diatoma D C., in part; Lyngb. Hydro. Dan. 181. 1819. C. Ag. Syst. Alg. 6. 1824.
Biddulphia S. F. Gray, Nat. Arr. **1**: 294, 1821, in part.
Isthmiella Cleve, Bih. Sv. Vet. Akad. Handl. **1**[13]: 10. 1873. De Toni, Syll. Alg. **2**: 834. 1894.

The restriction of the above genus by Cleve (see above) to the single species, *I. obliquata* (J. E. Smith.) Ehrenb., (*I. nervosa* Kütz.) and the forming of a new genus, Isthmiella, to include the species destitute of ribbing is wholly unwarranted, and has been followed by no one but De Toni in his Sylloge Algarum.

Isthmia obliquata (J. E. Smith.) Ehrenb. Infus. 209. *pl. 16. f. 5.* 1838. Ralfs, Ann. Mag. Nat. Hist. **12:** 272. *pl. 8. f. 2.* 1843.
Isthmia nervosa Kütz. Bacill. 137. *pl. 19. f. 5.* 1844. W. Smith, Synop. Brit. Diat. **2:** 52. *pl. 47.* 1856. Rabh. Beitr. **1:** 9. *pl. 4. f. 12.* 1863. O'Meara, Proc. Roy. Irish Acad. II. **2:** 279. *pl. 27. f. 15.* 1875. H. L. Smith, Sp. Diat. Typ. no.206. 1874. Schmidt, Atlas *pl. 135. f. 1–6.* 1888. Pritch. Hist. Infus. ed. 4. 851. 1861. Van Heur. Treat. Diat. 452. *pl. 34. f. 891.* 1861. Grun. in Fenzl, Reise Novara Bot. **1:** 102. *pl. 14. f. 21.* 1870.
Conferva obliquata J. E. Smith, Eng. Bot. **26:** *pl.* 1869. 1808, in part.
Diatoma obliquatum Lyng. Hydro. Dan. *pl. 62.* 1819, in part. C. Ag. Consp. Diat. 55. 1832.
Isthmia obliquata C. Ag. Consp. Diat. 55. 1832, in part. Kütz. Linnaea **8:** 579. *pl. 4. f. 59.* 1833.

Ehrenberg[a] was the first to separate the then single species of Isthmia into two, to the first of which, corresponding to what Kützing subsequently called *I. nervosa*, he gave the original specific name *obliquata.*[b] To the second he gave the name *enervis.*[c] The name *obliquata*, though recognized by some writers,[d] was generally dropped in favor of the more descriptive name of Kützing. Boyer, in attempting to reinstate *obliquata*, has done so at the expense of Ehrenberg's *enervis*, an arrangement quite impossible in view of Ehrenberg's descriptions and figures, Kützing's *nervosa* not having been proposed until 1844.[e]

It is remarkable how few specimens of this common marine diatom were met with in the dredgings and soundings examined for this report, especially as, on account of its large size and massive structure, it could not have been overlooked.

Found at stations 2844, 2848, 2851, 3200H, 4013H, 4530H, south of Alaska peninsula, off southern California and Honshu Island, Japan.

HEMIAULUS Ehrenb.

Hemiaulus Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 199, 203. 1845; Mikrog. *pl. 36. f. 43.* Char. emend. Heib. Krit. Overs. Danske Diat. 22, 43. 1863. Grev. Trans. Micr. Soc. Lond. n. s. **13:** 27. *pl. 3. f. 5–16.* 1865. De Toni, Syll. Alg. **2:** 836. 1892. Van Heur. Treat. Diat. 455. *f. 182–185.* 1896. Cf. H. L. Smith, The Lens **1**:89. 1872. and Grun. Denkschr. Akad. Wien **48**[2]: 60. 1884. Boyer, Proc. Acad. Phila. **1900:** 738. 1901.
Corinna Heib. Krit. Overs. Danske Diat. 22, 53. *pl. 3. f. 8.* 1863.
Trinacria Heib. Krit. Overs. Danske Diat. 22, 50. *pl. 3. f. 7.* 1863. Witt, Verh. Russ. Min. Ges. II. **22:** 34. *pl. 11. f. 1 11.* 1886. De Toni, Syll. Alg. **2:** 854. 1894.

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[a] Ehrenb. Infus. 209. 1838.
[b] Op. cit. *pl. 16. f. 5.*
[c] Op. cit. *pl. 16. f. 6.*
[d] Ralfs, Ann. Mag. Nat. Hist. **12:** 272. 1843. Lagerst. Bih. Sv. Vet. Akad. Handl. **1**[14]: 16. 1873.
[e] Cf. Boyer, Proc. Acad. Phila. **1900:** 688, 689. 1901.

Rabh. Fl. Eur. Alg. **1**: 317. 1864. Grun. Denkschr. Akad. Wien **48²**: 67. 1884. Truan & Witt, Diat. Hayti 24. 1888.

Solium Heib. Krit. Overs. Danske Diat. 22, 52. *pl. 4. f. 10.* 1863. Grun. Denkschr. Akad. Wien **48²**: 69. *pl 2. f. 61.* 1884. De Toni, Syll. Alg. **2**:860. 1894. Rabh. Fl. Eur. Alg. **1**: 319. 1864.

The original genus of Ehrenberg, though practically restored by Van Heurck by the inclusion of the three genera separated from it by Heiberg, contained some forms that would now be classed elsewhere. Thus *H. antarctica* Ehrenb.[a] is probably a Biddulphia. The grounds advanced by Heiberg for dividing the genus are of the most trivial character. As Grunow points out,[b] Trinacria and Solium are merely triangular and quadrangular examples of Hemiaulus; while Corinna differs simply in its frustules appearing wedge-shaped in zonal view. It may be added that certain species of Trinacria are indistinguishable from members of the loose genus Triceratium. The close relation of all these forms to the genus Biddulphia is evident; a fact strikingly illustrated by comparing *Hemiaulus polymorphus* Grun. with *Biddulphia elegantula* Grev.[c] The genus Ploiaria Pant., represented by the single species, *P. petasiformis* Pant.,[d] has great resemblance to Hemiaulus in the valval view; but when seen from the zonal view its somewhat concavo-convex form and its apices unprotruded and destitute of any spines, make its union here unnecessary.

Hemiaulus polycystinorum Ehrenb. Mikrog. *pl. 36. f. 43a–d.* 1854; Ber. Akad. Wiss. Berl. **1855**: 299. 1856; Phys. Abh. Akad. Wiss. Berl. **1875**: 52. *pl. 1. f. 12–15.* 1876. Grun. Denkschr. Akad. Wien **48²**: 65. *pl. 2. f. 43–45.* 1884. Schmidt, Atlas *pl. 143. f. 23–29.* 1889. Pritch. Hist. Infus. ed. 4. 851. 1861. De Toni, Syll. Alg. **2**: 849. 1894. Boyer, Proc. Acad. Phila. **1900**: 740. 1901.

Hemiaulus antarcticus Weisse in Witt, Verh. Russ. Minn. Ges. II. **22**: 39. *pl. 6. f. 1–2.* 1886, not Ehrenb.

Found at station 4029H, Bering Sea.

PLOIARIA Pant.

Ploiaria Pant. Beitr. Bacill. Ung. **2**: 84. *pl. 28. f. 403, 405.* 1889. De Toni, Syll. Alg. **2**: 860. 1894. Van Heur. Treat. Diat. 457. *f. 186.* 1896. Boyer, Proc. Acad. Phila. **1900**: 741. 1901.

Hemiaulus Ehrenb. in part; Pant. Beitr. Bacill. Ung. **1**: 50. *pl. 29. f. 295.* 1886.

The separation of this genus from Hemiaulus appears to me justified. The single species at present known differs from any species of Hemiaulus in several respects. In the zonal view the frustule is strongly concavo-convex and the apices are destitute of vertical projections tipped with a claw. The center of the valve on one side is raised into a strong dome almost or entirely wanting on the other valve. In the valval view this central area is seen to be unseparated from the rest of the valve by rectangular boundary lines, such as appear in the similar form of Hemiaulus, known as *Corinna excavata* Heib. So far as I know, the genus is exclusively fossil, and I have heard of no cases where the frustules occur in connected series, as they do in Hemiaulus.

Ploiaria petasiformis Pant. Beitr. Bacill. Ung. **2**: 84. *pl. 28. f. 403, 405.* 1889. De Toni, Syll. Alg. **2**: 860. 1894. Van Heur. Treat. Diat. 457. *f. 186.* 1896. Boyer, Proc. Acad. Phila. **1900**: 742. 1901.

Hemiaulus petasiformis Pant. Beitr. Bacill. Ung. **1**: 50. *pl. 29. f. 295.* 1886.

Found at station 4029H, Bering Sea.

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[a] Ehrenb. Mikrog. *pl. 35A. XXI. f. 13 15. XXII. f. 15.* 1854.

[b] Denkschr. Akad. Wien **48²**: 60. 1884.

[c] Schmidt, Atlas *pl. 143. f. 34.* and *pl. 119. f. 10.*

[d] Pant. Beitr. Bacill. Ung. **2**: 84. *pl. 28. f. 403, 405.* 1889.

TERPSINOE Ehrenb.

Terpsinoe Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841**: 402. *pl. 3. IV. f. 1. VII. f. 30.* 1843. Kütz. Bacill. 128. *pl. 30. f. 72.* 1844; Sp. Alg. 119. 1849. Pritch. Hist. Infus. ed. 4. 859. *pl. 11. f. 47.* 1861. Grun. in Fenzl. Reise Novara Bot. **1**: 23. 1870. De Toni, Syll. Alg. **2**: 894. 1894. Boyer, Proc. Acad. Phila. **1900**: 732. 1901.

Pleurodesmium Kütz. Bot. Zeit. 248. 1846. De Toni, Syll. Alg. **2**: 896. 1894. Kütz. Sp. Alg. 115. 1849.

Tetragramma Bail. Smithson. Contr. Knowl. **7**: 7. *f. 1.* 1854.

Hydrosera Wall. Quart. Journ. Micr. Sci. **6**: 251. *pl. 13.* 1858.

Triceratium Ehrenb. in part; Cleve, Bih. Sv. Vet. Akad. Handl. **18**^{3}: 24. *pl. 6. f. 75.* 1881.

This genus, though showing marked similarity to both Anaulus Ehrenb. and Porpeia Bail. and, therefore, more remotely to Biddulphia Gray, is clearly distinct. Its identity with the three genera enumerated in the synonymy is generally recognized, though De Toni and a few others preserve the separate rank of Pleurodesmium and Hydrosera. In regard to the former it is sufficient to note that the only striking difference is its finer beading of the middle band (zonal view) and coarser beading of the lateral bands, and we find in *T. intermedia* Grun., an otherwise typical *T. musica*, the beading of *Pleurodesmium brebissonii* Kütz., so that, as Grunow says,[a] the two genera are certainly the same. The genus Tetragramma was made on such insufficient distinctions that Bailey himself afterwards abandoned it.[b] Hydrosera even in its usual triangular form shows the music notes and all the characteristics of Terpsinoe.

Terpsinoe musica Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841**: 402. *pl. 3. IV. f. 1, VII. f. 30.* 1843; Mikrog. *pl. 34. V. A. f. 10. VI. A. f. 8–8*. VI. B. f.* 2. 1854. Kütz. Bacill. 128. *pl. 30. f. 72.* 1844. Pritch. Hist. Infus. ed. 4. 859. *pl. 11. f. 47.* 1861. L. W. Bail. Bost. Journ. Nat. Hist. **7**: 340. *pl. 8. f. 52–53.* 1862. Griff. & Henf. Micr. Dict. ed. 4. 759. *pl. 19. f. 33, pl. 25. f. 10.* 1883. Wolle, Diat. N. A. *pl. 61. f. 6, 13–15.* 1890. De Toni, Syll. Alg. **2**: 894. 1894. Boyer, Proc. Acad. Phila. **1900**: 732. 1901. Schmidt, Atlas *pl. 199. f. 9–13, pl. 200. f. 7–8.* 1895. H. L. Smith, Sp. Diat. Typ. no. 590. 1874.

Tetragramma americana Bail. Smithson. Contr. Knowl. **7**: 7. *f. 1.* 1854.

Terpsinoe javanensis Ehrenb. Mikrog. *pl. 34. VIII. f. 16.* 1854.

Terpsinoe americana Ralfs in Pritch. Hist. Infus. ed. 4. 859. 1861. Grun. in Fenzl, Reise Novara Bot. **1**: 23. 1870. Schmidt, Atlas *pl. 200. f. 9–13.* 1895. De Toni, Syll. Alg. **2**: 895. 1894. Boyer, Proc. Acad. Phila. **1900**: 734. 1901.

Terpsinoe magna Bail. Bost. Journ. Nat. Hist. **7**: 340. *pl. 8. f. 46.* 1862. Wolle, Diat. N. A. *pl. 61. f. 7.* 1890. De Toni, Syll. Alg. **2**: 896. 1894.

Terpsinoe tetragramma Bail. Bost. Journ. Nat. Hist. **7**: 340. *pl. 8. f. 50–51.* 1862. Wolle, Diat. N. A. *pl. 61. f. 8–9.* 1890. De Toni, Syll. Alg. **2**: 896. 1894.

Terpsinoe minima Bail. Bost. Journ. Nat. Hist. **7**: 340. *pl. 8. f. 54.* 1862. Wolle, Diat. N. A. *pl. 61. f. 12* (poor). 1890.

Terpsinoe intermedia Grun. Denkschr. Akad. Wien **48**^{2}: 59. 1884. Kain & Schultze, Bull. Torr. Club **16**: 209. *pl. 93. f. 2.* 1889. Schmidt, Atlas *pl. 198. f. 65.* 1877; *pl. 199. f. 1–8, pl. 200. f. 1–6.* 1895. Boyer, Proc. Acad. Phila. **1900**: 733. 1901. De Toni, Syll. Alg. **2**: 895. 1894.

Terpsinoe japonica Ehrenb.: De Toni, Syll. Alg. **2**: 895. 1894.

It may also be necessary to consider *Hydrosera triquetra* Wall.[c] as merely a triangular variety of this species, in which case the following would also belong here, as they

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[a] Denkschr. Akad. Wien **48**^{2}: 59. 1884.

[b] Bost. Journ. Nat. Hist. **7**: 340. 1862.

[c] Quart. Journ. Micr. Sci. **6**: 251. *pl. 13. f. 1–6.* 1858.

are synonymous with *H. triquetra*: *H. compressa* Wall.,[a] *H. mauritiana* Berger,[b] *H. boryana* Pant.[c] *Triceratium javanicum* Cleve.[d] But there is doubt whether these belong here. They would be very widely divergent varieties, and it seems best to leave them in a combination by themselves under the specific name *triquetra*. *T.* (*Pleurodesmium*) *brebissonii* Kütz., though an evident Terpsinoe, is also in strong enough contrast to stand specifically. I have based this conclusion on a careful comparison of the two species in H. L. Smith's type no. 388 (*P. brebissonii*) and no. 590 (*T. musica*) and on the agreement of these with the figures of Ralfs in Pritchard's History of Infusoria.[e]

Found at station 2807, Galapagos Islands.

PORPEIA Bail.

Porpeia Bail.; Pritch. Hist. Infus. ed. 4. 850. *pl. 6. f. 6.* 1861. Rabh. Fl. Eur. Alg. **1:** 315. 1864. Grev. Trans. Micr. Soc. Lond. n. s. **13:** 52. *pl. 6. f. 18–21.* 1865. De Toni, Syll. Alg. **2:** 893. 1892. Van Heur. Treat. Diat. 477. *f. 208.* 1896. Boyer, Proc. Acad. Phila. **1900:** 731. 1901.

This genus is a connecting link between Biddulphia Gray and Hemiaulus Ehrenb. Its difference from the former is largely a matter of greater massiveness of frustule and the internal septa; its difference from the latter is in the absence of straight or curved spines at the ends of its processes and in its septa. In fact, a study of the zonal view of these genera will show how little is needed to turn one into the other. Schmidt in his Atlas *f* has figured a species which, as he says, is highly interesting, a Hemiaulus-Porpeia with a rudimentary curved spine at the end of each process. Or, if we take figure 42 of the same plate and broaden laterally its central elevation till it presses on the two processes, we have a Porpeia, and the two sutures between the central area and the processes reproduce exactly the septa of Porpeia. But though this genus could in a broad sense be united with either of the other two, Hemiaulus could not be included in Biddulphia without abandoning entirely our present conception of it. For classification it is, therefore, certainly best to retain this genus, as is universally done.

Porpeia quadriceps Bail.; Pritch. Hist. Infus. ed. 4. 850. *pl. 6. f. 6.* 1861. Van Heur. Synop. *pl. 95bis. f. 12–14.* 1881. Grev. Trans. Micr. Soc. Lond. n. s. **13:** 52. *pl. 6. f. 18–19* (*pl. 8. f. 13* doubtful). 1865. Schmidt. Atlas *pl. 142. f. 38, 46–56.* 1889. Van Heur. Treat. Diat. 477. 1896. De Toni, Syll. Alg. **2:** 893. 1894. Moeb. Diat.-taf. *pl. 67. f. 18–19.* (*pl. 68. f. 13* doubtful). 1881. Wolle, Diat. N. A. *pl. 66. f. 25* (*f. 30* doubtful). 1890. Boyer, Proc. Acad. Phila. **1900:** 731. 1901.

Porpeia quadrata Grev. Trans. Micr. Soc. Lond. n. s. **13:** 53. *pl. 6. f. 20.* 1865. Moeb. Diat.-taf. *pl. 67. f. 20.* 1890. De Toni, Syll. Alg. **2:** 893. 1894. Van Heur. Synop. *pl. 95bis. f. 15.* 1881; Treat. Diat. 477. *f. 208.* 1896. Wolle, Diat. N. A. *pl. 66. f. 33.* 1890. Boyer, Proc. Acad. Phila. **1900:** 732. 1901.

Porpeia ornata Grev. Trans. Micr. Soc. Lond. n. s. **13:** 53. *pl. 6. f. 21.* 1865. Moeb. Diat.-taf. *pl. 67. f. 21.* 1890. De Toni, Syll. Alg. **2:** 894. 1894.

Porpeia robusta Truan & Witt, Diat. Hayti 18. *pl. 3. f. 23.* 1880? De Toni, Syll. Alg. **2:** 894. 1894.

Porpeia inflera Schmidt. Atlas *pl. 142. f. 58.* 1889.

I think Schmidt does rightly in combining his fourteen figures above cited under this single species. They practically are identical; figure 47 is what Greville calls *P. quadrata*, and his figures 54 and 56 are Greville's *P. ornata*. But I can see no reason

[a] Op. cit. 252. *pl. 13. f. 7–12.*
[b] Le Diatomiste **1:** 31. *pl. 51. pl. 5. f. 8.* 1890.
[c] Pant. Beitr. Bacill. Ung. **2:** 82. *pl. 30. f. 420, 423.* 1889.
[d] Bih. Sv. Vet. Akad. Handl. **18**[5]: 24. *pl. 6. f. 75.* 1881.
[e] Ed. 4. 859, *pl. 11. f. 47.* 1861.
f Pl. 142 f. 57.

for the separation by Schmidt of his *P. inflexa*. There is but little doubt of *P. robusta* belonging here; the slight difference in beading amounts to nothing, as this species is most variable in that respect, and the lighter and more curved septa appear to me unimportant. I have, however, followed this synonym with a question mark.

Found at station 2807, Galapagos Islands.

HEMIDISCUS Wall.

Hemidiscus Wall. Trans. Micr. Soc. Lond. n. s. **8**: 42. *pl. 2. f. 3 4.* 1860. Pritch. Hist. Infus. ed. 852. 1861.

Euodia Bail.; Pritch. Hist. Infus. ed. 4. 852. 1861. Rabh. Fl. Eur. Alg. **1**: 317. 1864. Castr. Rep. Voy. Chall. Bot. **2**: 148. 1886. Van Heur. Treat. Diat. 538. 1896. De Toni, Syll. Alg. **2**: 1324. 1894. H. L. Smith, The Lens **1**: 92. 1872.

Dichomeris Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1861**: 294. 1862; **1872**: 265. *pl. 9. f. 8.* 1873.

Palmeria Grev.; Grev. Ann. Mag. Nat. Hist. III. **16**: *pl. 5. f. 1–4.* 1865. Van Heur. Treat. Diat. 538. *f. 286.* 1896. H. L. Smith, Sp. Diat. Typ. no. 387. 1874.

Goniotheciun Ehrenb. Mikrog. *pl. 33. XVIII. f. 4.* 1854, in part. Griff. & Henf. Micr. Dict. ed. 3. 347. *pl. 42. f. 18.* 1875.

Most diatomists have retained the name Euodia Bailey, notwithstanding the fact that Hemidiscus of Wallich is a year older. Besides this objection to the name there is a still stronger one in the fact that the name Euodia was used by Forster in 1776 for a genus of flowering plants of the family Rutaceae. That Euodia Bailey and Hemidiscus Wall. are synonymous is certain, the only mark of distinction being the pseudonodule observed near the ventral margin of the valve by Wallich. As Ralfs remarks,[a] this may have been overlooked by Bailey; or, as is more likely, it was absent from his specimen. It is not infrequent to find the same forms with or without the pseudonodule, or to find a complete frustule with one valve bearing a pseudonodule and the other lacking it. It is also impossible to hold Greville's Palmeria as a separate genus. The indefinite hyaline central area is the only real difference it possesses, a characteristic too trivial to warrant its separation, as on the same basis we should have to divide many other genera, such as Coscinodiscus. The other quality claimed for Palmeria, namely, fine submarginal spines, with lines from these running radially to the center, is not at all peculiar to Greville's specimen. Wallich refers to the marginal processes as "marginal puncta" and figures them on the dorsal side. A careful examination of Greville's Palmeria in the excellent specimens of H. L. Smith's type slides no. 387 convinces me it is without the distinctions necessary for separate generic rank; though it should be classed as a separate species, viz. *Hemidiscus hardmanianus* (Grev.) Mann.[b] On the other hand, it should be here noted that the striking build of the members of this genus leads to the too easy conclusion that all cuneiform frustules bearing a reasonably close resemblance to the original species, *Hemidiscus cuneiformis* Wall., must be mere varieties of it. Of course such a conclusion would be no more justified than to look upon all circular diatoms covered with a delicate, radially arranged network of hexagons as varieties of *Coscinodiscus radiatus* Ehrenb. I have, therefore, below given to two specimens found by me the separate specific names bestowed by Castracane, although their general similarity to Wallich's original form is apparent.

Hemidiscus cuneiformis Wall. Trans. Micr. Soc. Lond. n. s. **8**: 42. *pl. 2. f. 3–4* 1860. Moeb. Diat.-taf. *pl. 31. f. 3–4.* 1890. Pritch. Hist. Infus. ed. 4. 853. *pl. 6. f. 14.* 1861.

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[a] Pritch. Hist. Infus. ed. 4. 853. 1861.

[b] ***Euodia hardmaniana*** **(Grev.) H. L. Smith; Hab. Cat. 132. 1877.**

Euodia gibba Bail.; Pritch. Hist. Infus. ed. 4. 852. *pl. 8. f. 22.* 1861. H. L. Smith, Sp. Diat. Typ. no. 161. 1874. Rabh. Fl. Eur. Alg. **1:** 318. 1864. De Toni, Syll. Alg. **2:** 1325. 1894. Van Heur. Treat. Diat. 538. *f. 285.* 1896. Wolle, Diat. N. A. *pl. 68. f. 26.* 1890.

Dichomeris subtilis Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1861:** 294. 1862; **1872:** 265. *pl. 9. f. 8.* 1873.

Euodia inornata Castr. Rep. Voy. Chall. Bot. **2:** 149. *pl. 12. f. 1.* 1886?

The last name above is doubtful. It agrees very closely with Wallich's figure, but is a larger diatom with finer markings. I do not include here Ehrenberg's *Goniothecium anaulus.*[a] Though plainly a member of this genus, it is not easily united with this species.[b] It is evidently a very coarsely marked form. Habirshaw, though placing it with the above, questions it. Without an accurate description, which it lacks, I consider its union here somewhat arbitrary and illustrative of the tendency mentioned above, to blend all similar forms with the original species of Wallich.

Hemidiscus rectus (Castr.) Mann.

Euodia recta Castr. Rep. Voy. Chall. Bot. **2:** 149. *pl. 12. f. 3.* 1886. De Toni, Syll. Alg. **2:** 1326. 1894.

My specimens of this very large diatom have more evidently radial markings than the above figure.

Found at stations 2919, 2923, off southern California.

Hemidiscus ventricosus (Castr.) Mann.

Euodia ventricosa Castr. Rep. Voy. Chall. Bot. **2:** 150. *pl. 12. f. 5.* 1886. De Toni, Syll. Alg. **2:** 1326. 1894.

There is a possible doubt about this being more than a large and delicately marked variety of *H. cuneiformis* Wall. But after comparing my specimens with those of that species from several localities I have found the contrast too wide to admit of making them synonymous.

Found at station 2920H, Hawaiian Islands.

RUTILARIA Grev.

Rutilaria Grev. Quart. Journ. Micr. Sci. n. s. **3:** 227. *pl. 9. f. 1–3.* 1863. Grev. Trans. Micr. Soc. Lond. n. s. **14:** 124. *pl. 11. f. 9–13.* 1866. Cleve, Bih. Sv. Vet. Akad. Handl. **18**[3]: 19. 1881 (exclusive of *R. recens* Cleve). De Toni, Syll. Alg. **2:** 1020. 1894. Van Heur. Treat. Diat. 433. *f.* 136. 1896.

The attempt to see a relationship between this genus and Nitzschia, as suggested by Greville, or between it and Melosira, as suggested by H. L. Smith, or between it and Cymatosira, mentioned in that view by Cleve, appear all of them rather far-fetched.

Rutilaria epsilon (Kitton) Grev. Quart. Journ. Micr. Sci. n. s. **3:** 228. *pl. 9. f. 1.* 1863. Moeb. Diat.-taf. *pl. 47. f. 1.* 1890. Gr. & St. Journ. Quek. Micr. Club II. **3:** 74 *pl. 6. f. 13.* 1887. De Toni, Syll. Alg. **2:** 1021. 1894. Temp. & Brun, Mem. Soc. Phys. et Hist. Nat. Geneva **31**[1]: 55. *pl. 1. f. 12.* 1891.

Nitzschia epsilon Kitton, Quart. Journ. Micr. Sci. n. s. **3:** 228. 1863, as synonym.

Rutilaria tenuicornis Grun.; Van Heur. Synop. *pl. 105. f. 10.* 1881.

Rutilaria longicornis Temp. & Brun, Mem. Soc. Phys. et Hist. Nat. Geneva **31**[1]: 54. *pl. 1. f. 1.* 1891. Van Heur. Treat. Diat. 433. *f. 156.* 1896. De Toni, Syll. Alg. **2:** 1021. 1894. Pant. Beitr. Bacill. Ung. **3:** *pl. 33. f. 478.* 1893.

Rutilaria hexagona Grun.; Van Heur. Synop. *pl. 105. f. 8.* 1881. Temp. & Brun, Mem. Soc. Phys. et Hist. Nat. Geneva **31**[1]: 55. *pl. 1. f. 2.* 1891.

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[a] Ehrenb. Mikrog. *pl. 33, XVIII, f. 4.* 1854.

[b] Cf. Griff. & Henf. Micr. Dict. ed. 3. 347, *pl. 42. f. 18.* 1875.

Rutilaria szakalensis Pant. Beitr. Bacill. Ung. **2:** 76. *pl. 24. f. 355.* 1889. De Toni, Syll. Alg. **2:** 1023. 1894.

Rutilaria kenerii Pant. Beitr. Bacill. Ung. **3:** *pl. 33. f. 474.* 1893. De Toni, Syll. Alg. **2:** 1024. 1894.

Rutilaria capitata Temp. & Brun. Mem. Soc. Phys. et Hist. Nat. Geneva **31**[1]: 54. *pl. 1. f. 3a–b.* 1891. De Toni, Syll. Alg. **2:** 1022. 1894. Pant. Beitr. Bacill. Ung. **3:** *pl. 33. f. 473.* 1893.

Rutilaria radiata Gr. & St. Journ. Quek. Micr. Club II. **2:** 322. *pl. 18. f. 4–5.* 1886.

Rutilaria edentula Castr. Rep. Voy. Chall. Bot. **2:** 92. *pl. 18. f. 14.* 1886.

Rutilaria obesum Grev.; Cleve. Bih. Sv. Vet. Akad. Handl. **18**[5]: 19. 1881?.

Rutilaria superba Grev. Trans. Micr. Soc. Lond. n. s. **14:** 125. *pl. 11. f. 11-12.* 1866. Moeb. Diat.-taf. *pl. 74. f. 11–12.* 1890. De Toni, Syll. Alg. **2:** 1022. 1894?

Rutilaria elliptica Grev. Quart. Journ. Micr. Sci. n. s. **3:** 229. *pl. 9. f. 3.* 1863. Moeb. Diat.-taf. *pl. 47. f. 3, pl. 74. f. 9–10.* 1890. Trans. Micr. Soc. Lond. n. s. **14:** 125. *pl. 11. f. 9–10.* 1866. De Toni, Syll. Alg. **2:** 1022. 1894?

Rutilaria ventricosa Grev. Quart. Journ. Micr. Sci. n. s. **3:** 228. *pl. 9. f. 2.* 1863. Pant. Beitr. Bacill. Ung. **1:** 44. *pl. 9. f. 78.* 1886. Moeb. Diat.-taf. *pl. 47. f. 2.* 1890. De Toni, Syll. Alg. **2:** 1022. 1894?

This species is subject to great variation. A good gathering will show nearly all the forms represented by the above names, together with intergradations. *R. radiata*, if judged from the figure alone, would seem quite distinct, but interpreting the lines as rows of beads, as we learn from the diagnosis that they are, we see that we have to do with an unimportant variety of the above. It is practically identical with *R. edentula* Castr. There is some doubt as to the worth of the last three names with the authority of Greville, but a comparison of the forms represented by these with all the above will indicate that they are probably varieties. I have followed the names with a question mark. The doubt over *R. obesum* is due to the lack of a figure. So far as can be made out it belongs here.

Found at Station 4029H, Bering Sea.

DENTICULA Kütz.

Denticula Kütz. Bacill. 43. (not *pl. 3. f. 60 a-b*). 1844. Char. emend. Grun. Verh. Zool. Bot. Ges. Wien **12:** 546. 1862. Pritch. Hist. Infus. ed. 4. 773. *pl. 13. f. 4.* 1861. Van Heur. Synop. 159. *pl. 49. f. 1–38.* 1881. Rabh. Fl. Eur. Alg. **1:** 12, 114. *f. 30.* 1864. De Toni, Syll. Alg. **2:** 557. 1892. W. Smith, Synop. Brit. Diat. **2:** 19. *pl. 34. f. 292 295.* 1856. Griff. & Henf. Micr. Dict. ed. 3. 230. *pl. 12. f. 25.* 1875. Brun, Diat. Alp. 112. *pl. 3. f. 34, 36 37.* 1880 (not Trans. Roy. Soc. Edinb. **21:** 495. *pl. 10. f. 34–36, 38–39* (except *f. 37*). 1857; Verh. Zool. Bot. Ges. Wien **12:** 548. *pl. 12. f. 15.* 1862).

Eunotia Ehrenb. Mikrog. *pl. 34. V. B. f. 7-8.* 1854, in part.

Odontidium Kütz. in part; O'Meara. Proc. Roy. Irish Acad. II. **2:** 288. 1875.

The genus as originally defined by Kützing is very indefinitely bounded and contains members of several other genera. Grunow's emendation is also quite faulty, as he lost sight of the true transverse character of the strong costae and thereby opened the way for costae on only one side of the valve; in other words, short and broad forms of Nitzschia. The genus is well marked by Van Heurck,[a] and the illustrations, which include all the figures of plate 49, are consistent and decisive. Its nearest relative is Diatoma (DC.) Heib., from which it is easily distinguished by the absence of an evident hyaline median line on the valves ("pseudoraphe"), by its rounded, uncon-

[a] Van Heur. Synop. 159. 1885.

stricted apices, and, in the zonal view, by the costae terminating near the girdle in enlarged or beaded ends. Its type species, *D. tenuis* Kütz., well represents the characteristics of the genus.

Denticula nicobarica Grun. in Fenzl, Reise Novara Bot. **1:** 97. *pl. 14. f. 5.* 1870. Van Heur. Synop. *pl. 49. f. 3.* 1881.

This minute diatom is most plentiful in the following single sounding.
Found at station 3635H, Bering Sea.

GRAMMATOPHORA Ehrenb.

Grammatophora Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1839:** 112, 152. 1841. Pritch. Hist. Infus. ed. 4. 807. *pl. 11. f. 48–49, 52–53.* 1861. Rabh. Fl. Eur. Alg. **1:** 26, 303. *f. 81.* 1864. Grun. Verh. Zool. Bot. Ges. Wien **12:** 413. 1862. Van Heur. Synop. 163. *pl. 53 53bis.* 1881; Treat. Diat. 353. *f. 105.* 1896. De Toni, Syll. Alg. **2:** 750. 1892. W. Smith, Synop. Brit. Diat. **2:** 42. *pl. 42.* Kütz. Bacill. 128. *pl. 17. f. 23 25.* 1844.

Disiphonia Ehrenb. Mikrog. *pl. 35A. II. f. 7.* 1854; Phys. Abh. Akad. Wiss. Berl. **1869:** 48. *pl. 2. II. f. 18.* 1870. Griff. & Henf. Micr. Dict. ed. 4. 267. *pl. 51. f. 16.* 1883.

Diatomella Grev. Ann. Mag. Nat. Hist. II. **15:** 259. *pl. 9. f. 10-13.* 1855. Pritch. Hist. Infus. ed. 4. 810. *pl. 4. f. 51, 53.* Grun. Verh. Zool. Bot. Ges. Wien **12:** 409. 1862. Brun. Diat. Alp. 129. *pl. 9. f. 18.* 1880. H. D. Smith. Sp. Diat. Typ. no. 650. 1874. Grun. in Fenzl, Reise Novara Bot. **1:** 5. 1870. Rabh. Fl. Eur. Alg. **1:** 3, 25. *f. 78.* 1864. Van Heur. Treat. Diat. 353. 1896. Lagers. Bih. Sv. Vet. Akad. Handl. **1**[14]: 20. 1873. De Toni. Syll. Alg. **2:** 742. 1892.

Diatoma (DC.) Heib. in part; Lyng. Hydro. Dan. 180. *pl. 62A.* 1819.

Fragilaria Lyng. in part: Lyng. Hydro. Dan. 182. *pl. 62. E F.* 1819.

Striatella C. Ag. in part; Ralfs, Ann. Mag. Nat. Hist. 1843. **11:** 457. *pl. 9. f. 5.* 1843.

There is great need of a capable monograph of this genus. Van Heurck's Synopsis gives two plates illustrating thirty species. Smith's British Diatoms illustrates superbly four species. Single species are scattered here and there through diatom literature. But the available figures are as a class poor and scanty. Owing to the delicate markings that characterize this genus, the earlier investigators, like Lyngbye, Agardh, and Ehrenberg, confused the species to an extreme extent. It is impossible to look upon Greville's genus Diatomella as anything more than a normally distinct species of Grammatophora. The main mark of distinction relied upon for separation, namely, the single straight septa as seen in zonal view, is neither confined to this species nor important enough, were it peculiar to it, to form a basis for a separate genus. Thus varieties of *G. undulata* Ehrenb., *G. arctica* Cleve, and *G. stricta* Ehrenb.[a] show the same quality. This characteristic, together with the extreme minuteness and delicacy of this form, mark it as a sharply distinct species, nothing more. Were, however, its generic status valid, it would necessarily take Ehrenberg's older name, Disiphonia, instead of that of Greville.

Grammatophora flexuosa Grun.; Van Heur. Synop. *pl. 53bis. f. 22–23.* 1881. Temp. & Brun, Mem. Soc. Phys. et Hist. Nat. Geneva **309:** 71. 1889. De Toni, Syll. Alg. **2:** 759. 1892.

Found at station 3013H, Hawaiian Islands.

Grammatophora lyrata Grun.; Van Heur. Synop. *pl. 53bis. f. 21.* De Toni, Syll. Alg. **2:** 759. 1892. Cleve & Moll. type no. 162.

My specimen agrees with the type, except that the lyrate valves are much less strongly undulated.

Found at station 2807, Galapagos Islands.

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[a] Cf. Castr. Rep. Voy. Chall. Bot. **2:** *pl. 20. f. 12.* 1886.

Grammatophora marina (Lyng.) Kütz. Bacill. 128. *pl. 17. f. 24* (not *pl. 18. f. I. 1–4*). 1844. Van Heur. Synop. 163. *pl. 53. f. 9 13.* 1881; Treat. Diat. 354. *pl. 11. f. 479 480a.* 1896. H. L. Smith. Sp. Diat. Typ. no. 188. 1874. Pritch. Hist. Infus. ed. 4. 808. *pl. 11. f. 52–53* (not *pl. 4. f. 47*). 1861. W. Smith, Synop. Brit. Diat. **2:** 42. *pl. 42. f. 314.* 1856. De Toni, Syll. Alg. **2:** 752. 1892. Rabh. Fl. Eur. Alg. **1:** 26. 303. *f. 81a–b.* 1864. Grun. Verh. Zool. Bot. Ges. Wien **12:** 415. 1862. Jan. Abh. Schl. Ges. Vaterl. Cult. **1862**[2]**:** 8. *pl. 2B. f. 5.* 1862. O'Meara. Proc. Roy. Irish Acad. II. **2:** 515. *pl. 29. f. 1.* 1875. Griff. & Henf. Micr. Dict. ed. 4. 363. *pl. 16. f. 35* (not *pl. 1. f. 14*). 1883.

Diatoma marinum Lyng. Hydro. Dan. 180. *pl. 62A.* 1819.

Grammatophora mexicana Ehrenb. Phys. Abh. Akad. Wiss. Wien **1841:** 443. *pl. 3. VII. f. 32.* 1843. Kütz. Bacill. 128. *pl. 18. I. f. 6. pl. 29. f. 78.* 1844.

Fragilaria latruscularia Lyng. Hydro. Dan. 182. *pl. 62E.* 1819.

Fragilaria fasciata Lyng. Hydro. Dan. 182. *pl. 62F.* 1819.

I do not include in the above synonymy several species classed here by De Toni and others. Thus *Bacillaria cleopatrae* Ehrenb.[a] can not be accurately identified as belonging to this or any similar species of Grammatophora. Its figures and descriptions make any assignment mere guesswork. I also exclude *G. oralauensis* Grun,[b] united with the above by De Toni: also *G. macilenta* W. Smith, united with the above by Grunow.[c] I look upon it, as does De Toni, as belonging under *G. oceanica* Ehrenb.[d]

Found at station 2848, Aleutian Islands.

Grammatophora maxima Grun. Verh. Zool. Bot. Ges. Wien **12:** 416. *pl. 8. f. 5.* 1882. Van Heur. Synop. *pl. 53bis. f. 12 13.* 1881. Cleve, in Nordensk. Vega Exped. **3:** 501, 508. 1883. De Toni, Syll. Alg. **2:** 754. 1892. Wolle, Diat. N. A. *pl. 49. f. 26.* 1890.

Grammatophora (*maxima* var.?) *ambigua* Grun.: Van Heur. Synop. *pl. 53bis. f. 14.* 1881.

This is possibly a variety of *G. stricta* Ehrenb. (=*G. parallela* Ehrenb.), as Grunow suggests. He refers to the valves as hyaline. By careful lighting they are seen to be covered with delicate lines in the three directions common to this species, that is, as in Gyrosigma.

Found at station 3688H, Okhotsk Sea.

Grammatophora stricta Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 298. 437, *pl. 1. I. f. 22, pl. 3. VII. f. 31.* 1843. Kütz. Bacill. 129. *pl. 29. f. 76.* Pritch. Hist. Infus. ed. 4. 808. 1861. Wolle, Diat. N. A. *pl. 49. f. 17* (not *f. 18*). 1890. H. L. Smith, Sp. Diat. Typ. no. 671. 1874. Truan & Witt, Diat. Hayti 16. *pl. 3. f. 7, 14.* 1888. Castr. Rep. Voy. Chall. Bot. **2:** 57. *pl. 29. f. 12.* 1886. Pant. Beitr. Bacill. Ung. **1:** 41. *pl. 26. f. 239, pl. 30. f. 307 309.* 1886.

Grammatophora tabellaria Ehrenb. Mikrog. *pl. 18. f. 89 90.* 1854. Pritch. Hist. Infus. ed. 4. 808. 1861.

Grammatophora parallela Ehrenb. Mikrog. *pl. 21. f. 26a–d, pl. 22. f. 63 a–b, pl. 33. XIV. f. 16, pl. 35A. XV. f. 3. pl. 39. II. f. 73.* 1854. Pritch. Hist. Infus. ed. 4. 808. 1861. Grun. Verh. Zool. Bot. Ges. Wien **12:** 417. 1862. Rabh. Fl. Eur. Alg. **1:** 305. 1864. De Toni, Syll. Alg. **2:** 754. 1892.

Grammatophora (*stricta* Ehrenb. var.?) *biharensis* Pant. Beitr. Bacill. Ung. **1:** 41. *pl. 30. f. 307-309.* 1886. De Toni, Syll. Alg. **2:** 755. 1892.

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[a] Ehrenb. Symb. Phys. Everteb. 5. *pl. 3, V. f. 2.* 1828; Infus. 199. *pl. 15. f. 3.* 1838.

[b] Van Heur. Synop. *pl. 53. f. 24 25.* 1881.

[c] Van Heur. Treat. Diat. 354. 1896.

[d] Cf. W. Smith, Synop. Brit. Diat. **2:** 43. *pl. 61. f. 382;* De Toni, Syll. Alg. **2:** 755. 1892.

Two references found in Ehrenberg's works should be excluded here.[a] In both of these cases Ehrenberg expresses doubt by an interrogation point. Grunow's selection of the specific name *parallela* over that of *stricta*, copied by De Toni, is inadmissible.

Found at station 2807, Galapagos Islands.

TESSELLA Ehrenb.

Tessella Ehrenb. Infus. 202. *pl. 20. f. 7.* 1838. In part (exclusive of Striatella forms, e. g. *Tesella arcuata* Ehrenb.). Ralfs, Ann. Mag. Nat. Hist. **12:** 104. *pl. 2. f. 1.* 1843 (not Ralfs in Pritch. Hist. Infus. ed. 4. 804. *pl. 8. f. 5;* not Kütz. nor O'Meara).

Striatella C. Ag. in part; Ralfs. Ann. Mag. Nat. Hist. **11:** 455. *pl. 9. f. 6.* 1843.

Rhabdonema Kütz. Bacill. 126. *pl. 21. II. f. 4, pl. 18. f. 6.* 1844. W. Smith, Synop. Brit. Diat. **2:** 32. *pl. 38.* 1853. Rabh. Fl. Eur. Alg. **1:** 305. 1864. Pritch. Hist. Infus. ed. 4. 804. 1861. Van Heur. Synop. 165. 1881; Treat. Diat. 360. *f. 111.* 1896. De Toni, Syll. Alg. **2:** 760. 1892. Grun. Verh. Zool. Bot. Ges. Wien **12:** 422. 1862.

This genus was constituted in 1838, though the name appears in literature in 1837.[b] As defined and figured by Ehrenberg it is truly synonymous with Kützing's Rhabdonema. Its type species, *T. catena*, is identical with *R. arcuatum* Kütz., and so recognized by Kützing; while Kützing's type species, *R. minutum*, is recognized by him to be *T. catena* Ralfs (not Ehrenb.) and its citation quoted. It is true that Ehrenberg probably included a species of Striatella C. Ag. in his genus Tessella, namely, *T. interrupta*;[c] but he recognizes Striatella C. Ag. as a distinct genus, gives it with diagnosis and figures, and thereby limits by exclusion his own genus Tessella. A reading of his discussion of Striatella[d] will make it evident that his Tessella can not be the same. All of the three species named by Kützing in his new genus Rhabdonema were previously named and figured as species of Tessella and are so recognized by him. He therefore should have emended the genus of Ehrenberg rather than have superseded it with Rhabdonema. He does, it is true, give Tessella as a separate genus, but it fails to correspond to the original and the single species he mentions is a Striatella. Under these circumstances Ehrenberg's name should be restored and simply emended by exclusion of frustules having interrupted septa.

Tessella adriatica (Kütz.) Mann.

Rhabdonema adriaticum Kütz. Bacill 126. *pl. 18. f. 7.* 1844; Sp. Alg. 115. 1849. Pritch. Hist. Infus. ed. 4. 805. *pl. 13. f. 27.* 1861. W. Smith, Synop. Brit. Diat. **2:** 35. *pl. 38. f. 305 b, a', b'.* 1856. Grun. Verh. Zool. Bot. Ges. Wien **12:** 424. 1862. Jan. & Rabh. in Rabh. Beitr. **1:** 11. *pl. 3. f. 20.* 1863. Rabh. Fl. Eur. Alg. **1:** 306. 1864. O'Meara, Proc. Roy. Irish Acad. II. **2:** 319. 1875. H. L. Smith, Sp. Diat. Typ. no. 432. 1874. Van Heur. Synop. 166. *pl. 54. f. 11–13.* 1881. Truan, Anal. Soc. Espan. Hist. Nat. **14:** 68. *pl. 3. f. 15.* 1885. De Toni, Syll. Alg. **2:** 764 1892. Wolle, Diat. N. A. *pl. 51. f. 2–4.* 1890. Schmidt, Atlas *pl. 217. f. 17-29.* 1895; *pl. 221. f. 14.* 1896.

Tessella sp.? Lobarz. Linnaea **14:** 270. *pl. 4. f. 2.* 1840, according to Kützing and De Toni.

Found at stations 2835, 3698H, 3712H, off Lower California and in Okhotsk Sea.

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[a] Phys. Abh. Akad. Wiss. Berl. **1847:** 448. *pl. 2. III. f. 22.* 1849; probably a species of Fragillaria; op. cit. **1870:** 72. *pl. 1. I. f. 41 a–d.* 1871; probably a Navicula.

[b] Phys. Abh. Akad. Wiss. Berl. **1835:** 173. 1837.

[c] Ehrenb. Infus. 202. 1838.

[d] Op. cit. 229–230.

Tessella catena Ehrenb. Infus. 202. *pl. 20. f. 7.* 1838, not Ralfs, Ann. Mag. Nat. Hist. **12:** 104. *pl. 2. f. 1.* 1843.

Diatoma arcuatum Lyng. Hydro. Dan. 180. *pl. 62.* 1819?

Striatella arcuata C. Ag. Consp. 16. 1832. Ralfs, Ann. Mag. Nat. Hist. **11:** 455. *pl. 9. f. 6.* 1843? not *S. arcuata* Ehrenb. Infus. 230. *pl. 20. f. 6.* 1838.

Rhabdonema arcuatum Kütz. Bacill. 126. *pl. 18. f. 6.* 1844. W. Smith, Synop. Brit. Diat. **2:** 34. *pl. 38. f. 305* (not *f. 305a'–b'.* 1853). Cleve, Bih. Sv. Vet. Akad. Handl. **1**[13]: 24. *pl. 4. f. 21.* 1873. Pritch. Hist. Infus. ed. 4. 804. *pl. 10. f. 203–204.* 1861. H. L. Smith, Sp. Diat. Typ. no. 433. 1874. Cleve & Möll. type no. 69. Schmidt, Atlas *pl. 220. f. 17–26.* Grun. Verh. Zool. Bot. Ges. Wien **12:** 423. 1862. Van Heur. Synop. *pl. 54. f. 14–16.* 1881; Treat. Diat. 360. *f. 111. pl. 12. f. 487a.* 1896. O'Meara, Proc. Roy. Irish Acad. II. **2:** 318, not *pl. 29. f. 5.* 1875. Rabh. Fl. Eur. Alg. **1:** 306. 1864. De Toni, Syll. Alg. **2:** 761. 1892.

Striatella crozierii Ehrenb. Mikrog. *pl. 35A. XXIII. f. 14–16.* 1854.

Rhabdonema crozierii Grun. Verh. Zool. Bot. Ges. Wien **12:** 423. 1862, not *R. crozierii* Ralfs in Pritch. Hist. Infus. ed. 4. 805. *pl. 4. f. 43.* 1861, nor H. L. Smith, Sp. Diat. Typ. no. 434. 1874, nor Schmidt, Atlas *pl. 220. f. 3–11.* 1899; *pl. 221. f. 1–1a.* 1900.

As will be seen by the above synonymy, there is great confusion among the names assigned to this diatom. As Cleve points out,[a] there is no important difference between *R. arcuatum* Kütz. and Grunow's *R. crozierii*, based on *S. crozierii* Ehrenb., the simple difference of outline being of no account. But the *R. crozierii* of Ralfs is an altogether different thing. It corresponds in its dilated center with the variety of *arcuatum* which Cleve calls variety *ventricosum;*[b] but in all other respects it is unlike it. Probably, as Cleve states, it is reproduced by Janisch[c] and called *R. arcuatum*. Whereas *R. arcuatum* Kütz. and *R. crozierii* (Ehrenb.) Grun. has moniliform striae or striae so nearly divided as to appear like a string of beads, the diatom shown by Ralfs, H. L. Smith, and Schmidt has transverse costae bearing fine punctate dots in a single median line, and whereas the zonal divisions of the former are strongly beaded, those of the latter are finely dotted with one or two rows of puncta. Habirshaw[d] masses all these forms together, with the result that he makes this species and *Tessella arcuata* Ehrenb. (=*Striatella*, probably *S. unipunctata*) synonymous, an evident absurdity.

I think *Diatoma arcuatum* Lyngb., and *Striatella arcuata* C. Ag., are not the same diatom; a question not relevant here, as neither can be safely identified with this species. My specimens are uniformly of the outline of Cleve's variety *ventricosum*, but with coarse beading on the valves and heavy markings of the zonal septa, as figured by Schmidt.[e]

Found at stations 3607, 3688H, 3712H, Bering and Okhotsk seas.

Tessella japonica (Temp. & Br.) Mann.

Rhabdonema japonicum Temp. & Br. Mem. Soc. Phys. et Hist. Nat. Geneva **30**[9]: 53. *pl. 1. f. 6.* 1889. De Toni, Syll. Alg. **2:** 762. 1892. Schmidt, Atlas *pl. 218. f. 7–31, pl. 219. f. 1–4, 6–12.* 1899; *pl. 221. f. 24.* 1900.

Rhabdonema mikado Pant. Beitr. Bacill. Ung. **3:** *pl. 33. f. 469–470.* 1893. Schmidt, Atlas *pl. 219. f. 2–4* (note). 1899.

I have examined a large number of specimens, compared with care all literature, together with figures, to get a clear-cut and satisfactory basis for distinguishing between

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[a] Bih. Sv. Vet. Akad. Handl. **1**[13]: 24. 1873.

[b] Op. cit. *pl. 4. f. 12.*

[c] Rabh. Beitr. **1:** 12. *pl. 3. f. 19.* 1863.

[d] Hab. Cat. 301. 1877.

[e] Schmidt, Atlas *pl. 220. f. 21–22a.* 1899.

this and *R. robustum* Grun., but have not succeeded. So far as the valval view is concerned, neither the median line, the arrangement and punctation of the striae, the outline, the size, the character of the border, or the shape of the apical hyaline areas give any constant marks of distinction. So far as I am aware, *robustum* never displays the striking double-lobed valves commonly met with in *japonicum;* but unfortunately this feature is not at all constant in the latter, and in fact the original type is not of that shape.[a] The only appreciable difference is to be found in the zonal view. The striae in *japonicum* are generally small and narrow, forming a closely set row for each compartment of the series, made up of coarse but obscure blotches, giving a semimoniliform appearance to the striae: or if the striae be broad and the blotches approach squares, they are also coarsely dotted. *Robustum* has generally large square markings, set loosely in the rows of each compartment, and marked with fine puncta. I am convinced that these two species are with difficulty to be kept separate; and that a study of the abundant figures in Schmidt[b] will prove this. I have named my specimens solely on the basis of the zonal markings, and many valves unquestionably belonging to a single species, but not affording a zonal view, could with equal accuracy be given Grunow's specific name.

The variety called by Pantocsek *R. mikado* occurs at station 3688H.

Found at stations 2844, 2848, 3604, 3688H, 3784, Bering and Okhotsk seas.

ENTOPYLA Ehrenb.

Entopyla Ehrenb. Ber. Akad. Wiss. Berl. **1848:** 6. 1849. Grun. Verh. Zool. Bot. Ges. Wien **12:** 428. 1862. Schmidt, Atlas *pl. 231.* 1902. De Toni, Syll. Alg. **2:** 773. 1892. Pritch. Hist. Infus. ed. 4. 810. 1861. Rabh. Fl. Eur. Alg. **1:** 308. 1864.

Eupleuria Arn. Quart. Journ. Micr. Sci. **6:** 89. 1858. Pritch. Hist. Infus. ed. 4. 809. 1861.

Margaritoxicon Jan. Abh. Schl. Ges. **1862**[2]**:** 6. 1862, as synonym.

Gephyria Arn. in part: Quart. Journ. Micr. Sci. **8:** 20. 1860. Pritch. Hist. Infus. ed. 4. 809. *pl. 4. f. 50.* 1861.

Achnanthes Bory, in part: Johnst. Quart. Journ. Micr. Sci. **8:** 15. *pl. 1. f. 14.* 1860.

Surirella Turp. in part: Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 388. *pl. 1. I. f. 96.* 1843.

The distinctive marks separating this genus from Gephyria Arn. are summarized by Schmidt,[c] as follows: (1) The costae on the valves of Entopyla alternate on either side the median line; in Gephyria they are transversely continuous. (2) The internal septa in Entopyla have their pores in a longitudinal straight row along either side and therefore show as straight rows of dots through the costae; in Gephyria these pores are in two zigzag longitudinal series. (3) These pores are in Entopyla close to the margin on either side; in Gephyria midway between the margin and the median line. Although the foregoing characteristics are well marked and seem to be constant, they constitute at best a scanty basis for generic distinction between forms otherwise so much alike.

Entopyla australis Ehrenb. Ber. Akad. Wiss. Berl. **1848:** 6. 1849. Pritch. Hist. Infus. ed. 4. 810. 1861. Jan. Abh. Schles. Ges. Vaterl. Cult. **1862**[2]: 6, 22, 32. *pl. 1B. f. 8, 14, 16–20.* 1862. De Toni, Syll. Alg. **2:** 773. 1892. Schmidt, Atlas *pl. 230. f. 1–16.* 1902.

Surirella australis Ehrenb. Phys. Abh. Akad. Wien **1841:** 388. *pl. 1. I. f. 9b.* 1843. Pritch. Hist. Infus. ed. 4. 798. 1861.

Eupleuria incurrata Arnott, Quart. Journ. Micr. Sci. **6:** 90. 1858.

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[a] Cf. Schmidt, Atlas *pl. 219. f. 13.* with *pl. 220. f. 1.* 1899.

[b] Op. cit. *pl. 217–221.*

[c] Op. cit. *pl. 231.* 1902.

Gephyria incurvata Arnott, Quart. Journ. Micr. Sci. **8:** 20. 1860. Pritch. Hist. Infus. ed. 4. 809. *pl. 4. f. 50.* 1861. H. L. Smith, Sp. Diat. Typ. no. 173. 1874. Grun. in Fenzl, Reise Novara Bot. **1:** 8. 1870.

Achnanthes costatus Johnst. Quart. Journ. Micr. Sci. **8:** 15. *pl. 1. f. 14.* 1860. Moeb. Diat.-taf. *pl. 27. f. 14.* 1890.

Entopyla incurvata Grun. Verh. Zool. Bot. Ges. Wien **12:** 428. 1862. De Toni, Syll. Alg. **2:** 773. 1892.

Entopyla cohnii Grun. Verh. Zool. Bot. Ges. Wien **12:** 429. 1862. Grun. in Fenzl, Reise Novara Bot. **1:** 8. 1870.

Margaritoxicon cohnii Jan. Abh. Schl. Ges. Vaterl. Cult. **1862**[2]: 6. 1862, as synonym.

Gephyria gigantea Grev. Trans. Micr. Soc. Lond. n. s. **14:** 122. *pl. 11. f. 7–8.* 1866. Moeb. Diat.-taf. *pl. 74. f. 7–8.* 1890. Castr. Rep. Voy. Chall. Bot. **2:** 42. *pl. 15. f. 10.* 1886. Wolle, Diat. N. A. *pl. 61. f. 1–2.* 1890. De Toni, Syll. Alg. **2:** 775. 1892.

Gephyria constricta Grev. Trans. Micr. Soc. Lond. n. s. **14:** 77. *pl. 8. f. 2.* 1866. Moeb. Diat.-taf. *pl. 72. f. 2.* De Toni, Syll. Alg. **2:** 775. 1892. Wolle, Diat. N. A. *pl. 61. f. 3.* 1890.

Entopyla hungarica Pant. Beitr. Bacill. Ung. **2:** 67. *pl. 4. f. 58.* 1889.

There is a possibility of questioning the last synonym, as the diagnosis is not thorough and the figure is plainly very carelessly drawn. I do not think the doubt is strong enough to warrant this form receiving separate rank.

Found at stations 3607, 4029H, Bering Sea.

GEPHYRIA Arnott.

Gephyria Arnott, Quart. Journ. Micr. Sci. **8:** 20. 1860. Char. emend. Schmidt, Atlas *pl. 231.* 1902. Rabh. Fl. Eur. Alg. **1:** p. 308. 1864. Grun. Verh. Zool. Bot. Ges. Wien **12:** 429. 1862. De Toni, Syll. Alg. **2:** 775. 1892. Pritch. Hist. Infus. ed. 4. 809. 1861. H. L. Smith. Sp. Diat. Typ. no. 662. 1874. Griff. & Henf. Micr. Dict. ed. 3. 340. 1875. Van Heur. Treat. Diat. 340. *f. 98.* 1896. Truan & Witt, Diat. Hayti 16. *pl. 4. f. 14–17.* 1880.

Eupleuria Arn. in part; Möll. type no. 21.

Achnanthes Bory in part; Johnst. Quart. Journ. Micr. Sci. **8:** 14. *pl. 1. f. 13a, b, f.* 1860.

Entopyla Ehrenb. in part; Grev. Trans. Micr. Soc. Lond. n. s. **14:** 122. *pl. 11. f. 7–8.* 1866.

For the marks of distinction between this and the close genus, Entopyla Ehrenb., see under the latter.

Gephyria media Arnott, Quart. Journ. Micr. Sci. **8:** 20. 1860. Pritch. Hist. Infus. ed. 4. 809. *pl. 4. f. 49.* 1861. Grun. Verh. Zool. Bot. Ges. Wien **12:** 429. 1862. Truan & Witt, Diat. Hayti 16. *pl. 4. f. 14–17.* 1880. Le Diatomiste **2:** *pl. 19. f. 8.* 1894. H. L. Smith, Sp. Diat. Typ. no. 662. 1874. De Toni, Syll. Alg. **2:** 775. 1892. Van Heur. Treat. Diat. 340. *f.* 98. 1896. Wolle, Diat. N. A. *pl. 61. f. 4 5.* 1890. Schmidt, Atlas *pl.* 231. *f. 18–21, pl. 233. f. 1–22.*

Eupeuria media Möll. type no. 21.

Achnantes angustata Johnst. Quart. Journ. Micr. Sci. **8:** 14. *pl. 1. f. 13a, b. f.* 1860.

Though Johnston's specific name precedes that of Arnott, it had been preempted by Greville for an entirely different diatom.[a] The genus Gephyria, not having been constituted, Johnston rightly placed his species in Achnanthes; for it should be noted the two genera are, together with Entopyla, quite similar in structure and in mode of growth. The specimen found by me is the short and robust variety called *forma miocena.*[b]

Found at stations 2920H, 3698, Hawaiian Islands and off Honshu Island, Japan.

[a] Quart. Journ. Micr. Sci. **7:** 163. *pl. 8. f. 9.* 1859.

[b] Le Diatomiste, **2:** *pl. 19, f. 8.* 1894.

CLIMACOSPHENIA Ehrenb.

Climacosphenia Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 314, 440. *pl. 2. VI. f. 1.* 1843. Grun. Verh. Zool. Bot. Ges. Wien **12:** 353. 1862; in Fenzl, Reise Novara Bot. **1:** 5. 1870. De Toni, Syll. Alg. **2:** 739. 1892.

Echinella Achar. err. det. Ehrenb. Ber. Akad. Wiss. Berl. **1841:** 144. 1842.

Clavicula Pant. in part; Beitr. Bacill. Ung. **3:** *pl. 3. f. 50.* 1893.

Climacosphenia elongata Bail. Smithson. Contr. Knowl. **7:** 8. *pl. 1. f. 10–11.* 1854. Grun. Verh. Zool. Bot. Ges. Wien **12:** 353. *pl. 6. f. 22.* 1862. Grun. in Fenzl, Reise Novara Bot. **1:** 5. 1870. Leud.-Fort. Mem. Soc. Emul. St. Brieuc 54. 1879. Pritch. Hist. Infus. ed. 4. 772. 1861. De Toni, Syll. Alg. **2:** 739. 1892.

Climacosphenia frauenfeldii Grun. Verh. Zool. Bot. Ges. Wien **12:** 353. 1862, as synonym.

Clavicula kinkeri Pant. Beitr. Bacill. Ung. **3:** *pl. 3. f. 50.* 1893.

Pantocsek figures the lower portion only of the outer plate of this diatom and names it *Clavicula kinkeri*. There can be no doubt of its being the above. It so happens that the form found by me has precisely the irregularity of beading of the central band near the lower extremity that Pantocsek has figured. Whether this is general or not, I do not know. I have, like Grunow, found it to be a very rare diatom. Leud.-Fort. in the citation above erroneously attributes the name to Grunow.

Found at station 3696, off Honshu Island, Japan.

Climacosphenia moniligera Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 314. *pl. 2. VI f. 1.* 1843. Kütz. Bacill. 123. *pl. 29. f. 80.* 1844. Jan. & Rabh. in Rabh. Beitr. 6. *pl. 2. f. 1.* 1863. Pritch. Hist. Infus. ed. 4. 772. *pl. 11. f. 45–46.* 1861. Grun. Verh. Zool. Bot. Ges. Wien **13:** 139. *pl. 14. f. 17.* 1863. Griff. & Henf. Micr. Dict. ed. 3. *pl. 19. f. 9.* 1875. Wolle, Diat. N. A. *pl. 29. f. 7–8.* 1890. Pant. Beitr. Bacill. Ung. **2:** 67. *pl. 30. f.* 426. 1889. H. L. Smith, Sp. Diat. Typ. no. 631. 1874. De Toni, Syll. Alg. **2:** 740. 1892.

Echinella moniligera Ehrenb. Ber. Akad. Wiss. Berl. **1841:** 144. 1842, nom. nud. not Achar. 1810.

Climacosphenia catena Shadb. Trans. Micr. Soc. Lond. n. s. **2:** *17. pl. 1. f. 15.* 1854. Moeb. Diat.-taf. *pl.* 3. *f. 15.* 1890.

The generic name Echinella of Acharius [a] was applied by Ehrenberg under a misapprehension, the name being that of a clustered form of marine ovae similar in appearance to clusters of Climacosphenia.[b] Ehrenberg corrected the generic name in the first citation given above.

Found at station 2920II, Hawaiian Islands.

PLAGIOGRAMMA Grev.

Plagiogramma Grev. Quart. Journ. Micr. Sci. **7:** 208. *pl. 10.* 1859. Moeb. Diat.-taf. *pl. 24.* 1890. Rabh. Fl. Eur. Alg. **1:** 117. 1864. Pritch. Hist. Infus. ed. 4. 773. 1861. Van Heur. Synop. 145. 1881; Treat. Diat. 337. *f. 95.* 1896. De Toni, Syll. Alg. **2:** 717. 1892.

Denticula Kütz. in part; Greg. Trans. Roy. Soc. Edinb. **21:** 494, 496. *pl. 10. f. 32, 37a c.* 1857.

This genus has close affinity with Dimeregramma Ralfs, and the doubtful genus Glyphodesmis Grev. It is, however, well marked from these by the internal transverse septa, especially those that divide off the central and the terminal hyaline areas from the rest of the valve. I am not in favor of including here any of the mem-

[a] Weber, Beitr. z. Naturk. **2:** 340. *pl. 4.* 1810.

[b] Griff. & Henf. Micr. Dict. ed. 3. 273. 1875.

bers of Ehrenberg's genus Heteromphala. Its type, *H. himantidium*,[a] is probably a Glyphodesmis, certainly not a Plagiogramma. De Toni,[b] quotes it in its original genus. Ralfs[c] changes it to *Plagiogramma himantidium*. As he there says, the side view is unknown. How he could decide on its being a Plagiogramma from Ehrenberg's description and without any knowledge of its side view is beyond my comprehension. There are two references in Ehrenberg which De Toni thinks it worth while to quote as members of this genus, one[d] called with some doubt "*Heteromphala? trinodis*," a probable Navicula, and the other *H. binodis*,[e] which is either a Navicula or a Glyphodesmis. Figure 22 of the same plate, called by Ehrenberg simply "Anaulus—?," is, despite the central and terminal nodules, almost certainly a representative of this genus, probably *P. elongatum* Grev., a fact which also indicates that what he calls Heteromphala is not identical with the present genus.

Plagiogramma elongatum Grev. Trans. Micr. Soc. Lond. n. s. **14:** 121. *pl. 11. f. 1–2.* 1866. Moeb. Diat.-taf. *pl. 74. f. 1 2.* 1890. De Toni, Syll. Alg. **2:** 720. 1892.

Anaulus sp.? Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1872:** 387. *pl. 2. f. 22.* 1873.

This species is like *P. crassum* Cleve & Grove,[f] except for the massive transverse septa of the latter.

Found at station 2807, Galapagos Islands.

Plagiogramma sceptrum Mann, sp. nov. PLATE LII, FIGURES 1, 2.

Valve elongated; sides nearly parallel to the broad rounded apices; markings of small but strong beading, set in transverse rows, interrupted by a median hyaline line, two beads wide, running nearly the entire length of the valve, that is, from one apical area to the other; four to five beads in each half row on either side of the median line; apical areas, in this genus usually hyaline or faintly mottled, here beaded with slightly smaller beads, spread out fan-wise toward the sides and apices of the valve and traversed by a thin irregular median line continuous with the median line of the rest of the valve; border not plain, but ornamented with a single row of beads larger than the rest. Instead of transverse "vittae" there are strong internal transverse septa, not continuous across the valve, but usually stopping at the position of the hyaline median line before mentioned and generally not opposite each other on the two sides of the valve; central area quite small, not reaching the border, transversely oval and bearing a decided boss in the middle; zonal view showing the internal septa enlarged at the inner ends like the music-notes of *Terpsinoe musica* Ehrenb.; the septa as seen both in zonal and valval view, placed at very irregular distances, there being from two to seven rows of beads between them; girdle with two faint longitudinal ridges dividing it into thirds, but no beading.

Length of valve, 0.200 to 0.212mm.; width of valve, 0.027 to 0.029mm.

The only species at all like this one is *P. rectum* Cleve & Grove. The resemblance is merely superficial.

Type in the U. S. National Museum, No. 590141, from station 2807, Galapagos Islands, April 4, 1888; 812 fathoms, bottom of Globigerina ooze and coral mud.

Plagiogramma tesselatum Grev. Quart. Journ. Micr. Sci. **7:** 208. *pl. 10. f. 7.* 1859. Moeb. Diat.-taf. *pl. 24. f. 7.* 1890. Pritch. Hist. Infus. ed. 4. 774. 1861. Lewis, Proc. Acad. Phila. **1861:** 68. 1862. De Toni, Syll. Alg. **2:** 719. 1892. Grun. Verh. Zool. Bot. Ges. Wien **12:** 359. 1862.

The absence of internal transverse septa in this species led Greville to have some doubt of its right here. Grunow thought it might be made a new genus. Except for

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[a] Ber. Akad. Wiss. Berl. **1858:** 13. 1859.
[b] De Toni, Syll. Alg. **2:** 730. 1892.
[c] Pritch. Hist. Infus. ed. 4. 775. 1861.
[d] Ber. Akad. Wiss. Berl. **1861:** 295. 1862,
[e] Phys. Abh. Akad. Wiss. Berl. **1872:** *pl. 2. 6. 23. 1873.*
[f] Le Diatomiste **1:** 54. *pl. 8. f. 4 5.* 1891.

this lack it is a perfectly typical Plagiogramma, and this negative quality is insufficient for separating it. Specimens found in the following dredging have a circular central area and nearly round instead of rectangular or "tesselated" beading.

Found at station 2808, Galapagos Islands.

DIMEREGRAMMA Ralfs.

Dimeregramma Ralfs in Pritch. Hist. Infus. ed. 4. 790. *pl. 5. f. 33–35.* 1861. Rabh. Fl. Eur. Alg. **1:** 13. 123. *f. 36.* 1864. Van Heur. Synop. 146. *pl. 36. f. 7–13.* 1881–1885. De Toni. Syll. Alg. **2:** 711. 1892. Walk. & Chase. Notes on Diat. **1:** 1. *pl. 1. f. 3.* 1886. Grun. Verh. Zool. Bot. Ges. Wien **12:** 377. 1862. Pritch. Hist. Infus. ed. 4. 790. *pl. 4. f. 34.* 1861.

Denticula Kütz. in part; Greg. Trans. Roy. Soc. Edinb. **21:** 495. *pl. 10. f. 39.* 1857.

The nearest genus to this is Glyphodesmis Grev., from which it differs by the absence of a large central boss. This single characteristic is, however, striking and uniform. Castracane[a] is wrong in stating that the only distinction between this genus and Denticula Kütz. is that the former has smooth sides to the valves. Dimeregramma may have the same; but it has a pronounced hyaline median line, "pseudoraphe," dilated at the center, is without transverse costae, and has large boss-like elevations at the apices (seen clearly in the zonal view), all which distinctions are inapplicable to Denticula.

Dimeregramma inflatum Mann, sp. nov. PLATE XLIV, FIGURE 6.

Valve seven to eight times as long as broad, inflated at the center, with bluntly tapering ends; at the apex of each a large beak-like process; valves marked with transverse rows of beading, extending from the margin for one-third the width of the valve, leaving a median hyaline area, also one-third the width of the valve; each row consisting of four beads, the outer largest and decreasing in size toward the center.

Length of valve 0.086 mm; width of valve 0.015 mm.

Type in the U. S. National Museum, No. 59042, from station 2823, Gulf of California, April 30, 1888; 26.5 fathoms, bottom of broken shells.

The nearest form to this is *D. marinum* (Greg.) Ralfs,[b] but I have found it impossible to refer it to that species. Gregory's form has striae with two beads somewhat separated, their line being continued outward to the margin by bars or costae; whereas the moniliform lines in my species begin with very large marginal beads and end inward with beads of extreme minuteness. Indeed the whole build of the diatom is distinct.

ACHNANTHES Bory.

Achnanthes Bory, Dic. Hist. Nat. **1:** 79. *pl. 51. f. 2.* 1822.

Monogramma Ehrenb. Ber. Akad. Wiss. Berl. **1843:** 136. 1844, no species, 1854, not Comm. 1809.

Achnanthidium Kütz. Bacill. 75. 1844.

Achnanthes dispar Mann, sp. nov. PLATE XLIV, FIGURES 4, 5.

Under valve beaded with minute moniliform striae, transverse until near the ends, then becoming concentric to the points of the apices; the raphe made up of a closely set but moniliform line of exceedingly small beads, at least toward its central and terminal portions, and forking near each end into two branches, one proceeding to the rounded apex and terminating in a small bead, the other and shorter branch running to one side and also terminating in a small bead; a narrow hyaline area on either side of the raphe; the transverse, median, hyaline stauros broad and increasing at the

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[a] Castr. Rep. Voy. Chall. Bot. **2:** 46. 1886.

[b] Trans. Roy. Soc. Edinb. **21:** 496. *pl. 10. f. 39.* 1857. Pritch. Hist. Infus. ed. 4. 90 1861. Van Heur. Synop. *pl. 36. f. 9.* 1881. De Toni, Syll. Alg. **2:** 712. 1892.

margins; upper valve with a broad, central, longitudinal, hyaline area, slightly wider near the center of the valve; striae of coarse and distant beads, two to four on each side of the median line, transverse until near the ends, then becoming concentric to the points of the apices.

Length of valve, 0.08 mm.: width of valve, 0.018 mm. Rows of beading on under valve, 88 in 0.1 mm.: on upper valve, 56 in 0.1 mm.

Type in the U. S. National Museum, No. 590143, from station 3635H, Bering Sea, August 21, 1895; 141 fathoms, bottom of gray sand.

The nearest approach to the above is *Achnanthidium* (=*Achnanthes*) *arctium*, Cleve,[a] but the differences are greater than the resemblance. The beading on the under (ventral) side of Cleve's species is 68 in 0.1 mm. with a valval length of 0.048 mm., whereas in mine it is 88 in 0.1 mm. with a valval length of 0.08 mm.: in other words, it is very much finer on a valve about twice as large, as the proportion between size of valve and striation in Cleve's species would be in my specimen 41 instead of 88 in 0.1 mm. But what shows that this is not a very finely marked though large specimen of the above is that the valves do not taper, but have blunt, rounded ends; the markings are strictly transverse except toward the apices; the stauros is quite broad; the raphe is beaded and bifurcates near the ends; there is a broad, hyaline line on either side of the raphe; a distinctly marked rim of uniform breadth runs around the entire valve.

COCCONEIS Ehrenb.

Cocconeis Ehrenb. Infus. 193. *pl. 14. f. 8-9, pl. 21. f. 11.* 1838.

Campylonеis Grun. Verh. Zool. Bot. Ges. Wien **12**: 429. 1862. Fenzl. Reise Novara Bot. **1**: 10. 1870.

Orthoneis Grun. in part, in Fenzl. Reise Novara Bot. **1**: 9 10. 1870.

Anorthoneis Grun. in Fenzl. Reise Novara Bot. **1**: 9 10. 1870.

Grunow breaks up Ehrenberg's genus by emending its scope and creating the above three new genera. I do not find any advantage in this arrangement. Ehrenberg's generic concept is a well-marked and precise one; its members are in clear contrast with other diatoms by their solitary growth attached by the inferior, raphe-bearing valve, by the concavo-convex shape of the frustules, by the general, perhaps universal, dissimilarity of the inferior and superior valves, and by their uniform oval or suboval contour. However useful Grunow's distinctions may be for subgeneric division, it seems to me best to leave these forms in the compact and satisfactory genus that Ehrenberg constructed for them. This view seems to prevail with most authors.

Cocconeisa antiqua Temp. & Brun. Mem. Soc. Phys. et Hist. Nat. Geneva **30**[3]: 32. *pl. 8. f. 5.* 1889. Schmidt, Atlas *pl. 191. f. 50, 52.* 1877.

Cocconeis trachytica Pant. Beitr. Bacill. Ung. **3**: *pl. 12. f. 382.* 1893.

The form from station 3604H is identical with Schmidt's figures above. It is, however, wide of the type, and I assign this name to it with some doubt. More typical specimens occur at station 4029H, together with a variety which lacks the curved hyaline bands midway between the raphe and the sides.

Found at stations 3604H, 4029H. Bering Sea.

Cocconeis baldjikiana Grun.; Van Heur. type no. 546. Schmidt, Atlas *pl. 190. f. 7 10.* 1894.

Cocconeis scutellum Ehrenb.; Grun. Bot. Centralblatt **33**: 324. 1888. Cleve in Schmidt, Atlas *pl. 190. f. 7 10.* 1877.

I agree with Schmidt in the above citation that Grunow's union of this beautiful and vigorous form with *C. scutellum* Ehrenb. is inadvisable. Even Smith's too strongly marked figure[b] of the latter lacks the beautiful broadening of the markings

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[a] Bih. Sv. Vet. Akad. Handl. **1**[13]: 25. *pl. 1. f. 22.* 1873.

[b] W. Smith, Synop. Brit. Diat. **2**: *pl. 3. f. 34.* 1856.

of this species, as well as their breaking up into fine puncta near their union with the margin.

Found at station 2848, south of Alaska Peninsula.

Cocconeis costata Greg. Quart. Journ. Mier. Sci. **3**: 39. *pl. 4. f. 10.* 1855. Trans. Mier. Soc. Lond. n. s. **5**: 68. *pl. 1. f. 27.* 1857. Moeb. Diat.-taf. *pl. 5. f. 10, pl. 12. f. 27.* 1890. Rabh. Fl. Eur. Alg. **1**: 104. 1864. Jan. Abh. Schles. Ges. Vaterl. Cult. **1862**[2]: 18. *pl. 1.1. f. 36.* 1862. Cleve in Nordensk. Vega Exped. **3**: 469. 1883. Van Heur. Synop. *pl. 30. f. 11 17.* 1881. Pritch. Hist. Infus. ed. 4. 871. 1861. Cleve, Sv. Vet. Akad. Handl. **27**[3]: 182. 1895.

Surirella quarnerensis Grun. Verh. Zool. Bot. Ges. Wien **12**: 456. *pl. 9. f. 10.* 1862.

Raphoneis scutelloides Grun. Verh. Zool. Bot. Ges. Wien **12**: 383. *pl. 4. f. 34.* 1862.

Raphoneis archeri O'Meara, Quart. Journ. Mier. Sci. n. s. **7**: 247. *pl. 7. f. 12.* 1867. Moeb. Diat.-taf. *pl. 77. f. 12.* 1890.

Cocconeis imperatrix Schmidt, Atlas *pl. 189. f. 10–15.* 1894.

Cocconeis janischii Schmidt, Atlas *pl. 189. f. 33.* 1894.

Cocconeis extravagans Jan.; Schmidt, Atlas *pl. 189. f. 28–32.* 1894.

Campylonеis costata Lagers. Bih. Sv. Vet. Akad. Handl. **2**[5]: 55. 1876. De Toni, Syll. Alg. **2**: 411. 1891.

Campylonеis grevillei Grun. in Fenzl. Reise Novara Bot. **1**: 11. 1870, not *Cocconeis grevillei* W. Smith.

There is not enough similarity between this species and *C. regina* Johns.[a] or between this and the gigantic *C. kerguelensis* Pet.,[b] to warrant uniting them, as is done by Cleve.[c] The species is, however, a very variable one both in size and markings.

Found at station 3604, Bering Sea.

Cocconeis decipiens Cleve, Bih. Sv. Vet. Akad. Handl. **1**[13]: 14. *pl. 1. f. 6.* 1873; Nordensk. Vega Exped. **3**: 469. 1883. Cleve & Grun. Sv. Vet. Akad. Handl. **17**[4]: 16. 1880. De Toni, Syll. Alg. **2**: 450. 1891.

Cocconeis arctica Cleve, Bih. Sv. Vet. Akad. Handl. **1**[13]: 14. *pl. 2. f. 11a* not *f. 11b.* 1873. Cleve & Grun. Sv. Vet. Akad. Handl. **17**[4]: 16. 1880.

Cocconeis sigmoidians Temp. & Brun, Mem. Soc. Phys. et Hist. Nat. Geneva **30**[3]: 33. *pl. 8. f. 4.* 1889.

Cocconeis sigma Pant. Beitr. Bacill. Ung. 1: 32. *pl. 8. f. 68.* 1886. Schmidt, Atlas *pl. 196. f. 11.* 1894. Temp. & Brun. Mem. Soc. Phys. et Hist. Nat. Geneva **30**[3]: 70. 1889.

Cocconeis oculus-catis Brun, Mem. Soc. Phys. et Hist. Nat. Geneva **31**[1]: 17. *pl. 18. f. 5.* 1891.

Cocconeis sparsipunctata Brun, Mem. Soc. Phys. et Hist. Nat. Geneva 31[1]: 18. *pl. 18. f. 8.* Schmidt, Atlas *pl. 196. f. 12 15.* 1894.

Cocconeis dirupta Greg. var.; Van Heur. Synop. *pl. 29. f. 18–19.* 1881. Cleve; Schmidt, Atlas *pl. 196. f. 16.* 1894.

Cocconeis fulgur Brun. Mem. Soc. Phys. et Hist. Nat. Geneva **31**[1]: 17. *pl. 18. f. 3.* 1891.

A discussion of the separation of this species from *C. dirupta* Greg., with which it is united by Cleve, may be found under the latter species. It may be here stated that the union of the above sigmoid forms agrees with De Toni[d] in so far as that he does not admit them under *C. dirupta*, but either gives them separate rank or unites one or two, as *C. decipiens* Cleve and *C. arctica* Cleve.

Most of the above are found in the following dredgings; that corresponding to

[a] Quart. Journ. Mier. Sci. **8**: 13. *pl. 1. f. 12.* 1860.
[b] Miss. Sci. Cap. Horn 116. *pl. 10. f. 5.* 1889.
[c] Bih. Sv. Vet. Akad. Handl. **27**[3]: 182. 1895.
[d] Syll. Alg. **2**: 450. 1891.

C. arctica at station 3607, itself an arctic dredging, is another illustration of the value of the diatoms for fixing the source of the material composing sea bottoms.

Found at stations 3607, 4516II, Bering Sea and off Lower California.

Cocconeis dirupta Greg. Trans. Roy. Soc. Edinb. **21**: 491. *pl. 1. f. 25*. 1857. Jan. Abh. Schles. Ges. Vaterls. Cult. **1862**[2]: 3. *pl. 2B. f. 14*. 1862. Grun. in Fenzl, Reise Novara Bot. **1**: 14. 1870. Cleve in Nordensk. Vega Exped. **3**: 460. 1883. H. L. Smith, Sp. Diat. Typ. no. 633. 1874. Van Heur. Synop. *pl. 29. f. 13 15*. 1881. Schmidt, Atlas *pl. 196. f. 7. 17, 18*. 1894. De Toni, Syll. Alg. **2**: 453. 1891.

Cocconeis diaphana W. Smith, Synop. Brit. Diat. **1**: 22. *pl. 30. f. 254B*. 1853.

Cocconeis beltmeyeri Jan.; Schmidt, Atlas *pl. 196. f. 22–23*. 1894.

Cocconeis delicata Schmidt, Atlas *pl. 196. f. 24*. 1894.

Cleve[a] unites under the above name, in addition to those here given, all cases of his own *C. decipiens*[b] which are similar to the above in the broadly oval character of the valves, in the fineness and curvature of the beading, in the presence of a transverse stauros at the middle of the lower valve, and in a general tendency toward a sigmoid outline in the median line of one or both valves. There is much in favor of this, for *C. dirupta* does show these characters, even the sigmoid curvature in some instances. But such unification is here attended with confusion. The forms thus grouped are too diverse, e. g., *C. beltmeyeri* Jan., a very evident variety of *C. dirupta* and *C. sparsipunctata* Temp. & Brun., a very evident variety of *C. decipiens*. To call these two one species is carrying condensation too far for practical use. I have accordingly united only the three above names with *C. dirupta* and have grouped all the other forms under *C. decipiens*. This arrangement, though no less artificial than that of Cleve, is no more so, and it affords an easy means of grouping these confusing forms. The salient characteristic of *C. dirupta* is, as its name indicates, a hyaline median area on one or both valves, broad at the center and tapering to a point at each end, slightly or not at all sigmoid. This line in *C. decipiens* is slightly or extremely sigmoid, the ends of the raphe curved like an "S" in opposite directions, the median area generally narrow or sometimes wanting, and the transverse stauros plain. It may be added that the members of the *C. dirupta* group are generally much smaller than those belonging to *C. decipiens*.

Found at stations 2690II, 4516II, off central and Lower California.

Cocconeis distans Greg. Quart. Journ. Micr. Sci. **3**: 39. *pl. 4. f. 9*. 1855; **5**: 67. *pl. 1. f. 25*. 1857. Moeb. Diat.-taf. *pl. 5. f. 9, pl. 12. f. 25*. 1890. Schmidt, Atlas *pl. 193. f. 29–37, 40*. 1894; Jahresb. Komm. Deut. Meere **2**: *pl. 3. f. 22–23*. 1874. Pritch. Hist. Infus. ed. 4. 870. *pl. 7. f. 38*. H. L. Smith, Sp. Diat. Typ. no. 70. 1874.

Grunow[c] makes this a variety of *C. scutellum* Ehrenb., for which there is some warrant. As there is, however, quite a difference between what I conceive to be Gregory's type and that of Ehrenberg, I have retained the above name. The two figures of Gregory's in the above citations are not at all alike. The first was evidently incorrectly drawn by Tuffen West, so far as the beading is concerned. It is represented in very regular rows evenly graded from the large marginal beads to the smaller medium ones. But Gregory says,[d] "This beautiful form is at once characterized by the equal size of the dots or granules and their great distance from each other, so that it almost loses the aspect of striation." The faulty representation of this is corrected, in fact over-corrected, in Gregory's second figure. When the type idea of Gregory's species is thus made out and is compared with Ehrenberg's original figure and description,[e] it seems to me the two are sufficiently wide apart to admit of the retention of both names.

Found at station 4505II, Santa Cruz light-house, Monterey Bay, Cal.

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[a] Sv. Vet. Akad. Handl. **27**[3]: 175. 1895.

[b] Bih. Sv. Vet. Akad. Handl. **1**[13]: 14. *pl. 1. f. 6*. 1873.

[c] Fenzl, Reise Novara Bot. **1**: 9. 1870.

[d] Op. cit. 39.

[e] Ehrenb. Infus. 194. *pl. 14. f. 8*. 1838.

Cocconeis grevillei W. Smith, Synop. Brit. Diat. **1**: 22. *pl. 3. f. 35.* 1853. Rabh. Fl. Eur. Alg. **1**: 102. 1864. Jan. Abh. Schl. Ges. Vaterl. Cult. **1862**[2]: 18. *pl. 2. f.* 10. 1862. H. L. Smith, Sp. Diat. Typ. no. 72. 1874. Pritch. Hist. Infus. ed. 4. 870. 1861.

Campyloneis grevillei Grun. err. det. in Fenzl, Reise Novara Bot. **1**: 10, 98. 1870. Journ. Roy. Micr. Soc. **1**: 245. *pl. 11. f. 5.* 1878. Petit, Fonds de la Mer **3**: 171. *pl. 4. f. 5.* 1877. Van Heur. Synop. 134. *pl. 28. f. 8–12.* 1881. De Toni, Syll. Alg. **2**: 439. 1891. Grun. Verh. Zool. Bot. Ges. Wien **12**: 430. 1862.

Campyloneis argus Grun. Verh. Zool. Bot. Ges. Wien **12**: 429. *pl. 10. f. 9.* 1862. Fenzl, Reise Novara Bot. **1**: 10. 1870. Van Heur. Synop. 134. *pl. 28. f. 15–16.* 1881. De Toni, Syll. Alg. **2**: 441. 1891. Truan. Anal. Soc. Espan. Hist. Nat. **13**: 363. *pl. 10. f. 22–23.* 1881.

De Toni[a] gives separate rank to *C. grevillei* W. Smith, *C. regalis* Grev. and *C. argus* Grun. under the generic head Campyloneis. Cleve, in above citation, unites the three under *Campyloneis grevillei* (W. Smith) Grun., thus following Grunow's analysis.[b] I do not think *C. grevillei* and *C. argus* can be held separate. Differences exist, but they are slight and variable, having chiefly to do with the thickenings on the internal articular plates. But the union of Greville's *C. regalis* with these is too radical. A comparison of the published figures does not show the strong contrast that is to be seen in specimens of these two species. The articular plates and the inferior valves are never closely alike; but the widest difference is to be seen in the superior plates, which in *C. grevillei* have beading actually or approximately alike in the middle and outer portions, while *C. regalis* has an oval central area marked with bars of fine puncta, while the outer area, separated from this central portion, is marked by very large beads. Two specimens afforded by H. L. Smith, types no. 72 and no. 635, show this contrast finely, the former of *C. grevillei* from Granville, France, and the latter of *C. regalis* from Cape of Good Hope. I therefore take the position of Van Heurck, De Toni, and others in classifying these species separately.

Found at stations 2807, 3698, Galapagos Islands and Honshu Island, Japan.

Cocconeis pellucida Grun. in Rabh. Beitr. **1**: 21. *pl. 6. f. 11.* 1862; in Fenzl, Reise Novara Bot. **1**: 12. 1870. not *C. pellucida* Grun. Verh. Zool. Bot. Ges. Wien **13**: 145. *pl. 13. f. 6.* 1863, which is *C. pseudomarginata* Greg. Schmidt, Atlas *pl. 191. f. 48, pl. 193. f. 5–8, pl. 194. f. 2, 15, pl. 195. f. 1–6.* 1894. Grun. in Fenzl, Reise Novara Bot. **1**: 98. *pl. 1. f. 7–8.* 1870. De Toni, Syll. Alg. **2**: 455. 1891. Cleve, Sv. Vet. Akad. Handl. **26**[2]: 178. 1894. Pant. Beitr. Bacill. Ung. **3**: *pl. 34. f. 465.* 1893.

Cocconeis curvi-rotunda Temp. & Brun. Mem. Soc. Phys. et Hist. Nat. Geneva **30**[9]: 32. *pl. 8. f. 6.* 1889. Schmidt, Atlas *pl. 195. f. 10–19.* 1894.

Cocconeis hungarcskii. Pant. Beitr. Bacill. Ung. **3**: *pl. 41. f. 564.* 1893.

Cocconeis notabilis Pant. Beitr. Bacill. Ung. **3**: *pl. 35. f. 494.* 1893.

Cocconeis circumcincta Schmidt. Atlas *pl. 195. f. 7–9.* 1894.

The doubt of Tempere and Brun of their *C. curvi-rotunda* being anything more than a variety of this species, indicated by their bracketing the latter name with their own, is, I think, well founded. Indeed, I have met with all possible varieties of these extremely close forms, and I am convinced they should be united. So also regarding *C. circumcincta* Schmidt. Its radially arranged markings and its generally straight raphe are not sufficient to separate it from the above. It occurs at stations 3346 and 3604. I exclude *C. heteroidea* Hantzsche and the variety of it regarded by Janisch as a species *C. flexella*,[d] though both Grunow and De Toni are impressed with their

[a] De Toni, Syll. Alg. **2**: 439–441. 1891.
[b] Fenzl, Reise Novara Bot. **1**: 10. 1870.
[c] Rabh. Beitr. **1**: 21. *pl. 6. f. 10.* 1862.
[d] Rabh. Beitr. **1**: 7. *pl. 1. pl. 11.* 1862.

close affinity. They belong, with *C. emmerici* Jan. and *C. aliena* Schmidt, to a very different group. Grunow explains[a] that he gave the name *pellucida*[b] to a specimen of *C. pseudomarginata* Greg., being misled by a poor figure of Ralfs.[c] He refers to the form cited by Hantzsch[d] as the true type.

Found at stations 2844, 2848, 3346, 3604, 3604H, Aleutian Islands and Bering Sea.

Cocconeis senegalensis Breb.; H. L. Smith, Sp. Diat. Typ. no. 79. 1874. De Toni, Syll. Alg. **2**: 464. 1891. Hab. Cat. 84. 1877.

Though both De Toni and Habirshaw recognize this as an authentic species, I suspect it is a synonym of some other form. I have been, however, unable to find such, and as my specimen agrees with Smith's type I am compelled to assign this name provisionally.

Found at stations 2680H, 2694H, 4516H, off central and Lower California.

Cocconeis splendida Greg. Trans. Roy. Soc. Edinb. **21**: 493. *pl. 9. f. 29.* 1857. Pritch. Hist. Infus. ed. 4. 870. 1861. Rabh. Fl. Eur. Alg. **1**: 102. 1864.

Orthoneis splendida Grun. in Fenzl, Reise Novara Bot. **1**: 15. 1870. Van Heur. Synop. *pl. 28. f. 1–4.* 1881. Cleve, Sv. Vet. Akad. Handl. **27**[3]: 148. 1895. Pant. Beitr. Bacill. Ung. **2**: *pl. 24. f. 352.* 1889. Truan & Witt, Diat. Hayti 18. *pl. 4. f. 13.* 1888. Truan, Anal. Soc. Espan. Hist. Nat. **13**: 363. *pl. 10. f. 20.* 1884.

Cocconeis punctatissima Grev. Quart. Journ. Micr. Sci. **5**: 8. *pl. 3. f. 1.* 1857. Moeb. Diat.-taf. *pl. 11. f. 1, 1*.* 1890.

Orthoneis punctatissima Lagerst. Bih. Sv. Vet. Akad. Handl. **3**[15]: 57. 1876. De Toni, Syll. Alg. **2**: 466. 1891.

Melosira cribrosa Grun. Verh. Zool. Bot. Ges. Wien **12**: 577. *pl. 5. f. 10a–d.* 1860.

It is not perfectly clear that Greville's and Gregory's species are the same. That of Greville would appear from the figures to be much more finely beaded, particularly as he says its beading is "very minute," especially toward the median line. The fact is also against their identity that Greville made the drawings for Gregory's paper, including this very form, yet does not look upon his own publication as a renaming of the same diatom. But they are united by Cleve, Grunow, De Toni, and others, while Ralfs holds them separate. If admitted to be the same, which seems on the whole to be best, the question what name should be assigned presents some difficulties. Both names were published in 1857.[e] There is no record in the Proceedings of the London Microscopical Society as to when Greville's paper was presented, in the records either of 1856 or of 1857. Gregory's paper was read January 19, 1857, and appeared that year. The preference would, therefore, be in favor of Gregory; and as his name is the better established of the two, I have for all these reasons adopted it.

Grunow's *Melosira cribrosa* must be included here. It appears to me more nearly to resemble the Greville type than that of Gregory, though Grunow and Cleve take an opposite view. It is also rather difficult to see the reasons for assigning only figures 10 a, b of Grunow's figures to this species and placing the other two, figures 10 c and d, in different species, as Grunow does.[f]

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[a] Fenzl, Reise Novara Bot. **1**: 12. 1870.

[b] Verh. Zool. Bot. Ges. Wien **13**: 145. 1863.

[c] Pritch. Hist. Infus. ed. 4. *pl. 7. f. 49.* 1861.

[d] Hantzsch in Rabh. Beitr. **1**: 21. *pl. 6. f. 11.* 1862.

[e] Greville's paper was published on pages 7–12 of the Quart. Journ. Micr. Sci. for 1857, which probably appeared before July, if not as early as April or May, 1857. While Gregory's paper was read on January 19, 1857, it was not published until an appendix dated May 28, 1857, and a corrigenda dated August 1, 1857. It constituted pages 473–542 of Trans. Roy. Soc. Edinb. **21**: 1857, which came at the end of the volume which unquestionably was not published until after August 1, 1857.

[f] Fenzl, Reise Novara Bot. **1**: 16. 1870.

Small specimens of the present species approach closely to robust specimens of *C. adriatica* Kütz., a variety of *C. scutellum* Ehrenb., the best mark of distinction being the round and widely set beads of *C. splendida* and the more compact and rectangular beads of *C. scutellum*.

Found at station 3696, off Honshu Island, Japan.

NAVICULA Bory.

Navicula Bory, Encycl. Meth. d'Hist. Nat. **2:** 562. 1824. Ehrenb. Infus. 173. 1838. Kütz. Bacill. 88. 1844. De Toni, Syll. Alg. **2:** 6. 1891. W. Smith, Synop. Brit. Diat. **1:** 46. 1853. Donk. Brit. Diat. 2. 1871–1873. Van Heur. Synop. 71. 1881; Treat. Diat. 162. 1896. Castr. Rep. Voy. Chall. Bot. **2:** 22. 1886. Pritch. Hist. Infus. ed. 4. 892. 1861. Rabh. Fl. Eur. Alg. **1:** 168. 1864. Cleve, Sv. Vet. Akad. Handl. **26**[2]**:** 4, 136. 1894; **27**[3]**:** 10. 1895. Cleve & Grun. Bih. Sv. Vet. Akad. Handl. **17**[2]**:** 27. 1880. Grun. Verh. Zool. Bot. Ges. Wien **10:** 513. 1860. Brun, Diat. Alp. 63. 1880.

Pinnularia Ehrenb. Ber. Akad. Wiss. Berl. **1840:** 213. 1841. W. Smith, Synop. Brit. Diat. **1:** 54. 1853.

Diploneis Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 84. 1845. Cleve, Sv. Vet. Akad. Handl. **26**[2]**:** 76. 1894.

Stauroptera Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 134. 1843.

Stauroneis Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 134. 1843. Kütz. Bacill. 194. 1844. De Toni, Syll. Alg. **2:** 204. 1891. Van Heur. Treat. Diat. 158. 1896.

Pleurostauron Rabh. in part; Grun. in Fenzl, Reise Novara Bot. **1:** 101. 1870.

Dickieia Berk. in part; Van Heur. Synop. *pl. 16. f. 10.* 1881; Treat. Diat. 233. 1896.

Anomoeoneis Pfitz.; Cleve, Sv. Vet. Akad. Handl. **27**[3]**:** 6. 1895.

Neidium Pfitz. in Hanst. Bot. Abhandl. **2:** 39. 1871. Cleve, Sv. Vet. Akad. Handl. **26**[2]**:** 68. 1894.

Caloneis Cleve, Sv. Vet. Akad. Handl. **26**[2]**:** 46. 1894.

Stenoneis Cleve, Sv. Vet. Akad. Handl. **27**[3]**:** 123. 1895.

Frustulia C. Ag. in part; Kütz. Linnaea **8:** *pl. 13. f. 16.* 1833.

Cymbella C. Ag. (=*Coccon*e*ma* Ehrenb.) in part; Consp. Diat. 8. 1832.

Synedra Ehrenb. in part; Kütz. Bacill. 63. *pl. 3. f. 29.* 1844.

Amphiprora Ehrenb. in part; Mikrog. *pl. 3. I. f. 10–11, III. f. 8a c.* 1854.

Schizonema C. Ag. in part; W. Smith, Synop. Brit. Diat. **2:** 71. 1856.

Colletonema Breb. in part; W. Smith, Synop. Brit. Diat. **2:** 70. *pl. 56. f. 351–353.* 1856.

Achnanthidium Kütz. in part; W. Smith, Synop. Brit. Diat. **2:** 31. *pl. 61. f. 380.* 1856.

Pleurosigma W. Smith in part; Ehrenb. Infus. 180. *pl. 13. f. 10.* Kütz. Bacill. 102 (no. 127, 128, etc.) *pl. 4. f. 25, 26.* etc.

The enormous size of this genus has incited many authors to attempt its division upon more or less tenable grounds. Thus Ehrenberg divided it into Navicula (Bory) Ehrenb. and Pinnularia Ehrenb., the chief distinction being that the former had smooth, the latter ribbed, valves. But the distinction was seen to be fictitious, and Kützing and Brebisson refused to accept it. William Smith revived the names, making the distinguishing feature the character of the striation, that in Pinnularia being composed of smooth costae, while Navicula had the striae broken more or less into moniliform or beaded lines. This would serve admirably to distinguish such species as *Pinnularia nobilis* Ehrenb. from *Navicula aspera* Ehrenb. But two difficulties have stood in the way of making application of this distinction in general; first, very few of the multitude of species in the genus can be positively classified by this criterion, every conceivable gradation between plain (or apparently plain) costae and rows of independent beads being presented; and, second, in even the extreme Pinnularia type the apparent presence or absence of perfectly smooth bars or costae is largely a matter of illumination. It is true that scientific classifications are chiefly valuable

for so assorting objects of nature into small groups as to render easy their availability and identification. Nor can at the present time that other purpose of classification, the indication of relationships, be pressed very strongly. But unless all the usual conceptions of the word "genus" are to be ignored, the distinctions drawn by William Smith must be considered as too unimportant and especially too unstable to admit of adoption.

By far the most painstaking and thorough analysis of Navicula is that of Cleve in his Navicuioid Diatoms.[a] I regret I can not follow his divisions of this genus. It would be aside from the purpose of this report to discuss in ample detail the merits of this extensive work. It must, therefore, suffice to say that a careful reading of the chapter "On the value of the characteristics," on page 4 of that work, will, in connection with the divisions of Navicula subsequently made in the work, reveal the fact that nearly all the characteristics there looked upon as inadequate are subsequently employed as bases for the new genera created. I therefore follow in general the majority of authors writing since Cleve's work appeared, in considering those distinctions of value for subgeneric grouping, though not of generic worth. Especially has Van Heurck[b] grouped the genus Navicula in a way satisfactory to the writer. Exception must, however, be taken to his recognition of the genus Stauroneis Ehrenb. as a genus. As Van Heurek there says, the true Stauroneis forms differ in no respect from Navicula, except "by the central nodule being transversely dilated into a stauros." This has always appeared to me to be a very trivial ground. The stauros is a most common accident of many species in several other genera, as Achnanthes Bory, in *A. coarctata* (Breb.) Grun.;[c] Pleurosigma W. Smith, in *P. asiaticum* Temp. & Brun and *P. staurophorum* Grun.;[d] and Cocconeis Ehrenb., in *C. formosa* Brun.[e] Nor is this any more or less the "dilation of the central nodule" in the one case than in the other. In short, the separation of stauros-bearing forms into a genus is an impossibility, either inside the genus Navicula or outside of it.

I look upon the following genera as having fairly good claim to separate standing: Mastogloia Thwaites, for reasons stated under that genus; Dictyoneis Cleve, on account of its peculiar internal plates and especially its loculate border,[f] though it may possibly be necessary to unite it with Mastogloia; Rouxia Brun & Herib.;[g] also the following six genera, which, although separate from Navicula, should be united under the same generic name: Frustulia C. Ag., in part, Berkeleya (Grev.) Van Heur., Reichelia Van Heur., Amphipleura Kütz., Brebissonia Grun., Vanheurekia Breb., for all which see under Frustulia in this report; also their figures and descriptions by Van Heurck.[h]

To the foregoing may be added Cleve's genus Cistula;[i] for although it at present includes only the single species *C. lorenziana* (Grun.) Cleve, this is perfectly constant and strikingly unlike other navicuioid diatoms. On the whole the best conception of Navicula and its allies is that of Van Heurck.[j]

Navicula aestiva Donk. Trans. Micr. Soc. Lond. n. s. **6**: 32. *pl. 3. f. 18.* 1858; Brit. Diat. 6. *pl. 1. f. 3.* 1871–73. Schmidt, Atlas *pl. 7. f. 8, 10, 11* (unnamed), *pl. 8. f. 26* (type), *f. 31* (unnamed). 1875. Rabh. Fl. Eur. Alg. **1**: 184. 1864. De Toni. Syll.

[a] Sv. Vet. Akad. Handl. **26**[3]: 1894; **27**[3]: 1895.
[b] Van Heur. Treat. Diat. 1896.
[c] Van Heur. Synop. *pl. 26. f. 18.* 1881.
[d] Perag. Le Diatomiste **1**[1, 5]: *pl. 8. f. 11, 15.* 1891.
[e] Schmidt, Atlas *pl. 194. f. 46.* 1891.
[f] Cf. Sv. Vet. Akad. Handl. **26**[3]: 124. 1894; and Van Heur. Treat. Diat. 157. 1896.
[g] Herib. Diat. Auvergn. 156. 1893.
[h] Van Heur. Treat. Diat. 239, 242–245. 1896.
[i] Sv. Vet. Akad. Handl. **26**[3]: 124. 1894.
[j] Van Heur. Treat. Diat. 162–237. 1896.

Alg. **2**: 93. 1891. O'Meara, Proc. Roy. Irish Acad. II. **2**: 384 (*pl. 32. f. 20.* worthless). 1875. Cleve, Sv. Vet. Akad. Handl. **26**^{4}: 91. 1894. Pritch. Hist. Infus. ed. 4. 899. 1861.

Navicula fusca Greg. variety; Schmidt. Atlas *pl. 7. f. 1 4.* 1875; Jahresb. Komm. Deut. Meere **2**: *pl. 8. f. 26.* 1874.

Navicula smithii Breb. variety; Van Heur. Treat. Diat. 198. 1896.

This beautiful form is, as Van Heurck claims, near to *N. smithii* Breb., but is vastly finer and, so far as I have seen, it never shows the double-headed striae of that species, its striae being delicate and obscurely moniliform. Its resemblance to *N. fusca* (Greg.) Ralfs is also superficial. Schmidt's figures of that species quoted above are quite distinct from Gregory's type, originally published as *N. smithii* Breb. variety *fusca* Greg., its true name, for as Ralfs, who makes it a separate species, says,[a] it "differs from *N. smithii* Breb. in its much larger size and more distinct striae." It is, therefore, even more strongly in contrast with the present species, and I agree with Cleve and De Toni in recognizing its distinctness. The peculiar termination of the two halves of the raphe at the center of the valve[b] is well displayed in a specimen accompanying this report.

Found at station 2920H, Hawaiian Islands.

Navicula anceps (Ehrenb.) Mann.

Stauroneis anceps Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841**: 306. 422. *pl. 2. I. f. 18.* 1843. Kütz. Bacill. 105. *pl. 29. f. 4.* 1844. W. Smith. Synop. Brit. Diat. **1**: 60. *pl. 19. f. 190.* 1853. Brun. Diat. Alp. 89. *pl. 9. f. 1 2.* 1880. Van Heur. Synop. 68. *pl. 4. f. 4 8.* 1881; Treat. Diat. 160. *pl. 1. f. 55 57.* 1896. Schum. Schrift. Phys. Ökon. Ges. Königsb. **5**: 22. *pl. 2. f. 27.* 1864. Wolle. Diat. N. A. *pl. 8. f. 4* (not *f. 8 9*). 1890. De Toni. Syll. Alg. **2**: 211. Cleve. Sv. Vet. Akad. Handl. **26**^{4}: 147. 1894. Cleve & Grun. Sv. Vet. Akad. Handl. **17**^{4}: 48. *pl. 3. f. 65.* 1880.

Stauroneis amphicephala Kütz. Bacill. 105. *pl. 30. f. 25.* 1844. Pritch. Hist. Infus. ed. 4. 912. 1861. Schum. Schrift. Phys. Ökon. Ges. Königsb. 22. *pl. 2. f. 29.* 1861.

Stauroneis linearis Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841**: 300. *pl. 1. II. f. 11.* 1843 ?; Mikrog. *pl. 39. II. f. 106.* 1854.

In adopting the above name to represent this widely known and variable diatom I am led by considerations of policy only. If a strict observance of priority were followed Ehrenberg's *linearis* would probably have to supersede his *anceps*, as the former appears earlier in both the text and plates of his article. Cleve[c] questions the union of *linearis* with this species. To me it seems impossible to diagnose either of them with any accuracy. Certainly the numerous figures of both given by Ehrenberg represent a considerable number of species. And it is because I can not see the boundaries of these two names by means of the original citations that I am unwilling to overturn the above accepted and widely-known specific name for a theoretically earlier one. Diatoms differ from most other organisms in that their minuteness and delicacy of structure are so extreme that only by the finest lenses and the most exact drawings can their specific characteristics be seen and recorded. As a consequence, most of the earlier observations of the more minute diatoms are untrustworthy, and too much weight is attached to the names assigned in these writings. A large part are veritable nomina nuda, and should be given consideration only when subsequent repetitions establish their character. For this reason *anceps* is to be preferred to *linearis*. The union of the Stauroneis diatoms with Navicula has been discussed under the genus.

Found at station 3669H, along Kurile Chain.

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[a] Pritch. Hist. Infus. ed. 4. 898. 1861.

[b] Cf. Schmidt. Atlas *pl. 1. f. 3.* 1875.

[c] Sv. Vet. Akad. Handl. **26**^{4}: 147. 1894.

Navicula antillarum (Cleve & Grun.) Mann.

Alloeis (*Navicula* ?) *antillarum* Cleve & Grun. in Cleve, Bih. Sv. Vet. Akad. Handl. **5**[8]: 8. *pl. 2. f. 11.* 1878. Castr. Rep. Voy. Chall. Bot. **2:** 35. *pl. 15. f. 5. pl. 20. f. 14. pl. 28. f. 14.* 1886.

Scolioplcura antillarum Pellet. Diat. 288. *f. 231.* 1888-89. De Toni. Syll. Alg. **2:** 265. 1891.

Trachyneis antillarum Cleve, Sv. Vet. Akad. Handl. **26**[2]: 193. 1894.

Navicula (*Alloeis* ?) *kurzii* Grun.; Cleve, Bih. Sv. Vet. Akad. Handl. **5**[8]: 8. *pl. 2. f. 12.* 1878.

The last does not seem to me to be a good sytonym, but as I have not been able to examine a specimen, and as Cleve himself is the authority for its identity, I must accept his judgment rather than his illustrations.

Found at stations 2823, 2835, Gulf of California and off Lower California.

Navicula omaruensis (Cleve) Mann.

Navicula apis Ehrenb. err. det. Donk. Brit. Diat. 48. *pl. 7. f. 3.* 1871-73. Schmidt, Atlas *pl. 12. f. 16, 18-19, 22-23, 25.* 1875; *pl. 174. f. 13.* 1892. Schmidt, Jahresb. Komm. Deut. Meere **2:** 86. *pl. 1. f. 9.* 1874, not Kütz.

Pinnularia apis Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 420. *pl. 3. VIII. f. 18.* 1843?

Diploneis adonis Brun variety *omaruensis* Cleve, Sv. Vet. Akad. Handl. **26**[2]: 85. 1894.

Navicula didyma Ehrenb. err. det.; De Toni, Syll. Alg. **2.** 72. 1891.

As Cleve says[a] it is impossible to decide positively what *N. apis* (Ehrenb.) Kütz. really denotes. Ehrenberg's figure and description of *Pinnularia apis* make it reasonably certain that it is not the present species; nor are the synonyms cited by Donkin at all illuminating. Kützing's figure[b] is almost anything but Donkin's diatom, and more unlike it, if possible, is W. Smith's figure determined as *N. didyma* Kütz.[c] I therefore look upon Donkin's form as a distinct species. Although Ehrenberg's name can not be satisfactorily determined, it is inapplicable to the present species as above noted, and as there is so much doubt about Grove and Cleve's identification it may be advisable to drop the name entirely until more accurate information is available. I have therefore selected the name *omaruensis* as the only one tenable. The form called *N. apis* Ehrenb., by Grove and Cleve (?[d] (Cleve[e] says "Grove & Sturt)," Cleve unites with *N. adonis* Brun, to which it bears no trace of resemblance. De Toni bundles the whole list together under *N. didyma* Ehrenb., giving without comment many utterly irreconcilable figures.[f] That Schmidt recognizes the independent status of Donkin's form is evidenced by the figures given by him under that name.[g]

Found at station 2848, south of Alaska peninsula.

Navicula ardua Mann, sp. nov. PLATE LIII, FIGURES 2, 3.

Valval view long-lanceolate, with sides not curved but proceeding in straight lines from the broad central portion to the rounded apices; costae set at an angle of 45° until very near the apices, then transverse; broader at their outer ends; remote from the raphe, leaving a hyaline line on either side of it; those at the center of the valve slightly

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[a] Sv. Vet. Akad. Handl. **26**[2]: 91. 1894.

[b] Kütz. Bacill. *pl. 28. f. 76.* 1844.

[c] W. Smith, Synop. Brit. Diat. **1:** 53. *pl. 17. f. 154a.* 1853.

[d] Schmidt, Atlas *pl. 174. f. 13.*

[e] Sv. Vet. Akad. Handl. **26**[2]: 85. 1894.

[f] Kütz. Bacill. *pl. 4. f. 7.* and *pl. 28. f. 75.* 1844. Donk. Brit. Diat. *pl. 7. f. 3.* and *pl. 7. f. 8a.* 1871-73.

[g] Schmidt, Jahresb. Komm. Deut. Meere **2:** 86. 1874.

shorter, giving thereby a broader hyaline area around the central nodule; zonal view subrectangular, with rounded corners, slightly narrowed at the middle by the depression of the centers of the valves; zone or girdle broad and hyaline.

Length of valve, 0.06 mm.; width of valve, 0.01 mm. Costae, 52 in 0.1 mm.

I have named this minute Navicula with reluctance, having tried to bring it into union with several known forms, such as *Gomphonema gracile naviculoides* Grun.,[a] or with *N. tenella* Breb.[b] It could be looked upon as a wide variety of the former of these two, which is the same as *Gomphonema naviculoides* W. Smith, if that diatom were at all like the figure given in Strose,[c] but the identification there is incorrect. The zonal view is beyond question that of a Navicula, and Strose shows his doubt of the name by an interrogation point. My species resembles somewhat a minute specimen of *N. pennata* Schmidt,[d] but the strictly unbeaded costae of my species, as well as the size, precludes a union. Its nearest representative is an unnamed figure of Schmidt's,[e] which it closely resembles except in the matter of the apices.

Type in the U. S. National Museum, No. 590144, from station 2680H off central California, October 11, 1891; 864 fathoms, bottom of brown mud and sand.

Navicula arenaria Donk. Quart. Journ. Micr. Sci. n. s. **1:** 10 *pl. 1. f. 8.* 1861; Brit. Diat. 56. *pl. 8. f. 5a–c.* 1871–73. Rabh. Fl. Eur. Alg. **1:** 177. 1864. Grun.; Schmidt, Atlas *pl. 47. f. 38–40* (not *f. 41*). 1876. Van Heur. Synop. *pl. 8. f. 18.* 1881?. O'Meara, Proc. Roy. Irish Acad. II. **2:** 411. *pl. 34. f. 17.* 1875. Lagers. Bih. Sv. Vet. Akad. Handl. **3**[15]: 34. 1876. Leud.-Fort. Mem. Soc. Emul. St. Brieuc 23. 1879, not H. L. Smith, Sp. Diat. Typ. no. 250. 1874.

Navicula lanceolata Kütz.; Cleve, Sv. Vet. Akad. Handl. **27**[3]: 22. 1895. Van Heur. Synop. 88. 1885. De Toni, Syll. Alg. **2:** 58. 1891, not *Cymbella lanceolata* C. Ag.

Although there is similarity between certain figures called *N. lanceolata* (C. Ag.) Kütz. and the above species, I find none that can be considered the same. In fact, I am at a loss to decide what this *lanceolata* of Kützing is specifically. No definite idea can be obtained from the original descriptions and figures,[f] the figures showing a variety of outlines, but devoid of any markings known in Navicula. I notice that Cleve[g] passes over all citations from Kützing and apparently bases his conception of the species on the description and figure in Lagerstedt.[h] If so, it is quite irreconcilable with Donkin's species. I think that here, as in some other cases, Cleve has carried condensation beyond the point of usefulness. The specimens found by me are so exactly Donkin's type that I accept his name as valid.

Found at station 3635H, Bering Sea.

Navicula aspera Ehrenb.; Donk. Brit. Diat. 62. *pl. 10. f. 1a–c.* 1871–73. Van Heur. Synop. 94. *pl. 10. f. 13.* 1881; Suppl. *pl. B. f. 26.* 1885; Treat. Diat. 205, *pl. 4. f. 165.* 1896. Schmidt, Atlas *pl. 48. f. 2–6, 21* (*f. 14–15* doubtful). 1876. Grun. Denkschr. Akad. Wien **48**[2]: 56. *pl. 1. f. 20.* 1884. Pant. Beitr. Bacill. Ung. **2:** 42. *pl. 10. f. 180.* 1889. Schultze, Bull. Torr. Club **14:** 70. *pl. 66. f. 6.* 1887. De Toni, Syl. Alg. **2:** 109. 1891.

Navicula aspera Ehrenb. Ber. Akad. Wiss. Berl. **1841:** 206. 1842, nom. nud.; Mikrog. *pl. 35A, XX. f. 5.* 1854, as synonym.

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[a] Van Heur. Synop. *pl. 24. f. 13.* 1881.
[b] Van Heur. Synop. *pl. 7. f. 20–21.* 1881.
[c] Strose, Bacillarienlager *pl. 1. f. 18, 21.* 1884.
[d] Schmidt, Atlas *pl. 48. f. 41–43.* 1876.
[e] Op. cit. *pl. 46. f. 65.*
[f] C. Ag. Consp. Diat. 9. 1832. Kütz. Bacill. 94. *pl. 28. f. 38, pl. 30. f. 48.* 1844.
[g] Sv. Vet. Akad. Handl. **26**[2]: 1894.
[h] Ofv. Kgl. Vet. Akad. **41**[2-3]: 49. *pl. 8. f. 5.* 1884.

Stauroptera aspera Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 299, 387. *pl. 1. I. f. 1–2, pl. 1. III. f. 1–2. pl. 2. VI. f. 20. pl. 4. IV. f. 1* (?). 1843: Mikrog. *pl. 19. f. 26, pl. 35A. XX. f. 5.* 1854. Bail. Smithson. Contr. Knowl. **7:** *pl. 1. f. 18.* 1854.

Stauroptera achnanthes Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 387. *pl. 3. III. f. 7* (?). *pl. 4. III. f. 2* (?). 1843, not Ehrenb. Mikrog. *pl. 17. I. f. 10.* 1854.

Stauroneis aspera Kütz. Bacill. 106. *pl. 29. f. 12a–b.* 1844.

Stauroneis pulchella W. Smith, Synop. Brit. Diat. **1:** 61. *pl. 19. f. 194a–b.* 1853.

Stauroptera oblonga Bail. Smithson. Contr. Knowl. **7:** 10. *pl. 1. f. 17* (?). 1854. Schmidt, Atlas *pl. 48. f. 16* 1876? Castr. Rep. Voy. Chall. Bot. **2:** 24. *pl. 20. f. 7. 11.* 1886.

Navicula neumeyeri Jan.; Schmidt, Atlas *pl.* 48. *f. 1* 1876?

Navicula pseudoaspera Pant. Beitr. Bacill. Ung. **3:** *pl. 18. f. 258.* 1893.

Trachyneis aspera Cleve, Sv. Vet. Akad. Handl. **26**[2]: 191. *pl. 3. f. 37.* 1894.

I have marked several of the above synonyms as doubtful, among them the *S. oblonga* of Bailey, though what Castracane calls by that name is an unquestionable example of the present species. I exclude the following species classed as synonyms by Cleve: *Stauroneis robusta* Petit.[a] *Stauroneis pygmea* Castr.,[b] *Navicula contramina* Schmidt,[c] *Navicula residua* Schmidt,[d] *Navicula amphora* Brun.,[e] *Navicula schmidtiana* Grun.[f]

De Toni, though recognizing Stauroneis as a valid genus, considers this particular species to be a Navicula.

Found at stations 2808, 2848, 2920H, 3013H.

Navicula (aspera ?) intermedia Grun.; Schmidt, Atlas *pl. 48. f. 14–15.* 1876.

I mention this variety separately because I think with Schmidt that it is classed with *N. aspera* with much difficulty. I discovered it in different dredgings from those that yielded *N. aspera.*

Found at stations 2807, 2823, 2919, 3611, Galapagos Islands to Bering Sea.

Navicula bisulcata Lagers. Bih. Sv. Vet. Akad. Handl. **1**[14]: 31. *pl. 1. f. 8–9.* 1873. Schmidt, Atlas *pl. 49. f. 15, 17, 18.* 1877. De Toni, Syll. Alg. **2:** 150. 1891.

Nodium bisulcatum Cleve, Sv. Vet. Akad. Handl. **26**[2]: 68. 1894.

It has the general build of *N. firma* Kütz., but is of extreme delicacy and fineness of structure. It resembles far less *N. scita* W. Smith,[g] to which Cleve compares it, this latter having dotted and slightly radiating striae and no pronounced hyaline central area.

Found at station 3712H, Okhotsk Sea.

Navicula bombus (Ehrenb.) Kütz. Sp. Alg. 83. 1849. Rabh. Fl. Eur. Alg. **1:** 204. 1864. Greg. Trans. Roy. Soc. Edinb. **21:** 484. *pl. 9. f. 12.* 1857. Donk. Brit. Diat. 50. *pl. 7. f. 7a* (not *f. 7b*). 1871 73. O'Meara, Proc. Roy. Irish Acad. II. **2:** 401. *pl. 33. f. 28.* 1875. Schmidt, Atlas *pl. 69. f. 28–29.* Van Heur. Synop. 90; Suppl. *pl. B. f. 22.* 1885. Pritch. Hist. Infus. ed. 4. 893. 1861. Cleve, in Nordensk. Vega Exped. **3:** 471. 1883. De Toni, Syll. Alg. **2:** 75. 1891. Van Heur. Treat. Diat. 194. *pl. 3. f. 149.* 1896.

Pinnularia bombus Ehrenb. Ber. Akad. Wiss. Berl. **1844:** 30. 1845.

Diploneis bombus Ehrenb. Mikrog. *pl. 19. f. 31.* Cleve, Sv. Vet. Akad. Handl. **26**[2]: 90. 1894.

Navicula bombus Ehrenb.; Schmidt, Atlas ed. 2. *pl. 13. f. 4–14, 16.* 1885.

[a] Fonds de la Mer **3:** 185. *pl. 5. f. 16a–b.* 1877.

[b] Castr. Rep. Voy. Chall. Bot. **2:** 25. *pl. 29. f. 7.* 1886.

[c] Schmidt, Atlas *pl. 48. f. 17–18.* 1876.

[d] Op. cit. *pl. 48. f. 29.*

[e] Mem. Soc. Phys. et Hist. Nat. Geneva **31**[1]: 32. *pl. 15. f. 3.* 1891.

[f] Schmidt, Atlas *pl. 48. (f. 12–13* unnamed, *f. 19–20.* 1876.

[g] Ann. Mag. Nat. Hist. II. **19:** 8. *pl. 2. f. 4.* 1857.

Navicula genuina Kütz. Bacill. 100. 1844?

Navicula genuina Schmidt, Atlas *pl. 13. f. 4–9, 13–14, 16.* 1875; Jahresb. Komm. Deut. Meere **2:** *pl. 1. f. 1* (not *pl. 2. f. 1c*). 1874.

This brilliant and massive diatom, though a well-marked species, is represented by many figures so bad as to cause confusion. Some of Schmidt's figures [a] of this as well as of the synonymous *N. gemina* [b] are much too delicately represented, while others [c] are so aberrant as to be difficult of recognition. Wolle's figures [d] are absolutely deceptive. The form called by Donkin [e] "a var. from Northumberland" is evidently an example of *N. didyma* (Ehrenb.) Kütz., [f] it also being from Northumberland. The best figures of the type are those of Ehrenberg, Van Heurck, and Schmidt, [g] enumerated below.

Schmidt wrote "*N. genina* A. S." instead of *N. genuina* Kütz. or *N. genuina* (Ehrenb.) Kütz., because, as he states, he was unable to figure out what the older names represented. Cleve avoids the difficulty by omitting any reference to Kützing or to the *Pinnularia genuina* Ehrenb. as figured in Schmidt's Atlas [h] or the *Navicula bombus* Ehrenb. It is, however, certain that all these are the same, unless it be the *P. genuina* Ehrenb., which in its single reference I look upon as a nomen nudum.

Found at stations 2916H, 2920H, Hawaiian Islands.

Navicula brasiliensis Grun. Verh. Zool. Bot. Ges. Wien **13:** 152. *pl. 14. f. 10.* 1863; in Fenzl, Reise Novara Bot. **1:** 19. 1870. Schmidt, Atlas *pl. 6. f. 19–21, 23–25, pl. 6. f. 31–33* (unnamed). 1875. Castr. Rep. Voy. Chall. Bot. **2:** 30. *pl. 20. f. 1–2.* 1886. Pant. Beitr. Bacill. Ung. **2:** 43. *pl. 5. f. 82.* Cleve, Sv. Vet. Akad. Handl. **27**[3]**:** 47. *pl. 1. f. 19.* 1895. De Toni, Syll. Alg. **2:** 55. 1891.

My specimens are identical with some unnamed figures of Schmidt's, [i] which he is disposed to regard as representing a new species. The minute differences he cites for separating these forms from the above, as figured by him on the same plate, are hardly sufficient to mark them as varieties, much less species.

Found at station 2920H, Hawaiian Islands.

Navicula brevis Greg. Trans. Roy. Soc. Edinb. **21:** 478. *pl. 9. f. 4.* 1857. Van Heur. Synop. *pl. 11. f. 18–19.* 1881. Donk. Brit. Diat. 19. *pl. 3. f. 4.* 1871–73. Schmidt, Jahresb. Komm. Deut. Meere **2:** *pl. 2. f. 14–15.* 1874. Pritch. Hist. Infus. ed. 4. 899. 1861. Wolle, Diat. N. A. *pl. 10. f. 7, 17.* De Toni, Syll. Alg. **2:** 123. Cleve, in Nordensk. Vega Exped. **3:** 465. 1883.

Navicula (*brevis* variety ?) *distoma* Grun. in Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]**:** 30. *pl. 1. f. 25–26.* 1880.

Caloneis brevis Cleve, Sv. Vet. Akad. Handl. **26**[2]**:** 61, 1894.

Cleve mentions as a possible synonym *N. crassa* Greg. [j] In form they are much alike, but I do not regard them as the same. If they were, *N. crassa* would supersede *N. brevis.* Gregory certainly did not consider them the same, and as Cleve & Grunow point out, [k] they are distinguished by the far finer dotting of the striae in *N. brevis.*

Found at station 2885, off Oregon.

[a] Schmidt, Atlas ed. 2. *pl. 14. f. 7–12.* 1885.
[b] Schmidt, Jahresb. Komm. Deut. Meere **2:** *pl. 1. f. 1.* 1874.
[c] Schmidt, Atlas *pl. 69. f. 28–29.* 1881.
[d] Wolle, Diat. N. A. *pl. 10. f. 47–48, 50, pl. 23. f. 3.* 1890.
[e] Donk. Brit. Diat. *pl. 7. f. 7b.* 1871–73.
[f] Donk. op. cit. *f. 8.*
[g] Ehrenb. Mikrog. *pl. 19. f. 31.* 1854. Van Heur. Synop. Suppl. *pl. B. f. 22.* 1885. Schmidt, Jahresb. Komm. Deut. Meere **2:** *pl. 1. f. 1a–b.* 1874.
[h] Ber. Alsad. Wiss. Berl. *1840:* 214. 1841.
[i] Schmidt, Atlas *pl. 6. f. 31–33.* 1875.
[j] Quart. Journ. Micr. Sci. **3:** 41. *pl. 4. f. 18.* 1855.
[k] Sv. Vet. Akad. Handl. **17**[2]**:** 30. 1880.

Navicula clavata Greg. Trans. Micr. Soc. Lond. n. s. **4**: 46. *pl. 5. f. 17.* 1856. Donk. Brit. Diat. 15. *pl. 2. f. 8.* 1871–73. Schmidt, Atlas *pl. 3. f. 13, pl. 70. f.* 50. 1881; *pl. 129. f. 16.* 1888; Jahresb. Komm. Deut. Meere **2**: *pl. 1. f. 33.* 1874. Cleve, Sv. Vet. Acad. Handl. **27**^{3}: 61. 1895. Pritch. Hist. Infus. ed. 4. 848. 1861. O'Meara, Proc. Roy. Irish Acad. II. **2**: 386. *pl. 32. f. 23* (figure poor). 1875.

Navicula wrightii O'Meara, Quart. Journ. Micr. Sci. n. s. **7**: 116. *pl. 5. f. 4* (figure poor). 1867.

Navicula caribaea Cleve; Schmidt, Jahresb. Komm. Deut. Meere, **2**: 89. *pl. 1. f. 40.* 1874; Atlas *pl. 2. f.* 17. 1875; *pl. 70. f. 48.* 1881?

Navicula hennedyi W. Smith; Van Heur. Synop. 93. 1881; Treat. Diat. 204. 1896. De Toni, Syll. Alg. **2**: 104. 1891.

Navicula lyra Ehrenb.; Schmidt, Atlas *pl. 70. f.* 47. 1881. Hab. Cat. 193, 212. 1877.

This diatom stands midway between *N. lyra* Ehrenb. and *N. hennedyi* W. Smith. The union here of O'Meara's *N. wrightii* is justified by Cleve, though the figure in the above citation would not lead one to suspect it, unless it were compared with the equally deceptive figure by O'Meara of *N. clavata*. Most of that author's machine-made illustrations are useless for identification. The specimens found by me are the variety with the spaces between the marginal and median striations strongly granulated instead of hyaline.

Found at station 2807, Galapagos Islands.

Navicula crabro (Ehrenb.) Kütz. Sp. Alg. 83. 1849; W. Smith, Synop. Brit. Diat. 94. 1856. Grev. Quart. Journ. Micr. Sci. **5**: 7. *pl. 3. f. 11.* 1857; Pritch. Hist. Infus. ed. 4. 894. 1861. Rabh. Fl. Eur Alg. **1**: 204. 1864. Grun. Verh. Zool. Bot. Ges. Wien **10**: 524. *pl. 3. f. 21.* 1860; in Fenzl. Reise Novara Bot. **1**: 18. 1870. Donk. Brit. Diat. 46. *pl. 7. f. 1.* 1871–73. Schmidt, Jahresb. Komm. Deut. Meere **2**: *pl. 1. f. 5, 6. pl. 2. f. 4.* 1874; Atlas *pl. 69. f. 1–4.* 1881; *pl. 174. f. 4, 6–7.* 1892. De Toni, Syll. Alg. **2**: 68. 1891. Van Heur. Synop. 83. *pl. 9. f. 1–2.* 1881; Treat. Diat. 192. *pl. 8. f.* 144. 1896.

Pinnularia crabro Ehrenb. Ber. Akad. Wiss. Berl. **1844**: 85. 1845. Rabh. Fl. Eur. Alg. **1**: 219. 1864.

Diploneis crabro Ehrenb. Mikrog. *pl. 19. f. 29a–c.* 1854. Cleve, Sv. Vet. Akad. Handl. **26**^{2}: 100. *pl. 2. f. 8* (?), *10* (?), *11.* (?) and *f. 9.* 1894.

Navicula pandura Breb. Mem. Soc. Sci. Nat. Cherb. **2**: 253. *f. 4.* 1854. Schmidt, Jahresb. Komm. Deut. Meere **2**: *pl. 2. f. 3.* 1874; Atlas *pl. 11. f. 1–2, 4, 8–9.* 1875. Greg. Trans. Micr. Soc. Lond. n. s. **4**: 43. *pl. 5. f. 11.* 1856. Truan & Witt, Diat. Hayti 17. *pl. 4. f. 14.* 1888.

Pinnularia pandura Greg. Trans. Roy. Soc. Edinb. **21**: 489. *pl. 9. f. 22.* 1857.

Navicula multicostata Grun. Verh. Zool. Bot. Ges. Wien **10**: 524. *pl. 1. f. 13.* 1860 (figure bad). Schmidt, Atlas *pl. 11. f. 14–20. pl. 12. f. 71–72.* 1875. De Toni, Syll. Alg. **2**: 69. 1891.

Pinnularia multicostata Rabh. Fl. Eur. Alg. **1**: 219. 1864.

Navicula greevillei Donk. Brit. Diat. 47. 1871–73.

Navicula nitida W. Smith; Greg. Trans. Micr. Soc. Lond. n. s. **4**: 44. *pl. 5. f.* 12* (not *f. 12*).

Navicula dirhombus Schmidt, Atlas *pl. 11. f. 21–22.* 1875; *pl. 69. f. 9–10.* 1881.

Navicula suspecta Schmidt, Atlas *pl. 11. f. 12–13, 26–27.* 1875?

Navicula gibelii Schmidt, Atlas *pl. 12. f. 73.* 1875?

Navicula separabilis Schmidt, Atlas *pl. 11. f. 3, 5–7, 10, 17.* 1875.

Navicula explota Schmidt, Atlas *pl. 69. f. 7–8.* 1881?

Navicula polita Brun, Mem. Soc. Phys. et Hist. Nat. Geneva **31**^{1}: 37. *pl. 15. f. 1.* 1891.

Navicula gloriosa Brun, Mem. Soc. Phys. et Hist. Nat. Geneva **31**^{1}: 34. *pl. 15. f. 8, 12.* 1891.

Navicula navigans Brun; Schmidt, Atlas *pl. 174. f. 1.* 1892.

Navicula sidcrialis Schmidt, Atlas: *pl. 174. f. 3.* 1892.
Navicula ornata Schmidt, Atlas *pl. 69. f. 5.* 1875; *pl. 174. f. 25.* 1892.

The above synonymy agrees mainly with that of Cleve.[a] I have, however, placed question marks after some in the list; for although they are near enough to *N. crabro* to suggest their union, I am not satisfied as to the wisdom of uniting them. The following, included by Cleve, I exclude from the list: *N. limitanea* Schmidt,[b] *Diploneis crabro pandurella* Cleve,[c] *N. confecta* Schmidt,[d] *N. mantichora* Pant.[e] This last name is a matter of doubt, there being no text to accompany the figure; but judging from the figure, as I infer Cleve did, I can not take the view that it is a "corroded" specimen of *N. crabro*. Anyone who reads Schmidt's pathetic appeal[f] for guidance out of the labyrinth of confused forms called *N. crabro*, *N. pandura*, and *N. mutticostata* can not but realize that Cleve has done a large and valuable work in simplifying this part of our nomenclature.

Found at stations 2807, 2808, 2920H, 3013H, Galapagos and Hawaiian islands.

Navicula curvilineata Mann, sp. nov. PLATE LH, FIGURE 4.

Valve broadly oval, tapering by nearly straight lines to the subacute apices; raphe extensively curved near the apices toward opposite sides, and sharply bent at the center toward the same side; otherwise straight; markings of large massive beads, so arranged in rows as to give curved lines, oblique to the raphe, in two directions; hyaline space much broader on one side of the raphe than on the other (Alloioneis type); a distinct border of strong, closely set lines perpendicular to the margin, broadest at the center of the valve and narrowing proportionately toward its apices; a large hyaline stauros at the center, about one-half the width of the valve.

Length of valve, 0.128 mm.; width of valve, 0.062 mm. Curved oblique striae (at center), 40 to 45 in 0.1 mm.; radiating striae (at center), 75 to 80 in 0.1 mm.

This brilliant diatom has some resemblance to the following species, united by Cleve[g] under the names *Anomoeoneis polygramma* (Ehrenb.) Cleve, *Stauroneis polygramma* Ehrenb.;[h] *Navicula costata* Kütz.;[i] *Navicula bohemica* Ehrenb.,[j] and *Navicula fossilis* Ehrenb.[k]

Type in the U. S. National Museum, No. 590145, from station 2807, Galapagos Islands, April 4, 1888; 812 fathoms, bottom of Globigerina ooze and coral mud.

Navicula cuspidata Kütz. Bacill. 94. *pl. 3. f. 24, 27.* 1844. Rabh. Sussw. Diat. 37. *pl. 5. f. 16.* 1853. W. Smith, Synop. Brit. Diat. 1: 47. *pl. 16. f. 131.* 1853. Pritch. Hist. Infus. ed. 4. 905 (not *pl. 12. f. 5*). 1861. Donk. Brit. Diat. 39. *pl. 6. f. 6.* 1871–73. O'Meara, Proc. Roy. Irish Acad. II. 2: 357, *pl. 31. f. 1.* 1875. Brun. Diat. Alp. 66. *pl. 7. f. 6.* 1880. Van Heur. Synop. 100. *pl. 12. f. 4.* 1881; Suppl. *pl. B. f. 30.* 1885; Treat. Diat. 214. *pl. 4. f. 190-191.* 1896. H. L. Smith, Sp. Diat. Typ. no. 259. 1874. Cleve, Sv. Vet. Akad. Handl. **26**[2]: 109. 1894. Truan, Anal. Soc. Espan. Hist. Nat. **13**: 342. *pl. 7. f. 26.* 1884. De Toni, Syll. Alg. **2**: 136. 1891. Wolle, Diat. N. A. *pl. 12. f. 16.* 1890.

Frustulia cuspidata Kütz. Linnaea **8**: *pl. 2. f. 26.* 1833.

[a] Sv. Vet. Akad. Handl. **26**[2]: 100-102. 1894.
[b] Schmidt, Atlas *pl. 11. f. 23.* 1875; *pl. 69. f. 12, 23.* 1881.
[c] Sv. Vet. Akad. Handl. **26**[2]: 101. *pl. 1. f. 9.* 1894.
[d] Op. cit. *pl. 12. f. 46.*
[e] Pant. Beitr. Bacill. Ung. **3**: *pl. 35. f. 490.* 1893.
[f] Schmidt, Jahresb. Komm. Deut. Meere **2**: 85-86. 1874.
[g] Sv. Vet. Akad. Handl. **27**[3]: 6. 1895.
[h] Phys. Abh. Akad. Wiss. Berl. **1841**: *pl. 2. VI. f. 30.* 1843.
[i] Kütz. Bacill. 93. *pl. 3. f. 56.* 1844.
[j] Ehrenb. Mikrog. *pl. 10. I. f. 4a.* 1854.
[k] Op. cit. *pl. 10. I. f. 6.*

Naricula ambigua Ehrenb. err. det. ?; W. Smith, Synop. Brit. Diat. **1:** 51. *pl. 16. f. 149. front. f. CXLIX.* 1853. Donk. Brit. Diat. 39. *pl. 6. f. 5.* 1871–73. O'Meara, Proc. Roy. Irish Acad. II. **2:** 360. *pl. 31. f. 10.* 1875. H. L. Smith, Sp. Diat. Typ. no. 243. 1874. Brun, Diat. Alp. 67. *pl. 7. f. 23.* 1880. Van Heur. Synop. 100. *pl. 12. f. 5.* 1881; Treat. Diat. 214. *pl. 4. f. 192.* 1896. Truan, Anal. Soc. Espan. Hist. Nat. **13:** 343. *pl. 7. f. 28.* 1884. Grun. Verh. Zool. Bot. Ges. Wien **10:** 529. *pl. 2. f. 33* (?). 1860. De Toni, Syll. Alg. **2:** 137. 1891 (not Schum. Schrift. Phys. Ökon. Ges. Königsb. **10:** 88. *pl. 2. f. 14.* 1869).

Naricula sphaerophora Kütz.; Grun. Verh. Zool. Bot. Ges. Wien **10:** 540. *pl. 2. f. 34.* 1860.?

Cleve unites *N. ambigua* Ehrenb., adding a question mark, and the same in Kützing,[a] to the above. I can see no reason for this. Ehrenberg's figures are as usual not uniform, but none of them, nor his meager descriptions, warrant their union with this well-marked species. The fact is that a number of authors, mainly those cited above, have given to a variety of *N. cuspidata* having the general outline of some of Ehrenberg's figures, the name *N. ambigua* Ehrenb. The first definite figure and description is by W. Smith[b] and many of the older diatomists have maintained that the name should be credited to him, a procedure entirely out of accord with modern usage. There is, however, no question that his species, so well figured and described, belongs here. De Toni and Brun look upon the two as separate, but Van Heurck and others, while printing their figures and descriptions separately, state that they are probably alike. I have not only examined the many figures but a number of specimens of the two, as H. L. Smith's types, nos. 243 and 259, and find them to be only unimportant varieties.

Cleve also groups here *N. sphaerophora* Kütz.[c] The figure is a little suggestive of that species, but it would be misleading to include this distinct diatom here. His union of *N. birostrata* Greg. and[d] *N. quarnerensis* Grun.[e] is a mistake. It is of interest that both *N. cuspidata* and the variety called as above, *N. ambigua*, afford frequent examples of the internal cricular plates which were formerly known as *Surirella cricula*, *Cricula ehrenbergii*, and *Stictodesmis cricula*. Good figures of this structure are given by Van Heurck and by Heribaud.[f]

Found at station 3607, Bering Sea.

Navicula didyma (Ehrenb.) Kütz. Bacill. 100. *pl. 4. f. VII. 1–2, pl. 28. f. 75.* 1844. Pritch. Hist. Infus. ed. 4. 893. *pl. 7. f. 61; pl. 15. f. 12.* 1861. Van Heur. Synop. 90. *pl. 9. f. 5–6.* 1881; Suppl. *pl. B. f. 20.* 1885; Treat. Diat. 193. *pl. 3. f. 147.* 1896. W. Smith, Synop. Brit. Diat. **1:** 53. *pl. 17. f. 154, Front. f. CLIV.* 1853. Donk. Brit. Diat. 51. *pl. 7. f. 8b* (not *f. 8a*). 1871–73. Rabh. Fl. Eur. Alg. **1:** 203. 1864. Schmidt, Jahresb. Komm. Deut. Meere **2:** 85. *pl. 1. f. 7a–b.* 1874. Schmidt, Atlas *pl. 13. f. 1–3.* 1875 (not *pl. 69. f. 30, 37–39.* 1881). O'Meara, Proc. Roy. Irish Acad. II. **2:** 402 (not *pl. 33. f. 29*). 1875. H. L. Smith, Sp. Diat. Typ. no. 265. 1874. De Toni, Syll. Alg. *2:* 71. 1891.

Navicula (Pinnularia) didyma Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1839:** 155. 1841.

Pinnularia didyma Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 383. *pl. 2. IV. f. 3, pl. 2. VI. f. 24, pl. 3. VII. f. 19* (?). 1843. Jan., Schles. Ges. Vaterl. Cult. **1862**[2]: 28. *pl. 2B. f. 13.* 1862.

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[a] Kütz. Bacill. 95. *pl. 28. f. 66.* 1844.

[b] W. Smith, Synop. Brit. Diat. **1:** 51. *pl. 16. f. 149.* 1853.

[c] Donk. Brit. Diat. 34. *pl. 5. f. 10.* 1871–73.

[d] Quart. Journ. Micr. Sci. **3:** 40. *pl. 4. f. 15.* 1855.

[e] Verh. Zool.-Bot. Ges. Wien **10:** 530. *pl. 3. f. 8.* 1860.

[f] Van Heur. Synop. *pl. 12. f. 6.* 1881; Treat. Diat. *pl. 4. f. 193.* 1896. Herib. Diat. Auverg. *pl. 4. f. 15.* 1893.

Diploneis didyma Ehrenb. Mikrog. *pl. 18. f. 69* (?), *pl. 19. f. 32*, *pl. 21. f. 34* (?), *pl. 22. f. 60* (?). 1854. Cleve, Sv. Vet. Akad. Handl. **26**[2]: 90. 1894.

Here again it is a question if Ehrenberg should be quoted as the author of this name. A bare reference to *Pinnularia didymus* is followed by a confusion of irreconcilable figures. That a well-understood conception has grown around this name is certain, but that it matches Ehrenberg's form or forms can not be proved. Cleve drops Ehrenberg out of the category, except for the original reference. De Toni masses the heterogeneous lot from Ehrenberg and other authors without comment. He also includes here *N.* (*Pinnularia*) *apis* Ehrenb. a thing not to be commended. There are a large number of diatoms of this general build, and the above species doubtless grades off into *N. bombus* (Ehrenb.) Kütz. on the one hand and *N. splendida* Greg. on the other. Their drawings are still more liable to overlap. But aside from the fact that *N. apis* Ehrenb. is an indefinite quantity, the modern conception of it in Kützing, Donkin, and others can not be joined with this species.

Found at station 3008H, Hawaiian Islands.

Navicula distans (W. Smith) Ralfs. Pritch. Hist. Infus. ed. 4. 907. 1861. Schmidt, Jahresb. Komm. Deut. Meere **2**: 91. *pl. 2. f. 38* (unnamed). 1874. Schmidt, Atlas *pl. 46. f. 11–14*. 1876. O'Meara, Proc. Roy. Irish Acad. II. **2**: 343 (not *pl. 30. f. 6*). 1875. Cleve, Bih. Sv. Vet. Akad. Handl. **1**[13]: 17. 1873. Grun. in Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 38. *pl. 2. f. 42*. 1880. Grun. Denkschr. Akad. Wien **48**[2]: 55. *pl. 1. f. 26*. 1884. Van Heur. Synop. Suppl. 87. *pl. A. f. 18*. 1885; Treat. Diat. 185. *pl. 3. f. 143*. 1896. De Toni, Syll. Alg. **2**: 53. 1891. Cleve, Sv. Vet. Akad. Handl. **27**[3]: 35. 1895.

Pinnularia distans W. Smith, Synop. Brit. Diat. **1**: 56. *pl. 18. f. 169*. 1853. Rabh. Fl. Eur. Alg. **1**: 217. 1891.

Found at stations 3526, 3604, 3635H, 3692H, Bering and Okhotsk seas.

Navicula fluminensis Grun. Verh. Zool. Bot. Ges. Wien **10**: 520. *pl. 1. f. 7*. 1860. Cleve, in Nordensk. Vega Exped. **3**: 463. 1888. Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 28. *pl. 1. f. 12*. 1880. De Toni, Syll. Alg. **2**: 111. 1891.

Navicula (*fluminensis* var.?) *floridana* Cleve, Sv. Vet. Akad. Handl. **18**[3]: 6. *pl. 1. f. 10*. 1881. De Toni, Syll. Alg. **2**: 35. 1891.

Navicula loczyi Pant. Beitr. Bacill. Ung. **2**: 51. *pl. 6. f. 114*. 1889.

Cleve makes this a variety of *Pinnularia quadratarea* (Schmidt) Cleve,[a] which is his own *N. pinnularia*.[b] He says, however, regarding *N. fluminensis:* "I have not seen original specimens and am therefore uncertain whether this form belongs to *P. quadratarea* or whether it is a Caloneis." It has no likeness to that form, except in its having the transverse striae interrupted by a stauros at the center. My specimen is much larger than any observed by Grunow, his largest (variety *kuguelensis*) being 0.057 mm. long, while mine is 0.085 mm. long. But Cleve's *N. floridana* and Pantocsek's *N. loczyi* approach it, the former being 0.075mm. and the latter 0.081mm. long.

Found at station 3692H, Okhotsk Sea.

Navicula formosa Greg. Trans. Micr. Soc. Lond. n. s. **4**: 42. *pl. 5. f. 6*. 1856. Schmidt, Atlas *pl. 50. f. 9 14* (not *f. 8, 15*). 1877. H. L. Smith, Sp. Diat. Typ. no. 274. 1874. Pritch. Hist. Infus. ed. 4. 909. 1861. Van Heur. Synop. 102. *pl. 11. f. 2*. 1881–85; Treat. Diat. 218. *pl. 5. f. 199*. 1896. De Toni, Syll. Alg. **2**: 142. 1891.

Pinnularia oregonica Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1870**: *pl. 2. I. f. 10* 1871.

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[a] Sv. Vet. Akad. Handl. **27**[3]: 96. 1895.

[b] Öfv. Kgl. Vet. Akad. Forhandl. **25**: 224. *pl. 4. f. 1 2*. 1868.

Navicula holmiensis Cleve, Sv. Vet. Akad. Handl. **18**[5]: 8. *pl. 2. f. 18.* 1881.
Navicula liburnica Grun.; Van Heur. Synop. 102. *pl. 11. f. 3.* 1881–85.
Caloneis formosa Cleve, Sv. Vet. Akad. Handl. **26**[2]: 57. 1894.

The truly transverse striae of *N. formosa fossilis* Pant.[a] makes it a questionable reference to the above. Cleve puts it in *Caloneis liber* (W. Smith) Cleve.[b] Gregory's original figure is a little more coarsely striated than normal.

Found at station 2929, off southern California.

Navicula gemmata Grev. Edinb. New Phil. Journ. n. s. **10:** 30. *pl. 4. f. 7.* 1859. Grun. in Fenzl, Reise Novara Bot. **1:** 100. *pl. 14. f. 16.* 1870. Schmidt, Atlas *pl. 8. f. 38, 42.* 1875; *pl. 70. f. 74* (unnamed). 1882. Pant. Beitr. Bacill. Ung. **1:** 25. *pl. 20. f. 181.* 1886. De Toni, Syll. Alg. **2:** 69. 1891.
Diploneis gemmata Cleve, Sv. Vet. Akad. Handl. **26**[2]: 98. 1894.
Navicula pseudogemmata Pant. Beitr. Bacill. Ung. **3:** *pl. 29. f. 420.* 1893.
Navicula grunowii Rabh. err. det. Schmidt, Atlas *pl. 70. f. 73.* 1882.
Navicula pristiophora Schmidt, Atlas *pl. 70. f. 72.* 1882.
Navicula mediterranean Grun.; Schmidt, Atlas *pl. 8. f. 40.* 1875 (?); Jahresb. Komm. Deut. Meere **2:** *pl. 2. f. 10.* 1874.
Navicula eudoxia Schmidt, Atlas *pl. 8. f. 39.* 1875; *pl. 70. f. 71.* 1882.
Navicula chimmoana O'Meara, Quart. Journ. Micr. Sci. n. s. **12:** 285. *pl. 13. f. 1.* 1872. Moeb. Diat.-taf. *pl. 81. f. 1.* 1890.
Navicula suluensis O'Meara, Quart. Journ. Micr. Sci. n. s. **12:** 285. *pl. 13. f. 2.* 1872. Moeb. Diat.-taf. *pl. 81. f. 2.* 1890.
Navicula bipunctata O'Meara, Quart. Journ. Micr. Sci. n. s. **12:** 286. *pl. 13. f. 5.* 1872. Moeb. Diat.-taf. *pl. 81. f. 5.* 1890?
Navicula unipunctata O'Meara (?) Quart. Journ. Micr. Sci. n. s. **12:** 286. *pl. 13. f. 4.* 1872. Moeb. Diat.-taf. *pl. 81. f. 4.* 1890.

I exclude from the above the following included by Cleve: *N. basilica* Brun[c] and *N. spectabilis* Grun.[d] This last is a preempted name, having been used by Gregory in 1856. Rabenhorst therefore renamed it *N. grunowii*.[e] It is not the same as the form so called by Schmidt, which is included here.

Found at station 2920H, Hawaiian Islands.

Navicula graeffii Grun.; Schmidt, Atlas *pl. 7. f. 5–6.* 1875. De Toni, Syll. Alg. **2:** 94. 1891.
Diploneis graeffii Cleve, Sv. Vet. Akad. Handl. **26**[2]: 93. 1894.

Found at station 4516H, Gulf of California.

Navicula gyrinida Mann, sp. nov. PLATE LII, FIGURE 6.

Valve broadly oval, curving from the center to the rounded ends; markings moniliform striae, extending from the margin to a line inclosing a spindle-shaped central area; this area ribbed transversely with smooth striae confluent with the outer moniliform striae, these last being radiate; a minute H-shaped hyaline central space.

Length of valve, 0.054 mm.; width of valve, 0.035 mm.

This species is close to the unnamed figure of Schmidt's,[f] of which he says, "mit *N. elliptica* schwerlich zu vereinen." It is certainly impossible to call it *N. elliptica* Kutz.[g] Nor can it be either of the irreconcilable figures of *N. elliptica* W. Smith.[h]

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[a] Pant. Beitr. Bacill. Ung. **2:** 46. *pl. 20. f. 310.* 1889.
[b] Sv. Vet. Akad. Handl. **26**[2]: 55. 1894.
[c] Mem. Soc. Phys. et Hist. Nat. Geneva **31**[1]: 32. *pl. 15. f. 14.* 1891.
[d] Verh. Zool. Bot. Ges. Wien **10:** 533. *pl. 1. f. 11.* 1860.
[e] Rabh. Fl. Eur. Alg. **1:** 203. 1864.
[f] Schmidt, Atlas *pl. 7. f. 24.* 1875.
[g] Kütz. Bacill. 98. *pl. 30. f. 55.* 1844, and Van Heur. Synop. *pl. 10 f. 10.* 1881.
[h] W. Smith, Synop. Brit. Diat. **1:** 48. *pl. 17. f. 152.* 1853.

The name here given refers to its resemblance in outline and convexity to the water-beetle, Gyrinida.

Type in the U. S. National Museum, No. 590146, from station 2807, Galapagos Islands, April 4, 1888; 812 fathoms, bottom of Globigerina, ooze and coral mud.

Navicula hennedyi W. Smith, Synop. Brit. Diat. **2**: 93. 1853. Greg. Trans. Micr. Soc. Lond. n. s. **4**: 40. *pl. 5. f. 3.* 1856. Grun. Verh. Zool. Bot. Ges. Wien **10**: 532. *pl. 1. f. 21–22.* 1860. Donk. Brit. Diat. 11. *pl. 2. f. 3.* 1871–73. Schmidt, Jahresb. Komm. Deut. Meere **2**: 89. *pl. 1. f. 41.* 1874. Schmidt, Atlas *pl. 3. f. 3–5, 17, 18.* 1875; *pl. 129. f. 10.* 1888. Van Heur. Synop. 93. *pl. 9. f. 14.* 1881; Treat. Diat. 204. *pl. 4. f. 160, pl. 27. f. 755.* 1896. Jan. Diat. Gaz. Exped. *pl. 15. f. 14.* Pritch. Hist. Infus. ed. 4. 898. *pl. 7. f. 69.* 1861. Witt, Verh. Russ. Min. Ges. II. **2**: 29. *pl. 9. f. 5.* 1886. O'Meara, Proc. Roy. Irish Acad. II. **2**: 387. *pl. 32. f. 241.* 1875. Rabh. Fl. Eur. Alg. **1**: 178. 1864. Leud.-Fort. Mem. Soc. Emul. St. Brieuc 29. *pl. 8. f. 88.* 1879 (?). Pant. Beitr. Bacill. Ung. **2**: 47. *pl. 12. f. 207.* 1889. Cleve, Sv. Vet. Akad. Handl. **18**[5]: 7. *pl. 1. f. 14–15* (not *pl. 2. f. 19*). 1881; **27**[3]: 57. 1895; **26**[2]: *pl. 4. f. 14.* 1894. De Toni, Syll. Alg. **2**: 103. 1891. Petit, Fonds de la Mer **3**: 182. *pl. 4. f. 13.* 1877 (?).

Navicula nebulosa Greg. Trans. Roy. Soc. Edinb. **21**: 480. *pl. 9. f. 8.* 1857. Donk. Brit. Diat. 11. *pl. 2. f. 2.* 1871–73. Schmidt, Atlas *pl. 3. f. 14.* 1875; *pl. 70. f. 44.* 1881. Cf. Van Heur. Treat. Diat. 204. *pl. 27. f. 755.* 1896.

Navicula californica Grev. Edinb. New Phil. Journ. n. s. **10**: 29. *pl. 4. f. 5.* 1859. Grun.; Schmidt, Atlas *pl. 3. f. 6, 19.* 1875.

Navicula polysticta Grev. err. det. Schmidt, Atlas *pl. 3. f. 26–28.* 1875. Schmidt, Jahresb. Komm. Deut. Meere **2**: 89. *pl. 1. f. 36, 42.* 1874. Cf. Edinb. New Phil. Journ. **10**: 28. *pl. 4. f. 2.* 1859.

Navicula bacillifera Pant. Beitr. Bacill. Ung. **2**: 42. *pl. 5. f. 80.* 1889.

Navicula (*hennedyi* var. ?) *caliginosa* Cleve. & Grove, Le Diatomiste **1**: 67. *pl. 10. f. 9.* 1891.

Navicula perennis Pant. Beitr. Bacill. Ung. **3**: *pl. 41. f. 560.* 1893.

This widely distributed diatom is most variable and grades off so gradually into forms so different from the type that it is out of the question to draw a boundary line around this species. It merges into *N. praetexta* Ehrenb. and *N. lyra* Ehrenb. I have excluded from the synonymy such species as seem to me too wide of the ideal to be in any way confused with it; though I recognize that there are transitional forms in nearly every instance. For this reason I do not include *N. sandriana* Grun.,[a] *N. fallax* Cleve,[b] *N. schleinitzii* Jan.,[c] and it is with some uncertainty that I have followed the lead of Cleve in classing the very delicate *N. nebulosa* Greg. with the above. This last occurs plentifully at station 2807 and W. Smith's type at stations 2807 and 2835.

Found at stations 2807, 2808, 2835, 2920H, Galapagos and Hawaiian islands and off Lower California.

Navicula impressa Grun.; Schmidt, Atlas *pl. 6. f. 17–18.* 1875. Cleve, Sv. Vet. Akad. Handl. **26**[2]: 50. 1894. De Toni, Syll. Alg. **2**: 134. 1891. Schmidt, Atlas *pl. 6. f. 36* (unnamed). 1875.

My specimen is an unsatisfactory example of this diatom. It agrees accurately with Schmidt's unnamed figure cited above. Though I share the doubt of Schmidt of this being identical with any known species, I think the similarity to the above is too close to admit of maintaining here two good species. Lagerstedt[d] has given this name by mistake to a variety of *N. cancellata* Donk.

Found at station 3712H, Okhotsk Sea.

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[a] Verh. Zool. Bot. Ges. Wien **13**: 153. *pl. 4. f. 5.* 1863.

[b] Sv. Vet. Akad. Handl. **26**[2]: 135. *pl. 5. f. 27.* 1894.

[c] Schmidt, Atlas *pl. 70. f. 48.* 1881; Jan. Diat. Gaz. Exped. *pl. 15. f. 1.*

[d] Bih. Sv. Vet. Akad. Handl. **3**[15]: 33. *pl. 1. f. 3.* 1876.

Navicula invenusta Mann, sp. nov. PLATE LIII, FIGURES 6, 7,

Valve elliptical, broad, massive; costae punctate with a double row of *alternating* minute beads; the inner ends of the costae forming a straight line parallel to the raphe; an irregularly placed row of large beads near the inner ends of the costae; sutures between the costae projected inward, with enlarged ends, the three on either side of the hyaline central space extending farther than the rest; a single row of round beads bordering the median line, the latter terminating in a rectangular hyaline area at each apex.

Length of valve, 0.120 to 0.165 mm.; width of valve, 0.040 to 0.056 mm.

The larger of the two specimens photographed for the above figures was selected because, being slightly tilted, it shows the two kinds of beading previously mentioned.

Type in the U. S. National Museum, No. 590147, from station 2807, Galapagos Islands, April 4, 1888; 912 fathoms, bottom of Globigerina ooze and coral mud.

Navicula irrorata Grev. Edinb. New Phil. Journ. n. s. **10:** 27. *pl. 4. f. 1.* 1859. Schmidt, Atlas *pl. 2. f. 19, 22-23.* 1875. Cleve, Sv. Vet. Akad. Handl. **27**[3]: 56. 1895; **26**[2]**:** *pl. 4. f. 13.* 1894. De Toni, Syll. Alg. **2:** 100. 1891. Pant. Beitr. Bacill. Ung. **2:** 49. *pl. 8. f. 147.* 1889. Pritch. Hist. Infus. ed. 4. 897. 1861.

Navicula approximata Grev.; Grun. in Schmidt, Atlas *pl. 2. f. 20.* 1875.

Such varieties as Schmidt's figure 19, cited above, show the transition of this species into varieties of *N. sculpta* W. Smith.[a]

Found at station 2823, Gulf of California.

Navicula lacrimans Schmidt, Atlas *pl. 12. f. 59-61.* 1875. Pant. Beitr. Bacill. Ung. **2:** 50. *pl. 2. f. 18.* 1889. De Toni, Syll. Alg. **2:** 70. 1891.

Diploneis gemmulata Cleve, Sv. Vet. Akad. Handl. **26**[2]: 104. 1894, not *Navicula gemmulata* Grun.; Schmidt, Atlas *pl. 13. f. 20–21.* 1875.

Cleve's union of the first two of the three figures of Schmidt, cited above, with Grunow's *Navicula gemmulata* is not to be commended. First of all, the three represent one species; then, further, they are widely different from *N. gemmulata* Grun. It may be added that his joining with these *N. taschenbergei* Schmidt[b] and *N. beyrichiana* Schmidt[c] is equally bad. Later[d] he held the last-named separate.

Found at station 2807, Galapagos Islands.

Navicula lata (Breb.) W. Smith, Synop. Brit. Diat. **1:** 55. 1853. Donk. Brit. Diat. 71. 1871–73. Schum. Verh. Zool. Bot. Ges. Wien **17:** 73. *pl. 4. f. 54.* 1867. Grun. Verh. Zool. Bot. Ges. Wien **10:** 515. 1860. Van Heur. Synop. 76. *pl. 6. f. 1–2.* 1881; Treat. Diat. 169. *pl. 2. f. 76.* 1896. De Toni, Syll. Alg. **2:** 18. 1891. Grun. Denkschr. Akad. Wien **48**[2]: 98. *pl. 1. f. 14–17.* 1884. Herib. Diat. Auverg. 86. *pl. 4. f. 5.* 1893. H. L. Smith, Sp. Diat. Typ. no. 289. 1874. Pritch. Hist. Infus. ed. 4. 908. 1861, not Kütz. Bacill. 92. *f. 51.* 1844

Frustulia lata Breb. Consid. Diat. 18. 1838.

Pinnularia pachyptera Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 421. *pl. 4. II. f. 9.* 1843; Mikrog. *pl. 38A. XVII. f. 7* (not *pl. 35A. f. 17*). 1854. Rabh. Sussw. Diat. 45. *pl. 6. f. 11.* 1853. Bail. in Fremont. Rep. Expl. Exped. 1842–44. 302. *pl. 5. f. 6.* 1845.

Navicula pachyptera Kütz. Bacill. 98. *pl. 28. f. 58.* 1844. Pritch. Hist. Infus. ed. 4. 896. 1861. O'Meara, Proc. Roy. Irish Acad. II. **2:** 342. *pl. 30. f. 5.* 1875. Schmidt, Atlas *pl. 45. f. 5–8.* 1845. Pant. Beitr. Bacill. Ung. **3:** *pl. 20. f. 302.* 1893.

Pinnularia lata W. Smith, Synop. Brit. Diat. **1:** 55. *pl. 18. f. 167.* 1853. Rabh. Sussw. Diat. 42. 1853; Fl. Eur. Alg. **1:** 212. 1864. Brun, Diat. Alp. 85. *pl. 8. f. 25.* 1880. Cleve, Sv. Vet. Akad. Handl. **27**[3]: 81. 1895.

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[a] Van Heur. Synop. *pl. 12. f. 1.* 1881.

[b] Op. cit. *pl. 174. f. 8–9.*

[c] Op. cit. *pl. 69. f. 16–17.*

[d] Journ. Quek. Micr. Club II. **2:** 167. 1885.

Pinnularia megaloptera Ehrenb. Mikrog. *pl. 3. I. f. 4, III. f. 2.* 1854; Phys. Abh. Akad. Wiss. Berl. **1870:** *pl. 3. I. f. 16.* 1871.
Navicula megaloptera Herib. Diat. Auverg. 88. *pl. 4. f. 6.* 1893.
Navicula costata Ehrenb.; Herib. Diat. Auverg. 87. *pl. 4. f. 7.* 1893, not Kütz. 1844.

A mistake that is constantly being repeated is the uniting of Kützing's figure with this species, to which it has not the remotest resemblance. It is the same as *N. microstoma* Kütz.,[a] which is only a variety of *N. firma* Kütz., as De Toni[b] and others point out. Nevertheless, De Toni,[c] after recognizing this fact, quotes this error of Kützing. Cleve falls into the same mistake, though omitting any reference to the figure of Kützing, his diagnosis being in perfect harmony with his figure. Both Donkin and O'Meara in the above citations note the mistake made by Kützing.

Found at station 3611, Bering Sea.

Navicula lyra Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 419. *pe. 1. I. f. 9a.* 1843. Kütz. Bacill. 94. *pl. 28. f. 55.* 1844. Greg. Trans. Roy. Micr. Soc. Edinb. **21:** 485. *pl. 9. f. 13–14b.* 1857. Jan. & Rab. in Rabh. Beitr. **1:** 10. *pl. 3. f. 7.* 1863. Jan. Abh. Schl. Ges. Vaterl. Cult. **1862:** *pl. 1. I. f. 26.* 1862. W. Smith, Synop. Brit. Diat. **1:** *pl. 17. f. 152a*.* 1853; **2:** 93. 1856. Pritch. Hist. Infus. ed. 4. 897. 1861. Donk. Brit. Diat. 14. *pl. 2. f. 7.* 1871–73. Schmidt, Atlas *pl. 2. f. 4–5, 8–9, 16, 18* (not *f. 29–33, f. 25–27* doubtful). 1875; Jahresb. Komm. Deut. Meere **2:** *pl. 1. f. 34–35, 38–39* (all doubtful). 1874. Rabh. Fl. Eur. Alg. **1:** 177. 1864. Van Heur. Synop. 93. *pl. 10. f. 1-2.* 1881–85; Treat. Diat. 203. *pl. 4. f. 161.* 1896. Jan. Diat. Gaz. Exped. *pl. 15. f. 8-9, 13.* Cleve, Bih. Sv. Vet. Akad. Handl. **5:** 4. *pl. 1. f. 1.* 1878; Sv. Vet. Akad. Handl. **27:** 63. 1895. De Toni, Syll. Alg. **2:** 95. 1891. Pant. Beitr. Bacill. Ung. **1:** 27. *pl. 17. f. 150.* 1886; **2:** 50. 1889; **3:** *pl. 33. f. 466, 468, pl. 34. f. 479.* 1893. Grev. Edinb. New Phil. Journ. n. s. **10:** 28. *pl. 4. f. 3.* 1859. Castr. Rep. Voy. Chall. Bot. **2:** 33. *pl. 30. f. 13.* 1886. Truan, Anal. Soc. Espan. Hist. Nat. **13:** 44. *pl. 8. f. 23-24.* 1884. Grun. Verh. Zool. Bot. Ges. Wien **10:** 532. *pl. 3. f. 22* (not *f. 23*). 1860. H. L. Smith, Sp. Diat. Typ. no. 292. 1874. Wolle, Diat. N. A. *pl. 16. f. 4, 6, 9, 14, 26.* 1890.

Navicula bullata Norm. Trans. Micr. Soc. Lond. n. s. **9:** 8. *pl. 2. f. 7.* 1861. Moeb. Diat.-taf. *pl. 36. f. 7.* 1890. Schmidt, Atlas *pl. 3. f. 8–9.* 1875. Castr. Rep. Voy. Chall. Bot. **2:** 29. *pl. 28. f. 7* (not *f. 10*), *pl. 30. f. 7.* 1886.

Pinnutaria couperii Bail. Smithson. Contr. Knowl. **2:** 39. *pl. 2. f. 33.* 1851.
Navicula couperi Bail.; Schmidt, Atlas *pl. 2. f. 12.* 1875?

Navicula zanzibarica Grev. Trans. Micr. Soc. Lond. n. s. **14:** 129. *pl. 12. f. 22.* 1866. Schmidt, Atlas *pl. 2. f. 3.* 1875. Castr. Rep. Voy. Chall. Bot. **2:** 31. *pl. 28. f. 8.* 1886.

Navicula robertsoniana Grev. Trans. Bot. Soc. Edinb. **8:** 235. *pl. 3. f. 9.* 1866. Schmidt, Atlas *pl. 2. f. 7, 11.* 1875. Wolle, Diat. N. A. *pl. 16. f. 8.* 1890.

Navicula durandii Kitt.; Schmidt, Atlas *pl. 129. f. 1–3.* 1888.

I have not included here the reference in O'Meara,[d] because all six figures are worse than worthless. Nor is Schmidt's figure, cited above and called *N. couperi* Bail., like the original or a good example of *N. lyra*. Cleve adds *N. seductilis* Schmidt,[e] which I also omit. It is plain that this polymorphic form has no hard and fixed boundaries, and that what is to be included or what not must always be somewhat a matter of personal preference. I feel that in this and similar cases condensation ought to be carried only so far as that the average student will be more likely to pick out the species assigned than any other. Where, in other words, the relationship begins to seem

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[a] Kütz. Sp. Alg. 71. 1849.
[b] De Toni, Syll. Alg. **2:** 155. 1891.
[c] Op. cit. 18.
[d] Proc. Roy. Irish Acad. II. **2:** 391. *pl. 33. f. 1–6.* 1875.
[e] Schmidt, Atlas *pl. 2. f. 35–36.* 1875.

forced, I think it is time to stop. Thus it seems to me that Schmidt's figure 34,[a] though clearly grading into *N. lyra*, would be more likely to be taken for *N. forcipata* Grev.[b] I therefore classify it so, Greville's species not being considered by anyone to be synonymous with *N. lyra*. Cleve gives 25 named varieties of *N. lyra*. I omit these. They could easily be increased to 100; but our nomenclature will soon change from binomial to trinomial if this plan becomes a general one.

Found at stations 2694H, 2807, 2808, 2835, 2920H, 3013H, 3604, 3635H, 4014H, Galapagos Islands to Bering Sea and off Honshu Island, Japan.

Navicula major Kütz. Bacill. 97. *pl. 4. f. 19–20.* 1844. Donk. Brit. Diat. 69. *pl. 11. f. 2.* 1871–73. Van Heur. Synop. 73. *pl. 5. f. 3–4.* 1881; Treat. Diat. 165. *pl. 2. f. 69.* 1896. Schmidt, Atlas *pl. 42. f. 8.* 1876 (all other figures doubtful). Pant. Beitr. Bacill. Ung. **3:** *pl. 7. f. 113.* 1893. De Toni, Syll. Alg. **2:** 10. 1891. H. L. Smith, Sp. Diat. Typ. no. 294. 1874. Truan, Anal. Soc. Espan. Hist. Nat. **13:** 341. *pl. 7. f. 20.* 1884. Pritch. Hist. Infus. ed. 4. 896. *pl. 7. f. 65.* 1861.

Frustulia major Kütz. Linnaea **8:** 547. *f. 25.* 1833 ?

Pinnularia major W. Smith, Synop. Brit. Diat. **1:** 54. *pl. 18. f. 162.* 1853. Rabh. Sussw. Diat. 42. *pl. 6. f. 5.* 1853. Cleve, Sv. Vet. Akad. Handl. **27**[3]**:** 89. *pl. 1. f. 22.* 1895.

Navicula heroina Schmidt, Atlas *pl. 43. f. 2.* 1876.

Navicula nobilis Ehrenb.; Brun, Diat. Alp. 84. *pl. 8. f. 1.* 1880.

Navicula transversa Schmidt, Atlas *pl. 43. f. 5–6.* 1876 (?).

Navicula viridis Ehrenb. Infus. 182. *pl. 13. f. 16* (not *pl. 21. f. 12*). 1838, in part; Phys. Abh. Akad. Wiss. Berl. **1837:** *pl. 1. f. 19.* 1839. Bail. Am. Journ. Sci. **42:** 96. *pl. 1. f. 16.* 1842.

Here we meet a problem of specific limitation that is particularly difficult. I have in the main followed the arrangement of Cleve,[c] though it leaves much to be desired. *Pinnularia subacuta* Ehrenb.[d] I do not include here. But aside from this, the question of what distinction can be drawn between the above and *N. dactylus* (Ehrenb.) Kütz., also *N. nobilis* (Ehrenb.) Kütz., is not satisfactorily answered. De Toni[e] unites *N. dactylus* and *N. nobilis*, but separates them from *N. major*. All these, as well as figures of *N. viridis* (Ehrenb.) Kütz. are without any lines of separation from each other. Schmidt says[f] "*Pinn. viridis* und *dactylus*, E., *N. major* und *viridis*, K. verschwimmen so in einander, dass sich ein genügender Nachweiss über ihr Verhältniss zu einander gar nicht geben lässt."

Found at stations 2848, 2929, south of Alaska peninsula and off southern California.

Navicula nitescens (Greg.) Ralfs, Pritch. Hist. Infus. ed. 4. 898. 1861. Donk. Brit. Diat. 8. *pl. 1. f. 7.* 1871–73. Schmidt, Atlas *pl. 7. f. 37–41, pl. 8. f. 14–16* (unnamed). 1875. Jan. & Rabh. in Rabh. Beitr. **1:** 10. *pl. 2. f. 7.* 1863. O'Meara, Proc. Roy. Irish Acad. II. **2:** 389. *pl. 32. f. 32.* 1875. De Toni, Syll. Alg. **2:** 91. 1891. Van Heur. Treat. Diat. 198. *pl. 26. f. 747.* 1896. Pant. Beitr. Bacill. Ung. **2:** 53. *pl. 9. f. 163.* 1889.

Diploneis nitescens Cleve, Sv. Vet. Akad. Handl. **26**[2]**:** 97. 1894.

Navicula smithii Breb. variety; Greg. Trans. Roy. Soc. Edinb. **21:** 487. *pl. 9. f. 16.* 1857.

Navicula adriatica Grun. Verh. Zool. Bot. Ges. Wien **10:** 525. *pl. 1. f. 17.* 1860.

Pinnularia arraniensis O'Meara, Quart. Journ. Micr. Sci. **14:** 116. *pl. 5. f. 6.* 1867.

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[a] Schmidt, Atlas *pl. 2. f. 34.* 1875.

[b] Quart. Journ. Micr. Sci. **7:** 83. *pl. 6. f. 10–11.* 1859.

[c] Sv. Vet. Akad. Handl. **27**[3]**:** 89. 1895.

[d] Ehrenb. Mikrog. *pl. 35A.* VI. *f. 12.* 1854, and Schmidt, Atlas *pl. 43. f. 31–33.* 1876.

[e] De Toni, Syll. Alg. **2:** 9. 1891.

[f] Atlas *pl. 42. f. 3.* 1876.

As Ralfs[a] points out, this is too wide of *N. smithii* to make a variety, as Gregory proposed. I do not think it necessary to include here *N. serrulata* Schmidt,[b] as is done by Cleve. Schmidt himself points out that they are related, but they seem to me, as to him, worthy of separation.

Found at station 3696, off Honshu Island, Japan.

Navicula notabilis Grev. Trans. Micr. Soc. Lond. n. s. **11:** 18. *pl. 1. f. 9.* 1863. Moeb. Diat.-taf. *pl. 49. f. 9.* 1890. De Toni, Syll. Alg. **2:** 192. 1891. Schmidt, Jahresb. Komm. Deut. Meere **2:** 88. *pl. 1. f. 20, pl. 2. f. 11.* 1874. Schmidt, Atlas *pl. 8. f. 46–52.* 1875. Van Heur. Treat. Diat. 200. *pl. 26. f. 750–751.* 1896.

Diploneis notabilis Cleve, Sv. Vet. Akad. Handl. **26**[2]**:** 93. 1894.

My specimen agrees with the two figures of Schmidt,[c] *N. notabilis expleta*, which make so divergent a variety that it would almost be allowable to raise the form to specific rank instead of considering it a variety of the above species.

Found at station 2808, Galapagos Islands.

Navicula oamaruensis Grun.; Schmidt, Atlas *pl. 129. f. 9.* 1888. Cleve, Sv. Vet. Akad. Handl. **27**[3]**:** 57. 1895.

It is a question if this can be maintained as a separate species from *N. praetexta* Ehrenb. It is so close to *N. haytiana* Truan & Witt,[d] that the only point of contrast is in the latter having the marginal striae interrupted at the terminations of the raphe, while the above has the striae unbroken around the entire valve. The close resemblance is noted by Grunow in the above citation. Cleve unites *N. haytiana* with *N. praetexta*, yet gives this separate rank. I can only say in conforming to this rather inconsistent arrangement that the line has to be drawn somewhere. It is significant that the following dredging which furnishes this form also furnishes the normal *N. praetexta* and the typical *N. haytiana*, as will be noted under *N. praetexta*.

Found at station 2807, Galapagos Islands.

Navicula pennata Schmidt, Atlas *pl. 48. f. 41 43.* 1876. De Toni, Syll. Alg. **2:** 113. 1891. Cleve, Sv. Vet. Akad. Handl. **27**[3]**:** 32. 1895.

Navicula kinkeri Pant. Beitr. Bacill. Ung. **2:** 50. *pl. 9. f. 169.* 1889. De Toni, Syll. Alg. **2:** 21. 1891.

Scoliopleura szakalensis Pant. Beitr. Bacill. Ung. **2:** 57. *pl. 8. f. 154.* 1889. De Toni, Syll. Alg. **2:** 267. 1891.

Navicula pinnata Pant. Beitr. Bacill. Ung. **2:** 54. *pl. 20. f. 308.* 1889. Cleve, Sv. Vet. Akad. Handl. **27**[3]**:** 33. 1895. De Toni, Syll. Alg. **2:** 64. 1891.

Leaving out the unimportant matter of size, this species differs from *N. longa* Greg. chiefly in its tapering and transversely cut striae. I see no reason to consider any of the above forms of Pantocsek as different from this species. Cleve unites the first two here, but assigns inconsequent reasons for giving *N. pinnata* separate standing. *Scoliopleura szakalensis* is merely a contorted specimen of *N. kinkeri;* both come from the same fossil deposit at Szakal. *N. pinnata*, though not recorded by Pantocsek from Szakal, is of wide distribution, occurring with *N. kinkeri* and *S. szakalensis* at Nagy-Kurtos, as well as at Bory and Bremia. The union of *N. pinnata* here happens to have the added advantage of making synonymous a name too easily confused with that given by Schmidt.

Found at station 4516H, Gulf of California.

Navicula phoenicenteron (Nitzsch) Ehrenb. Ber. Akad. Wiss. Berl. **1836:** 53. 1837; Infus. 175. *pl. 13. f. 1.* 1838.

Bacillaria phoenicenteron Nitzsch. Neue Schrift. Naturf. Ges. Halle **3:** *pl. 3. f. 12, 14* (exclusive of other figures). 1817. Ehrenb. Infus. 175. 1838.

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[a] Pritch. Hist. Infus. ed. 4. 893. 1861.

[b] Schmidt, Atlas *pl. 7. f. 42 43.* 1875.

[c] Opp. cit. *pl. 8. f. 49 50.*

[d] Truan & Witt, Diat. Hayti *pl. 4. f. 9.* 1888.

Cymbella phoenicenteron Ag. Consp. Diat. 10. 1832.

Stauroneis lanceolata Kütz. Bacill. 104. *pl. 30. f. 24.* 1844. Grun. Verh. Zool. Bot. Ges. Wien **10:** 563. 1860. Pritch. Hist. Infus. ed. 4. 913. 1861. Rabh. Sussw. Diat. 48. *pl. 9. f. 9.* 1853.

Stauroneis phoenicenteron Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 387. *pl. 2. V. f. 1, pl. 3. I. f. 17.* 1843; Mikrog. *pl. 2. II. f. 8, pl. 3. I. f. 7. II. f. 4, pl. 6. I. f. 21, pl. 9. I. f. 15, pl. 15. I. A. f. 27. B. f. 10, pl. 16. I. f. 5. II. f. 5, III. f. 28.* 1854 (not Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1870:** *pl. 2. I. f. 29, pl. 3. I. f. 21.* 1871). Rabh. Sussw. Diat. 47. *pl. 9. f. 1.* 1853. W. Smith, Synop. Brit. Diat. **1:** 59. *pl. 19. f. 185.* 1853. Pritch. Hist. Infus. ed. 4. 913. *pl. 9. f. 139, pl. 12. f. 17–18.* 1861. Brun. Diat. Alp. 88. *pl. 9. f. 5, 7.* 1880. Griff. & Henf. Micr. Dict. ed. 4. 735. *pl. 15. f. 43.* 1883. Van Heur. Synop. 67. *pl. 4. f. 2.* 1881; Treat. Diat. 158. *f. 30,* 159. *pl. 1. f. 50.* 1896. De Toni, Syll. Alg. **2:** 204. 1891. Cleve, Sv. Vet. Akad. Handl. **26**[2]**:** 148. 1894. H. L. Smith, Sp. Diat. Typ. no. 496. 1874. Belloc, Rev. de Comm. **3:** 40. *pl. 3. f. 11.* 1887. Not Kütz.

Stauroneis baileyi Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 422. 1843; Mikrog. *pl. 2. III. f. 12* (not *f. 10*), *pl. 3. III. f. 6-7. IV. f. 11, pl. 4. I. f. 4. II. f. 11–12. III. f. 2, pl. 5. I. f. 13. III. f. 14. pl. 6. I. f. 17.* 1854. Kütz. Bacill. 105. 1844. Pritch. Hist. Infus. ed. 4. 913. 1861. De Toni, Syll. Alg. **2:** 207. 1891.

Stauroneis pteroidea Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 423. 1843; Mikrog. *pl. 14. I. f. 5.* 1854. Kütz. Bacill. 105. 1844. De Toni, Syll. Alg. **2:** 207. 1891.

Stauroneis amphilepta Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 386. *pl. 1. II. f. 9, 13.* 1843; Mikrog. *pl. 14. f. 18.* 1854. Kütz. Bacill. 105. *pl. 29. f. 16–17.* 1844. Pritch. Hist. Infus. ed. 4. 913. 1861.

Stauroneis brunii Perty; Herib. Diat. Auverg. 76. *pl. 3. f. 22.* 1893.

Cleve leaves out the two first-named synonyms and consequently credits the name to Ehrenberg. I am dependent for the reference upon the accuracy of Ehrenberg's citation;[a] but as it is about universally conceded to be correct I quote the reference to Nitzsch without having seen the original publication.

I do not favor placing *Stauroneis gracilis* Ehrenb. in this list. Ehrenberg's original figures[b] represent a diatom sharper, much smaller, and much more delicate. The same is true of Smith's figures,[c] though this fails to agree with the Ehrenberg type because of its narrower stauros.

The question of the union of Stauroneis with the present genus has been discussed under Navicula above.

Found at station 2882, off Oregon.

Navicula pinguis Mann, sp. nov. PLATE LIII, FIGURE 5.

Valve broad, slightly narrowed at the center; ends blunt, center depressed; markings of heavy ridges bearing large oval beads, three to four, the outer row being elongated to the margin; a longitudinal hyaline area, through which runs the raphe, connecting the apices and bordered on either side by a single row of large oval beads of the same number as and continuous with the ridges.

Length of valve, 0.160 mm.; width of valve, 0.070 mm. Striae, 28 in 0.1 mm.

This species bears considerable resemblance to Grunow's figure of *N. subcincta* Schmidt,[d] and were this identification correct I would not hesitate to write this as a

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[a] Ehrenb. Infus. 175. 1838.

[b] Phys. Abh. Akad. Wiss. Berl. **1841:** 386. *pl. 1. II. f. 14, pl. 2. I. f. 17.* 1843; Microg. *pl. 2. I. f. 2.* 1854.

[c] W. Smith, Synop. Brit. Diat. **1:** 59. *pl. 19. f. 186.* 1853.

[d] Denkschr. Akad. Wien **48**[2]**:** 56. *pl. 1. f. 39.* 1884.

wide variety of that species. But Grunow's form is in no sense Schmidt's diatom. Aside from a general similarity of outline and of the median line area, they are most strongly contrasted. Not only does it fail to agree in beading and the direction of the striae, especially at the center, with the figure in the Atlas quoted by Grunow,[a] but if we take Schmidt's original type form[b] the difference is even more pronounced. Grunow also includes what Lagerstedt has perhaps erroneously called *N. didyma* (Ehrenb.) Kütz.[c] This form, the author says in a note, is close to one of Donkin's figures of *N. didyma*.[d] But without going into the merits of Lagerstedt's identification it is enough to say that it has little if any resemblance to either Schmidt's *subcincta* or to my species, and that *subcincta* is far closer to Donkin's figure of *didyma* than the one given by Lagerstedt, a fact noted under *N. subcincta* in this report. The exact type form of Schmidt's *N. subcincta* occurs at station 3008H, corresponding with it in form, markings, and size. When it is compared with this species, all true resemblance vanishes. It may be instructive to add here the measurements of Grunow's and Schmidt's specimens for comparison with those given above. Length of Grunow's largest specimen, 0.107 mm.; smallest, 0.062 mm; of Schmidt's type, *N. subcincta*, 0.054 mm.

Type in the U. S. National Museum, No. 590148, from station 3604, Bering Sea, August 12, 1895; 1,401 fathoms, bottom of green ooze.

Navicula pleurostaurum Mann.

Stauroneis acuta W. S. Smith, Synop. Brit. Diat. **1:** 59. *pl.* 19. *f. 187*, front. *f. 187*. 1853. Pritch. Hist. Infus. ed. 4. 914. *pl. 7. f. 76*. 1861. Van Heur. Synop. 68. *pl. 4. f. 3*. 1881; Treat. Diat. 159. *pl. 1. f. 51*. 1896. Grun. Denkschr. Akad. Wien **48**[2]: 47. 1884. H. L. Smith, Sp. Diat. Typ. no. 485. 1874. Wolle, Diat. N. A. *pl. 8. f. 11*. 1890. Schmidt, Atlas *pl. 141. f. 4 5*. 1889. Deby, Ann. Soc. Malacol. Belg. **11:** 88. 1876. Cleve, Sv. Vet. Akad. Handl. **26**[2]: 150. 1894.

Pleurostaurum acutum Rabh. Hedwigia **1:** 17. *pl. 1. f. B*. 1859. Jan. in Hedwigia **1:** 25. 1859; **5:** *pl. 3. f. 1–8*. 1863. Rabh. Fl. Eur. Alg. **1:** 20. 259. *f. 6*. 1864.

Pleurostauron acutum Rabh.; De Toni, Syll. Alg. **2:** 222. 1891.

Stauroneis kochii Pant. Beitr. Bacill. Ung. **3:** *pl. 6. f. 93*. 1893.

As I find it necessary to discard the genus Stauroneis as separate from Navicula for reasons already given, I am compelled to give a new specific name to this well-known diatom. The name *N. acuta* is preempted by *N. acuta* Kütz., an indeterminate form,[e] as well as *N. acuta* (W. Smith) O'Meara.[f]

The synonymous form *Stauroneis kochii* Pant. can not be used, as there is a *N. kochii* Pant.[g] I therefore apply to this diatom the specific name *pleurostaurum*, taking the lapsed generic name of Rabenhorst,[h] of which this particular diatom was the type. As Rabenhorst has pointed out, this diatom is peculiar in the sunken stauros as well as in the internal thickening of the side margins, especially toward the ends, which give a thickened, hooded aspect to the apices. De Toni and others accept this as an adequate generic distinction. I do not consider this and similar forms, as *N.* (*Stauroneis*) *fulmen* Bright., to be sufficiently distinct from other examples of Navicula to require their separation. Cleve,[i] while retaining this in Stauroneis, makes use of Pleuro-

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[a] Schmidt, Atlas *pl. 13. f. 41*. 1875.

[b] Jahresb. Komm. Deut. Meere **2:** *pl. 2. f. 7*. 1874.

[c] Bih. Sv. Vet. Akad. Handl. **3**[15]: 36. *pl. 1. f. 4*. 1876.

[d] Donk. Brit. Diat. *pl. 7. f. 8b*. 1871–73.

[e] Kütz. Bacill. 93. *pl. 3. f. 69*. 1844.

[f] Proc. Roy. Irish Acad. II. **2:** 407. *pl. 34. f. 5. 1875*.

[g] Pant. Beitr. Bacill. Ung. **2:** 49. *pl. 4. f. 74*. 1889.

[h] Hedwigia **1:** 17. 1859.

[i] Sv. Vet. Akad. Handl. **26**[2]: 150. 1894.

stauron as a subgeneric distinction. As such it is to be commended, though I think Cleve is here inconsistent, as Pleurostaurum (original spelling) is as different from his Stauroneis as it is from Navicula.

Found at station 3635H, Bering Sea.

Navicula praetexta Ehrenb. Ber. Akad. Wiss. Berl. **1840:** 214. 1841. Greg. Trans. Roy. Soc. Edinb. **21:** 481. *pl. 1. f. 11.* 1857. Kütz. Bacill. 98. 1844. Donk. Brit. Diat. 10. *pl. 2. f. 1.* 1871-73. O'Meara, Proc. Roy. Irish Acad. II. **2:** 387. *pl. 32. f. 27.* 1875. Schmidt, Atlas *pl. 3. f. 30-34.* 1875; *pl. 129. f. 7-8.* 1888. Van Heur. Synop. 92. *pl. 9. f. 13.* 1881-85; Treat. Diat. 204. *pl. 4. f. 159.* 1896. Rabh. Fl. Eur. Alg. **1:** 183. 1864. Pritch. Hist. Infus. ed. 4. 898. 1861. Witt, Verh. Russ. Min. Ges. II. **22:** 165. *pl. 9. f. 4.* 1886. Pant. Beitr. Bacill. Ung. **1:** 30. *pl. 9. f. 79.* 1886. Truan, Anal. Soc. Espan. Hist. Nat. **13:** 44. *pl. 8. f. 27.* 1884. Cleve, Sv. Vet. Akad. Handl. **27**[3]: 55. 1895. De Toni, Syll. Alg. **2:** 102. 1891. Wolle, Diat. N. A. *pl. 20. f. 1, 7* (not *pl. 111. f. 3*). 1890. Truan & Witt, Diat. Hayti 17. *pl. 4. f. 8.* 1888.

Pinnularia praetexta Ehrenb. Mikrog. *pl. 19. f. 28.* 1854.

Navicula lunyaeskii Pant. Beitr. Bacill. Ung. **1:** 28. *pl. 14. f. 122.* 1886?

Navicula haytiana Truan & Witt, Diat. Hayti *pl. 4. f. 9.* 1888.

Navicula reticulo-radiata Temp. & Brun, Mem. Soc. Phys. et Hist. Nat. Geneva **30**[9]: 44. *pl. 5. f. 4.* 1889. Schmidt, Atlas *pl. 204. f. 18.* 1897. Cleve, Sv. Vet. Akad. Handl. **27**[3]: 55. 1895.

It is somewhat of a stretch to include here the above-named synonym of Pantocsek's; but the very suggestive figure cited above by Truan & Witt is so evident a comment on the validity of Pantocsek's species that I follow Cleve in joining them. I think that with almost equal reason another figure on the same plate,[a] called *N. neupauerii* Pant., could be classed here. De Toni[b] and Cleve[c] include *N. haytiana*, as above. Three reasons are given by the authors for holding it separate from *N. praetexta*. The best answer to these is found in comparing their own figures of the two species on plate 4, figures 8 to 9. This particular form, *haytiana*, is found at station 2807 in company with the true type.

Found at stations 2807, 2920H, Galapagos and Hawaiian islands.

Navicula prodiga Mann, sp. nov. PLATE LII, FIGURE 4.

Valve outline of 6 perfectly straight lines forming an elongated hexagon, the apices alone being rounded; the two median sides shorter than those running to the apices; markings of moniliform striae arranged in the general lyrate pattern, the striae of large rounded beads, the actually median striae alone being transverse, those on either side of the middle curving and becoming concentric to the two apices; interspaces between the striae one-half the width of a bead; lyrate hyaline area narrow, its ends not approaching, hence the beaded rows on each side of the raphe of nearly equal width from center to apices; marginal striae at the middle of the valve fully two-fifths its width, thence diminishing toward the apices as the sides approach; valve surface just within the margin all around depressed, whereas the margin itself is slightly elevated above the rest of the surface, thus producing the appearance of a border.

Length of valve, 0.150 mm.; width of valve, 0.085 mm.; striae, 48 in 0.1 mm.

The hexagonal form called *N. hennedyi cuneata* Schmidt[d] resembles my species only in its hexagonal outline. A far nearer form in Janisch's Diatoms of the Gazelle Expedition, plate 15, figure 23, is named *N. lyra elliptica* Schmidt by Cleve,[e] where it is joined with figures in Van Heurck's Synopsis, plate 10, figure 2, Schmidt's Nordsee

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[a] Pant. Beitr. Bacill. Ung. **1:** *pl. 14. f. 123.* 1886.

[b] De Toni, Syll. Alg. **2:** 103. 1891.

[c] Sv. Vet. Akad. Handl. **27**[3]: 55. 1895.

[d] Schmidt, Atlas *pl. 3. f. 4.* 1875.

[e] Sv. Vet. Akad. Handl. **27**[3]: 63. 1895.

Diatomaceen,[a] plate 1, figure 39, and Schmidt's Atlas, plate 2, figure 29. It also has considerable resemblance to Schmidt's Atlas, plate 2, figure 10, *N. kittoniana* Schmidt, which Cleve[b] makes a variety of *N. approximata* Grev.; though how he can see *N. approximata* in that form and *N. lyra* in the form figured by Janisch just mentioned is beyond my understanding. Whether or not the form represented by Janisch's figure, the *N. kittoniana* of Schmidt, and my specimen should be classed as a variety of *N. lyra* is a question of the limits of a species and the degree of dissimilarity it is desirable to include under one name. Taking the view that it is advantageous to add as few new forms as possible to the already enormous species *N. lyra*, I have given the above name. For reasons mentioned in the introduction, the naming of varieties is not favored by the writer. It may be noted that my specimen differs in several respects from the two I have here associated with it, especially in the H-shaped hyaline space not having its tips approach, but strictly parallel, whereby the central rows of striae are of the same width from the apices to the center. But the minor differences between my form and that of Janisch's above can not make them two species.

Type in the U. S. National Museum, No. 590149, from station 2920H, Hawaiian Islands, November 21, 1891; 570 fathoms, bottom of brown mud and fine sand.

Navicula sandriana Grun. Verh. Zool. Bot. Ges. Wien **13**: 153. *pl. 13. f. 5.* 1863. Schmidt, Atlas *pl. 3. f. 10.* 1875; *pl. 70. f. 45.* 1881. O'Meara, Proc. Roy. Irish Acad. II. **2:** 388. *pl. 32. f. 29.* 1875 (figure poor). Lagers. Bih. Sv. Vet. Akad. Handl. **3**[15]**:** 41. 1876. De Toni, Syll. Alg. **2:** 105. 1891. Cleve, Sv. Vet. Akad. Handl. **27**[3]**:** 59. 1895.

Navicula rimosa Grev. Trans. Micr. Soc. Lond. n. s. **14:** 129. *pl. 12. f. 25.* 1866. Moeb. Diat.-taf. *pl. 75. f. 25.* 1890.

It seems to me the original figures of both the above give emphasis to a rather inconstant feature of this diatom, namely, the narrow sickle-shaped line of striae midway between the center and the margin. This is very liable to be reduced to a somewhat indefinite granulation blending with the more indistinct granulation about it. In fact, there are unmistakable varieties in which these sickle-shaped lines can virtually disappear. In such a case we are confronted by the question in what respect such a form is separable from varieties of *N. hennedyi* and *N. praetexta*, nor can we find any satisfactory answer. In other words, however useful for classification it undoubtedly is to retain the enumerated names to designate the more diverse of these forms, it is probable that both *N. sandriana* and *N. hennedyi* will eventually be considered only striking variations of *N. praetexta*.

Found at station 4516H, Gulf of California.

Navicula silicula Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 419. 1843; Mikrog. *pl. 6. I. f. 16, pl. 10. I. f. 13, pl. 14. f. 22, pl. 15A. f. 37a–b.* 1854. Pritch. Hist. Infus. ed. 4. 894. 1861.

Navicula limosa Kütz. Bacill. 101. *pl. 3. f. 50.* 1844. Grun. Verh. Zool. Bot. Ges. Wien **10:** 544. *pl. 3. f. 8a–c, 10* (not *f. 7, 8d–e, 9*). 1860. Donk. Quart. Journ. Micr. Sci. n. s. **9:** 294. *pl. 18. f. 7.* 1869. Moeb. Diat.-taf. *pl. 79. f. 7.* 1890. Donk. Brit. Diat. 73. *pl. 12. f. 6.* 1871–73. Brun, Diat. Alp. 73. *pl. 7. f. 12.* 1880 Van Heur. Synop. 103. *pl. 12. f. 18–20, 22–23.* 1881; Treat. Diat. 219. *pl. 5. f. 207–208.* 1896. Lagers. Bih. Sv. Vet. Akad. Handl. **1**[14]: 31. *pl. 1. f. 6, 7a.* 1873. Rabh. Sussw. Diat. 41. *pl. 6. f. 31.* 1853. Pritch. Hist. Infus. ed. 4. 894. 1861. De Toni, Syll. Alg. **2:** 147. 1891.

Navicula silicula Grun.; Van Heur. Synop. *pl. 12. f. 21.* 1881.

Caloneis silicula Cleve, Sv. Vet. Akad. Handl. **26**[2]**:** 51. 1894.

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[a] Jahresb. Komm. Deut. Meere **2:** *pl. 1. f. 39.* 1874.

[b] Loc. cit.

Navicula gibberula Kütz. Bacill. 101. *pl. 3. f. 50.* 1844. W. Smith, Synop. Brit. Diat. **1:** *pl. 17. f. 160.* 1853. Lagers. Bih. Sv. Vet. Akad. Handl. **1**[14]: 31. *pl. 1. f. 7.* 1873. De Toni, Syll. Alg. **2:** 148. 1891.

Navicula ventricosa Ehrenb. err. det. Donk. Brit. Diat. 74. *pl. 12. f. 7.* 1871–73. Van Heur. Synop. 103. *pl. 12. f. 24–26.* 1881; Treat. Diat. 220. *pl. 5. f. 209.* 1896. Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 29. *pl. 1. f. 16–18.* 1880. De Toni, Syll. Alg. **2:** 148. 1891. Cleve in Nordensk. Vega Exped. **3:** 464. 1883.

Navicula subventricosa Grun.; Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 29. *pl. 1. f. 19.* 1880. De Toni, Syll. Alg. **2:** 150. 1891. Cleve in Nordensk. Vega Exped. **3:** 464. 1883.

Navicula horvathii Grun. Verh. Zool. Bot. Ges. Wien **10:** *pl. 6. f. 18.* 1860.

Navicula haslinszkyi Pant. Beitr. Bacill. Ung. **2:** 48. *pl. 11. f. 193.* 1889.

Navicula neogena Pant. Beitr. Bacill. Ung. **3:** *pl. 17. f. 252, pl. 25. f. 372.* 1893.

There is some doubt of the propriety of including here *N. ventricosa*, especially if we take into consideration Ehrenberg's authorship. It should either be left out of this category or referred to as *N. ventricosa* Ehrenb. err. det. Donk. as above. The contrast is considerable even in that case, because of the striking stauros. But if we take into consideration *N. haslinszkyi* (see above), we find a perfect gradation from one phase to the other. Donkin has included here several species that have absolutely nothing in common with this species except the trinodal outline; thus, *N. leptogongyla* Ehrenb.[a] O'Meara offers such absurd figures of this diatom[b] that they are much worse than none.

Found at station 3696, off Honshu Island, Japan.

Navicula smithii Breb.; W. Smith, Synop. Brit. Diat. **2:** 92. 1856. Grun. Verh. Zool. Bot. Ges. Wien **10:** 531. 1860; Denkschr. Akad. Wien **48**[2]: 56. *pl. 1. f. 40–41.* 1884; in Fenzl, Reise Novara Bot. **1:** 18. 1870. Schmidt, Jahresb. Komm. Deut. Meere **12:** *pl. 1. f. 19.* 1874; Atlas *pl. 7. f. 14–20* (*f. 21–22* doubtful). 1875. Rabh. Fl. Eur. Alg. **1:** 178. 1864. Donk. Brit. Diat. 6. *pl. 1. f. 40.* 1871–73. O'Meara, Proc. Roy. Irish Acad. II. **2:** 382. *pl. 32. f. 18.* 1875. Van Heur. Synop. 91. *pl. 9. f. 12;* Suppl. *pl. B. f. 23.* 1881–85; Treat. Diat. 197. *pl. 4. f. 151.* 1896. Pant. Beitr. Bacill. Ung. **2:** 55. 1889. Truan, Anal. Soc. Espan. Hist. Nat. **13:** 45. *pl. 8. f. 25–26.* 1884. Petit, Journ. Roy. Micr. Soc. **1:** 245. *pl. 14. f. 14.* 1878. De Toni, Syll. Alg. **2:** 86. 1891 (not *N. smithii* (C. Ag.). Van Heur. Treat. Diat. 231. 1896). Wolle, Diat. N. A. *pl. 12. f. 11, pl. 14. f. 12* (not *pl. 20. f. 8*). 1890.

Diploneis smithii (Breb.) Cleve, Sv. Vet. Akad. Handl. **26**[2]: 96. 1894.

Navicula elliptica W. Smith, Synop. Brit. Diat. **1:** 48. *pl. 17. f. 152a* (not *f. 152a**). 1853 (not Kütz. 1844).

Navicula doczyi Pant. Beitr. Bacill. Ung. **2:** 45. *pl. 14. f. 247.* 1889.

De Toni here includes *Pinnularia scutellum* O'Meara,[c] which is *Navicula scutellum* O'Meara.[d] This is a gross error. O'Meara's form, judged by its figures and descriptions, is a truly costate-ribbed diatom which shows none of the double-rowed beading so characteristic of *N. smithii.* I think if such were present, it could not have been twice overlooked by O'Meara. Cleve[e] questions Van Heurck's determination of *N. scutellum* O'Meara,[f] referring the figure doubtfully to *N. smithii* Breb. It is something like *N. smithii*, but in the absence of the beading I think it is a poor figure of O'Meara's species. Van Heurck[g] has transferred *Schizonema smithii* C. Ag. to *Navi-*

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[a] Ehrenb. Mikrog. *pl. 10. I. f. 11, pl. 16. I. f. 10. II. f. 7. III. f. 22.* 1854.

[b] Proc. Roy. Irish Acad. II. **2:** *pl. 31. f. 30–31.* 1875.

[c] Quart. Journ. Micr. Sci. n. s. **9:** 151. *pl. 12. f. 5.* 1869.

[d] Proc. Roy. Irish Acad. II. **2:** 396. *pl. 33. f. 14.* 1875.

[e] Sv. Vet. Akad. Handl. **26**[2]: 96. 1894.

[f] Van Heur. Synop. *pl. 9. f. 11.* 1881.

[g] Van Heur. Treat. Diat. 231. *pl. 5. f. 241.* 1896.

cuta smithii (C. Ag.) Van Heur., and refers to his former figures.[a] Undoubtedly the figures given by Van Heurck are a Navicula, and undoubtedly all such forms should be changed from Schizonema to Navicula. Were this, therefore, a justifiable identification, *N. smithii* Breb. would have to give way to *N. smithii* (C. Ag.) Van Heur., as *Schizonema smithii* C. Ag. was published in 1824.[b] There are two early representations of *S. smithii* C. Ag.[c] In the earlier there is no mention of the markings of the valve, the description being concerned with the shape of the gelatinous threads inclosing the frustules, as is common in Kützing. The figures are too small to give any clear idea of the valve. Enough, however, is evident to show that Kützing's idea of this species of Agardh is irreconcilable with that of William Smith. Smith's figure is clear and the description accurate, yet the author quotes Kützing's entirely discordant figure. Van Heurck's figures are different from both the foregoing, and he says[d] of this form, "nec Kütz., Smith, &c.," and on figure 4 of the same plate he refers both the figure in Kützing and that in Smith to *S. ramosissimum* C. Ag. De Toni[e] recognizes Van Heurck's idea of *S. smithii* C. Ag. to be correct, while Cleve[f] makes it a synonym of *Navicula avenacea* Breb. I think there can be no doubt that the *S. smithii* C. Ag. of Smith's Synopsis[g] is the same as *S. ramosissimum* C. Ag. as that form is interpreted by Van Heurck, Cleve, and others. I could extend indefinitely the recital of this muddle over *S. smithii* C. Ag. were it worth while. Enough has been said to illustrate the fact I now wish to mention, namely, that in dealing with members of the old genus Schizonema we are as a rule confronted with indefinable names, impossible to include in our synonymy, if we wish to be at all accurate as to facts. This arises from the custom in the earlier books of laying stress on the gelatinous envelope to the partial or complete neglect of the diatoms inclosed, so that the species and in many cases the genus of the original form is absolutely obscured. Here and there we find a case where a name, originally indefinable, becomes in subsequent works repeated and more clearly imaged, and grows to be widely accepted as standing for a diatom of well-marked and generally understood characteristics. In such cases it is perhaps well to refer to the original citation and include it in the synonymy. But *S. smithii* C. Ag. is an example of a host of forms with no such history. Nobody knows what Agardh meant by his name. There is no agreement among the various authors as to its structure. We can not even know that it was a Navicula. To take what, practically speaking, is a nomen nudum, and transfer it to Navicula on the basis of mere guesswork, thereby invalidating a long-established and thoroughly understood name, is manifestly not justifiable, for it destroys a valid name for an indefinable one.

Found at stations 2920H, 3696, 3712H, Hawaiian Islands, Honshu Island, and Okhotsk Sea.

Navicula solaris Greg. Trans. Micr. Soc. Lond. n. s. **4**: 43. *pl. 5. f. 10.* 1856. Moeb. Diat.-taf. *pl. 10. f. 10.* 1890. Schmidt, Atlas *pl. 46. f. 16.* 1876. Rabh. Fl. Eur. Alg. **1**: 181. 1864. O'Meara, Proc. Roy. Irish Acad. II. **2**: 410. *pl. 34. f. 13.* 1875 (poor figure). Pritch. Hist. Infus. ed. 4. 904. 1861. Cleve, Sv. Vet. Akad. Handl. **27**[3]: 32. 1895. De Toni, Syll. Alg. **2**: 53. 1891.

Schmidt's doubt of his figure, quoted above, being *N. solaris* was shown to be unnecessary by a complete frustule I found in the dredging at station 3607, in which one

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[a] Van Heur. Synop. *pl. 15. f. 33.* 1881; Treat. Diat, *pl. 5. f. 241.* 1896.

[b] C. Ag. Syst. Alg. 10. 1824.

[c] Kütz. Bacill. 114. *pl. 27. f. 5.* 1844. W. Smith, Synop. Brit. Diat. **2**: 75. *pl. 57. f. 362.* 1856.

[d] Van Heur. Synop. *pl. 15. f. 33.* 1881.

[e] Syll. Alg. **2**: 293. 1891.

[f] Sv. Vet. Akad. Handl. **27**[3]: 15. 1895.

[g] W. Smith, Synop. Brit. Diat. **2**: 75. 1856.

valve corresponded exactly to his figure and the other showed the sun-like rays around the center, referred to in the specific name. I find a minute error in focusing intensifies this "solar" effect, which must be the method by which such greatly exaggerated representations as that by O'Meara were obtained.

Found at stations 3607, 3611, Bering Sea.

Navicula speciosa Mann, sp. nov. PLATE LII, FIGURE 5.

Valve deeply constricted at the middle; the two halves broadest just beyond this constriction; thence narrowing rapidly to the blunt, rounded apices; striae moniliform, except at the constriction, where they are fused into three ridges; beads large, oval, the marginal ones double the length of the others; striae toward the middle of the valve oblique to the raphe, but not curved, toward the apices becoming curved; a single row of large beads on either side of the median line; ends of the raphe at the center separated by a small hyaline round area, the central nodule.

Length of valve, 0.12 mm.; width of valve, 0.045 mm., and at the middle, 0.012 mm.

Type in the U. S. National Museum, No. 590150, from station 2807, Galapagos Islands, April 4, 1888; 812 fathoms, bottom of Globigerina ooze and coral mud.

Navicula spectabilis Greg. Trans. Roy. Soc. Edinb. **21:** 481. *pl. 9. f. 10.* 1857. Rabh. Fl. Eur. Alg. **1:** 178. 1864. Schmidt, Atlas *pl. 2. f. 31, pl. 3. f. 20–21, 29.* 1875. Donk. Brit. Diat. 12. *pl. 2. f. 5.* 1871–73. Cleve, Sv. Vet. Akad. Handl. **27**[3]**:** 60. 1895. Castr. Rep. Voy. Chall. Bot. **2:** 32. *pl. 28. f. 9.* 1886. De Toni, Syll. Alg. **2:** 98. 1891. Pritch. Hist. Infus. ed. 4. 898. 1861. O'Meara, Proc. Roy. Irish Acad. II. **2:** 390. 1875. Van Heur. Treat. Diat. 202. *pl. 27. f. 757.* 1896 (not *N. spectabilis* Grun. Verh. Zool. Bot. Ges. Wien **10:** 533. *pl. 1. f. 11.* 1860).

Navicula excavata Grev. variety; Schmidt, Atlas *pl. 3. f. 22–25.* 1875 (not *N. excavata* Grev.). Jan. Diat. Gaz. Exped. *pl. 15. f. 22.* Cleve, Sv. Vet. Akad. Handl. **18**[5]**:** 8. *pl. 2. f. 20.* 1881 (not Schmidt, Atlas *pl. 70. f. 46.* 1881, according to Grun.).

Navicula mikado Pant. Beitr. Bacill. Ung. **3:** *pl. 23. f. 334.* 1893.

Although the figures above cited of *N. excavata* Grev. variety are clearly synonyms of this species, I do not think the original form of Greville's diatom,[a] nor the figure so named by Grunow,[b] can safely be looked upon as the same. Beyond question *N. o'swaldii* Jan.[c] is the same as Greville's species, as Grunow points out.[b] But when we compare any of these figures of *N. excavata* which are in harmony with the original with the type of *N. spectabilis* as given by Gregory or in the superb figure by Donkin, it is plainly too wide a stretch to cover both forms by one specific name. As Cleve says, this species merges toward *N. lyra* Ehrenb., on the one hand, and *N. hennedyi* W. Smith, on the other; but if it is to be a species at all and have any boundaries, it can not include Greville's diatom. Nor is Cleve correct in adding to the above synonymy *N. bullata* Norm.[d] and *N. rattrayi* Pant.[e] If we wish to see the result of this over condensation on the part of Cleve, we can not do better than compare figures 46 and 52 in plate 70 of Schmidt's Atlas, both of which he ranges under *N. spectabilis.* Such a "species" is out of all bounds and not worth retaining.

Found at stations 2807, 2920H, Galapagos and Hawaiian islands.

Navicula splendida Greg. Trans. Micr. Soc. Lond. n. s. **4:** 44. *pl. 5. f. 14.* 1856. Pritch. Hist. Infus. ed. 4. 893. Schmidt, Jahresb. Komm. Deut. Meere **2:** 85. *pl. 1. f. 3–4; pl. 2. f. 2.* 1874; Atlas *pl. 13. f. 31–34.* 1875; *pl. 69. f. 22.* 1881. Van. Heur. Synop.

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[a] Trans. Micr. Soc. Lond. n. s. **14:** 130. *pl. 12. f. 15.* 1866.

[b] Schmidt, Atlas *pl. 70. f. 46.* 1881.

[c] Schmidt, Atlas *pl. 70. f. 46.* 1881. Jan. Diat. Gaz. Exped. *pl. 15. f. 12.* Pant. Beitr. Bacill. Ung. **2:** 52. *pl. 25. f. 370.* 1889.

[d] Castr. Rep. Voy. Chall. Bot. **2:** 29. *pl. 28. f. 10.* 1886. Schmidt, Atlas *pl. 70. f. 51–52.* 1881.

[e] Pant. Beitr. Bacill. Ung. **2:** 52. *pl. 30. f. 427.* 1889.

pl. 9. f. 4. 1881; Treat. Diat. 193. *pl. 26. f. 729.* 1896. O'Meara, Proc. Roy. Irish Acad. II. **2:** 402. *pl. 33. f. 30* (poor). 1875. De Toni, Syll. Alg. **2:** 80. 1891.

Navicula entomon Ehrenb. err. det. Donk. Brit. Diat. 49. *pl. 7. f. 5.* 1871–73.

Navicula didyma Ehrenb. err. det. Greg. Trans. Micr. Soc. Lond. n. s. **4:** 45. *pl. 5. f. 16* (not *f. 15*). 1856.

Navicula gemmatula Grun. err. det. Cleve, Journ. Quek. Micr. Club II. **2:** 167. *pl. 12. f. 1.* 1885.

Diploneis splendida Cleve, Sv. Vet. Akad. Handl. **26**[2]: 87. 1894.

Donkin's placing this species under *N. entomon* Ehrenb. is not to be favored, as his figure is clearly a *N. splendida*. It is difficult to determine what *N. entomon* is, as Ehrenberg's figures[a] are not remotely alike; but certainly they can not be united with the above species. Rabenhorst[b] erroneously includes here *N. incurrata* Greg., an arrangement accepted by De Toni.[c] Cleve holds them separate, and also groups here quite a number of species that I do not consider synonymous. There is, however, one in his list,[d] namely *N. diplosticta* Grun.[e] which is close to this species, perhaps too close.[f] A specimen from station 3604 is unusually small and with very delicate beading, but built on the general plan of this species. See also remarks under *N. onaruensis* (Cleve) Mann Ehrenb. in this report.

Found at stations 2920II, 3008H, 3603, 3604, Hawaiian Islands and Bering Sea.

Navicula spuma Mann, sp. nov. PLATE LII, FIGURE 7.

Valve broadly elliptical, tapering by even curve to the rounded, somewhat produced apices; raphe perfectly straight, on either side of it a very narrow hyaline space, expanded at the center into a large circular hyaline area one-half the width of the valve; markings a fine shagreen, this near the margin all around the valve broken up into a row of foam-like flakes; margin delicately beaded.

Length of valve, 0.075 mm.; width of valve, 0.030 mm.

The general aspect of this diatom is that of a Mastogloia, but it entirely lacks the internal marginal plates or septa characteristic of that genus.

Type in the U. S. National Museum, No. 590151, from station 4029H, Bering Sea, June 27, 1900; 913 fathoms, bottom of grey sand and clay.

Navicula subacuta (Ehrenb.) Ralfs in Pritch. Hist. Infus. ed. 4. 908. 1861. Schmidt, Atlas *pl. 43. f. 31–33.* 1876. De Toni, Syll. Alg. **2:** 192.

Pinnularia subacuta Ehrenb. Mikrog. *pl. 35A, VI. f.* 12. 1854.

Pinnularia major Cleve, Sv. Vet. Akad. Handl. **27**[3]: 89. 1895, not *Navicula major* Kütz. Bacill. 97. *pl. 4. f. 19, 21.* 1844.

Some of my specimens approach one of Schmidt's unnamed figures,[g] and therefore somewhat resemble Schmidt's figure of *N. formosa* Greg.,[h] though this present species and *N. formosa* are clearly distinct. Cleve's union of *N. subacuta* with *N. major* Kütz. is not wise. See under that species in this report.

Found at station 4029 H, Bering Sea.

Navicula subcincta Schmidt, Jahresb. Komm. Deut. Meere **2:** 87. *pl. 2. f.* 7. 1874. Schmidt, Atlas *pl. 13. f. 41.* 1875.

Navicula succincta Schmidt, Atlas *pl. 69. f. 32.* 1881. De Toni, Syll. Alg. **2:** 76. 1891.

Diploneis subcincta Cleve, Sv. Vet. Akad. Handl. **26**[2]: 86. 1894.

[a] Phys. Abh. Akad. Wiss. Berl. **1841:** *pl. 1. I. f. 3 4.* 1843; Mikrog. *pl. 19. f. 30.* 1854.
[b] Rabh. Fl. Eur. Alg. **1:** 204. 1864.
[c] De Toni, Syll. Alg. **2:** 81. 1891.
[d] Sv. Vet. Akad. Handl. **26**[2]: 87 88. 1894.
[e] Schmidt, Atlas *pl. 13. f. 25–30.* 1875.
[f] Cf. also Schmidt, Atlas *pl. 69. f. 22.* 1881; *pl. 174. f. 10.* 1892.
[g] Schmidt, Atlas *pl. 43. f. 29.* 1876.
[h] Schmidt, Atlas *pl. 50. f. 12.* 1877.

This is probably distinct from *N. didyma* (Ehrenb.) Kütz., though it closely approaches Donkin's figure of that species.[a] I look upon this resemblance as much more striking than that between the present species and *N. didyma* (Ehrenb.) Kütz.,[b] as suggested by Grunow.[c] Grunow's own figures of this species are a quite different thing, and agree more closely with the diatom I have named *N. pinquis;* see under this for fuller discussion. O'Meara[d] is careless in calling this *N. subcirita* on his plate, and his figure is inexcusably bad.

Found at station 3008H, Hawaiian Islands.

Navicula undata Mann, sp. nov. PLATE LIII, FIGURE 1.

Valve an elongated ellipse, with blunt apices, the sides scarcely curved until about half way between the center and the ends, thence the curvature more pronounced for a short distance, and finally the sides nearly straight to the broad and blunt apices; markings of coarse beading of the *N. aspera* type, but the beads round, not oval, arranged in oblique moniliform striae, the beads of which are so spaced as to give a marked wavy appearance to the valve; raphe obscurely beaded, especially toward the center, there each half slightly bent toward the same side of the valve; a broad median area on either side the raphe, extended at the center as a large stauros running from one side of the valve to the other; terminations of the raphe at the extreme apices of the valve surrounded by large hyaline circular areas, reaching over the curve of the apices to the border.

Length of valve, 0.080 mm; width of valve, 0.019 mm. Striae, 17 in 0.01 mm.

This very minute but robust diatom belongs to the *N. aspera* group, except for its coarse beads being round and its central hyaline band extending from one side to the other, like the stauros of the Stauroneis type. It is in marked contrast with any known form, the nearest species being *N. macraeana* Pant.,[e] which differs greatly in its apices, its delicate beading, its stauros, its raphe, etc.

Type in the U. S. National Museum, No. 590152, from station 3571H, Bering Sea, July 6, 1895; 696 fathoms, bottom of green mud and ooze.

Navicula vagabunda Brun; Schmidt, Atlas *pl. 174. f. 5.* 1892.

Diploneis vagabunda Cleve, Sv. Vet. Akad. Handl. **26**[2]: 103. *pl. 2. f. 13, 15.* 1894.

This diatom is suggestively near that variety of *N. crabro* (Ehrenb.) Kütz., known as *N. pandura* Breb.

Found at station 2808, Galapagos Islands.

Navicula vidovichii Grun. Verh. Zool. Bot. Ges. Wien **13:** 150. *pl. 13. f. 4.* 1863. PLATE LII, FIGURE 3.

Navicula egyptica Grev. Trans. Micr. Soc. Lond. n. s. **14:** 127. *pl. 12. f. 16–17.* 1886. Moeb. Diat-taf. *pl. 75. f. 16–17.* 1890.

Naricula bartholomei Cleve; Schmidt, Atlas *pl. 160. f. 9.* 1890, not Cleve, Bih. Sv. Vet. Akad. Handl. **5**[8]: 6. *pl. 1. f. 5.* 1878.

Naricula sectilis Schmidt; Pant. Beitr. Bacill. Ung. **2:** 55. *pl. 8. f. 152.* 1889?.

The above combination represents a clear and satisfactory specific concept. *N. egyptica* is exactly the same as *N. vidovichii;* the variety called by Schmidt *N. bartholomei* Cleve variety, differs merely in being more constricted at the center of the valve, and the variety called by Pantocsek *N. sectilis boryana* differs merely in being less constricted at the center of the valve. To add to these other species less clearly related, though similar, as Cleve[f] and De Toni[g] have done, is to lose all boun-

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[a] Donk. Brit. Diat. *pl. 7. f. 8b.* 1871–73.
[b] Bih. Sv. Vet. Akad. Handl. **3**[15]: *pl. 1. f. 4.* 1876.
[c] Denkschr. Akad. Wien **48**[2]: 56. 1884.
[d] Proc. Roy. Irish Akad. II. **2:** 398. *pl. 33. f. 22.* 1875.
[e] Pant. Beitr. Bacill. Ung. **2:** 52. *pl. 8. f. 155.* 1889.
[f] Sv. Vet. Akad. Handl. **26**[2]: 63. 1894.
[g] De Toni, Syll. Alg. **2:** 174. 1891.

daries of the species, and, what is worse, to find no halting place whatever. Both the the authors mentioned place this species under *N. pouchetii* Lewis;[a] to which combination is added by Cleve *N. bartholomei* Cleve.[b] The resemblance between this species and *N. pouchetii* is slight. Why not then add the more nearly related *N. mirabilis* Leud.-Fort.,[c] *N. intercedens* Schmidt,[d] *N. amica* Cleve & Grun.,[e] and so on ad libitum? This general type of Navicula has a vast number of related forms, and we must draw the line rather strictly around a given species or have no line to draw. For this reason I do not favor making the above a variety of *N. pouchetii*. I have figured the variety found by me, as it presents the interesting phase of having the marginal as well as the internal rows of costae interrupted at the center, thus making a stauros-like transverse band from side to side.

Length of (perfect) valve, 0.160 mm.; width of valve, 0.033 mm. Striae, 50 in 0.1 mm.

Found at station 4029H, Bering Sea.

Navicula viridis (Nitzsch) Ehrenb. Infus. 182. *pl. 13. f. 16* (in part), *pl. 21. f. 12*. 1838.

Bacillaria viridis Nitzsch, Neue Schrift. Naturf. Ges. Halle **3**: 97. *pl. 4. f. 1–3*. 1817.
Frustulia viridis Kütz. Linnaea **8**: 551. Syn. Diat. 1833.
Navicula viridula Ehrenb. Infus. 183. *pl. 13. f. 17* (not *pl. 21. f. 14*). 1838, not Kütz.
Pinnularia viridis Ehrenb. in part: Phys. Abh. Akad. Wiss. Berl. **1841**: *pl. 3. I. f. 1–2* (not *pl. 1. I. f. 7. III. f. 3. IV. f. 31*. 1843. W. Smith, Synop. Brit. Diat. **1**: 54. *pl. 18. f. 163d* (not *f. 163a–b*). 1853. Rabh.: Brun. Diat. Alp. 83. *pl. 8. f. 5* (not *f. 4*.) 1880. Cleve, Sv. Vet. Akad. Handl. **27**[3]: 91. 1895.
Navicula viridis Kütz. Bacill. 97. *pl. 4. f. 18, pl. 30. f. 12*. 1844. Pritch. Hist. Infus. ed. 4. 907. *pl. 9. f. 133–136*(poor). 1861. Schmidt, Atlas *pl. 42. f. 11–14, 19–21*. 1876. Van Heur. Synop. 73. *pl. 5. f. 5* (not *f. 6*). 1881; Treat. Diat. 165. *pl. 2. f. 70* (not *f. 71*). 1896. De Toni. Syll. Alg. **2**: 11. 1891. Eng. & Pr. Pflanzenfam. Bacill. **1**[1b]: 43. *f. 55C–D*. 1896.
Navicula leptogongyla Ehrenb.(?): Schmidt, Atlas *pl. 45. f. 26–28*. 1876.
Navicula communata Grun.; Schmidt, Atlas *pl. 45. f. 35–37* (not *f. 22–25*). 1876.
Navicula (*Pinnularia*) *rupestris* Hantzsch; Schmidt, Atlas *pl. 45. f. 41–43* (*f. 38–40, 44?*). 1876.
Navicula decemana Pant. Beitr. Bacill. Ung. **3**: *pl. 35. f. 499*. 1893.

This very variable diatom might well be subdivided into several species were it not that the intergradations are so close that no definition of their differences can be made. It approaches another large and variable species, *N. major* Kütz., so that certain forms are about as well referred to one of these as the other.

Found at station 3691H, Okhotsk Sea.

FRUSTULIA C. Ag. char. emend.

Frustulia C. Ag. in part; Syst. Alg. 13. 1824; char. emend. Ag. Consp. Diat. 43. 1832. Rabh. Fl. Eur. Alg. **1**: 20, 227. *f. 64*. Ehrenb. Infus. 231. 1838. Grun. Verh. Zool. Bot. Ges. Wien **12**: 573. 1860. De Toni, Syll. Alg. **2**: 276. 1891. Cleve, Sv. Vet. Akad. Handl. **26**[2]: 121. 1894.
Van Heurckia Breb. Ann. Soc. Phyt. et Micr. Belg. 201. 1868. Van Heur. Synop. 112. *pl. 17. f. 1–2*. 1881; Treat. Diat. 239. *f. 89*. 1896.

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[a] Proc. Acad. Phila. **1861**: 65. *pl. 2. f. 2*. 1862.
[b] Bih. Sv. Vet. Akad. Handl. **5**[8]: 6. *pl. 1. f. 5*. 1878.
[c] Mem. Soc. Emul. St. Brieuc 31. *pl. 2. f. 21*. 1879. Schmidt, Atlas *pl. 160. f. 6–8*. 1890.
[d] Op. cit. *pl. 160. f. 3–5*.
[e] Sv. Vet. Akad. Handl. **18**[3]: 12. *pl. 3. f. 37*. 1881.

Brebissonia Grun. Verh. Zool. Bot. Ges. Wien **12**: 512. 1860. O'Meara, Proc. Roy. Irish Acad. II. **2**: 388 (not fig.). 1875. Van Heur. Treat. Diat. 244. *f. 44.* 1896.

Colletonema Breb. in part; W. Smith, Synop. Brit. Diat. **2**: 70. *pl. 56. f. 351.* 1856.

Coconema Ehrenb. in part; Ralfs in Pritch. Hist. Infus. ed. 4. 878. *pl. 7. f. 48a–b.* 1861.

Doryphora (Kütz.) W. Smith, Synop. Brit. Diat. **1**: 77. *pl. 24. f. 223.* 1853, in part.

Schizonema C. Ag. in part, Thwaites, Ann. Mag. Nat. Hist. II. **1**: 170. *pl. 12. f. H.* 1848. Van Heur. Synop. *pl. 17. f. 3, 6.* 1881.

Berkeleya Grev., in part; Scott. Crypt. Fl. **1**: 294. 1823, Ralfs, Ann. Mag. Nat. Hist. **16**: 110. *pl. 3. f. 2.* 1845. Van Heur. Treat. Diat. 245. *f. 46.* 1896.

Amphipleura Kütz. Bacill. 103. *pl. 3. f. 52.* 1844, in part. Van Heur. Synop. 113. *pl. 17. f. 14–15.* 1881. Cleve, Sv. Vet. Akad. Handl. **26**^{2}: 125. 1894. Van Heur. Treat. Diat. 242. *f. 42.* 1896.

Reicheltia Van Heur. Treat. Diat. 243. *f. 43.* 1896 (?).

Navicula Bory, in part; W. Smith, Synop. Brit. Diat. **1**: 46. *pl. 16. f. 129.* 1853. Kütz. Bacill. 94. *pl. 28. f. 45, pl. 30. f. 44.* 1844. Donk. Brit. Diat. 42. *pl. 6. f. 11–12.* 1872.

The separation of the above genera, in whole or in part, from the true Navicula diatoms is generally felt by students to be necessary. Although they have a naviculoid outline and possess valves that are alike and that bear a raphe divided at the center, they possess several characteristics found in no other naviculoid diatoms. The chief characteristic is the elevated, ridge-like border of silica that surrounds the two halves of the raphe, partly or completely inclosing them and, by its longitudinal extension at the center of the valve (where it represents the central nodule), separating the two halves of the raphe farther and farther, until in Amphipleura and Reicheltia the greater length of the valve is traversed by this ridge and the two halves of the raphe are near the apices. It is on the basis of the gradual extension of this ridge and the consequent progressive separation of the two halves of the raphe that I have here combined these forms into one genus, as it appears to me there is no distinction between the genera above enumerated except this variable one. Viewed from this standpoint the series would be as follows: (1) Frustulia (=Van Heurekia), where the central extension of the ridge is short and the two halves of the raphe traverse nearly the whole length of the valve; (2) Brebissonia (synonymous with Doryphora), where the central extension of the ridge is greater; (3) Berkeleya, where the central extension of the ridge is one-sixth to one-fourth the length of the valve and the two halves of the raphe are correspondingly reduced; (4) Amphipleura and Reicheltia, in which the central extension of the ridge is extreme and the two halves of the raphe very short and near the apices. It seems to me simplicity is gained by this union, since one member of the series runs into another, and especially since they are otherwise greatly alike, being characterized by great delicacy of structure with transverse beaded striae of extreme fineness covering the entire valve, except the ridge. Reicheltia is the most aberrant of this group, its striae being large, though very finely punctate, and the beaded terminations of the divisions of the raphe being peculiar.[a] Still it is so manifestly a unique species of Amphipleura that it is difficult to separate it.

Pfitzer[b] brings out the interesting fact that the above differ strikingly from Navicula in internal structure, in the process of fission, and in that of conjugation.

Frustulia rhomboides (Ehrenb.) De Toni, Syll. Alg. **2**: 277. 1891. Cleve, Sv. Vet. Akad. Handl. **26**^{2}: 122. 1894.

Navicula rhomboides Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841**: 419. *pl. 3. I. f. 15.* 1843? Kütz. Bacill. 94. *pl. 28. f. 45, pl. 30. f. 44.* 1844? W. Smith,

[a] Cf. Van Heur. Treat. Diat. 243. *f. 43.* 1896.

[b] Hanst. Bot. Abhandl. **2**: 1871.

Synop. Brit. Diat. **1:** 46. *pl. 16. f. 129.* 1853. Rabh. Fl. Eur. Alg. **1:** 171. 1864. Pritch. Hist. Infus. ed. 4. 903. 1861. Grun. Verh. Zool. Bot. Ges. Wien **12:** 549. *pl. 3. f. 14a–b.* 1860? Schum. Verh. Zool. Bot. Ges. Wien Suppl. **17:** 68 (not *pl. 3. f. 41*). 1867. Donk. Brit. Diat. 42. *pl. 6. f. 11.* 1842. Lewis, Proc. Acad. Phila. **1865:** 10. *pl. 2. f. 10–11.* 1865. Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 47. *pl. 3. f. 59.* 1880.

Colletonema viridulum Breb.; Kütz. Sp. Alg. 105. 1849. H. L. Smith, Sp. Diat. Typ. no. 88. 1874. Pritch. Hist. Infus. ed. 4. 926. 1861.

Navicula crassinervia Breb.; W. Smith. Synop. Brit. Diat. **1:** 47. *pl. 31. f. 271.* 1853. Pritch. Hist. Infus. ed. 4. 900. 1861. Grun. Verh. Zool. Bot. Ges. Wien **12:** 548. *pl. 3. f. 12.* 1860. Donk. Brit. Diat. 42. *pl. 6. f. 12.* 1872. H. L. Smith, Sp. Diat. Typ. no. 313. 1874.

Frustulia torfacea A. Braun in Rabh. Sussw. Diat. 50. *pl. 7. f. 2.* 1853.

Frustulia saxonica Rabh. Fl. Eur. Alg. **1:** 227. 1864. Griff. & Henf. Micr. Dict. ed. 3. 323. *pl. 14. f. 17.* 1875. H. L. Smith, Sp. Diat. Typ. no. 172. 1874. Rabh. Sussw. Diat. 50., *pl. 7. f. 1.* 1853. Pritch. Hist. Infus. ed. 4. 924. 1861. Plitz. in Hanst. Bot. Abhandl. **2:** 58. *pl. 4. f. 4–8.* 1871.

Schizonema viridulum Rabh. Fl. Eur. Alg. **1:** 266. 1864.

Vanheurekia rhomboides Breb. Ann. Soc. Phyt. et Micr. Belg. 204. 1868. Van Heur. Synop. 112. *pl. 17. f. 1–2.* 1881; Treat. Diat. 240. *pl. 5. f.* 249–250. Truan, Anal. Soc. Espan. Hist. Nat. **13:** 352. *pl. 8. f. 1.* 1884.

Vanheurekia crassinervia Breb. Ann. Soc. Phyt. et Micr. Belg. 204. 1868. Van Heur. Synop. *pl. 17. f. 4 5.* 1881. Truan, Anal. Soc. Espan. Hist. Nat. **13:** 352. *pl. 8. f. 2.* 1884.

Vanheurekia viridula Breb. Ann. Soc. Phyt. et Micr. Belg. 203. 1868. Van Heur. Synop. 112. *pl. 17. f. 3.* 1881.

Frustulia viridula De Toni, Syll. Alg. **2:** 278. 1891.

I have worked out the above extensive synonymy because this diatom is very widely distributed and has been included in the older as well as the more recent diatom literature under so many names that the nomenclature is very confusing. In one or two instances I have left out supposed synonyms, because their exact application is impossible to determine. Thus *Navicula lincolata* Ehrenb.[a] is included by Cleve[b] in the above, though upon what basis I can not determine. The figures and descriptions of Ehrenberg convey no image sufficiently exact to determine even if it belongs to this genus, much less if to this species. In fact, De Toni includes it, and with as much reason, under *Navicula serians* (Breb.) Kütz.[c] Many of Ehrenberg's figures are quite unlike the others. The same is true to some extent of the original *Navicula rhomboides* Ehrenb., from which the above specific name is derived; and I would not hesitate to pass over this authority, were it not for the fact that this particular name has been so constantly repeated by succeeding authors with better figures and descriptions that it is pretty certain this particular diatom is meant in each instance. As these diatoms, though sometimes free, are generally inclosed in gelatinous tubes or masses, the older observers gave especial attention to this transient condition; and in many cases we have elaborate descriptions of the appearance of these forms in bulk, without a word on the sculpture or build of the frustules; and where figures of the original plants are attempted they are likely to be so minute as to be worthless. Cleve has repeatedly stated his inability to identify some of these earlier figures and descriptions.

Found at station 2885, off Oregon.

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[a] Phys. Abh. Akad. Wiss. Berl. **1841:** 418. *pl. 1. III. f. 4a, pl. 2. VI. f. 27, pl. 4. I. f. 6.* 1843; Mikrog. *pl. 16. I. f. 3, II. f. 1–2.* 1854.

[b] Sv. Vet. Akad. Handl. **26**[2]: 122. 1894.

[c] De Toni, Syll. Alg. **2:** 141. 1891.

GYROSIGMA Hass.

Gyrosigma Hass. Hist. Brit. Algae **1**: 435. *pl. 102. f. 11.* 1845. Rabh. Sussw. Diat. 47. 1853. Cleve, char. emend. Sv. Vet. Akad. Handl. **26**^{2}: 112. 1894.

Pleurosigma W. Smith, Ann. Mag. Nat. Hist. 1. *pl. 1–2.* 1852. Synop. Brit. Diat. **1**: 61. *pl. 20–22.* 1853. Rabh. Fl. Eur. Alg. **1**: 230. 1864. Pritch. Hist. Infus. ed. 4. 915. 1861. Grun. Verh. Zool. Bot. Ges. Wien **10**: 555. 1860. Cleve & Grun. Sv. Vet. Akad. Handl. **17**^{2}: 48. 1880. Van Heur. Synop. 114. *pl. 18 21.* 1881; Treat. Diat. 249. *pl. 6 7. 28.* 1896. Perag. Le Diatomiste **1**$^{4-5}$: 1–35. *pl. 1 10.* 1891. Castr. Rep. Voy. Chall. Bot. **2**: 36. 1886. Griff. & Henf. Micr. Dict. ed. 4. 606. *pl. 15.* 1883. De Toni, Syll. Alg. **2**: 231. 1891. Cleve, Sv. Vet. Akad. Handl. **26**^{2}: 112. 1894.

Frustulia C. Ag. in part; Kütz. Linnaea **8**: 555 (nos. 49–50). *pl. 14. f. 35–36.* 1833.

Navicula Bory, in part; Ehrenb. Infus. 180–181 (nos. 226–230). *pl. 13. f. 10–14.* 1838. Kütz. Bacill. 102 (no. 132). *pl. 4. f. 32.* 1844.

Toxonidea Donk. Trans. Micr. Soc. Lond. n. s. **6**: 19. *pl. 4. f. 1–2.* 1858. Cleve, Sv. Vet. Akad. Handl. **26**^{2}: 45. 1894. Van Heur. Treat. Diat. 247. 1896. Pritch. Hist. Infus. ed. 4. 920. 1861. Perag. Le Diatomiste **1**$^{4-5}$: 27. *pl. 9.* 1891.

Donkinia Ralfs in Pritch. Hist. Infus. ed. 4. 920. *pl. 8. f. 49.* 1861. Van Heur. Treat. Diat. 248. 1896. Perag. Le Diatomiste **1**$^{4-5}$: 29. *pl. 9.* 1891.

Rhoicosigma Grun. Hedwigia **6**: 10. 1867. Van Heur. Treat. Diat. 260. 1896. Perag. Le Diatomiste **1**$^{4-5}$: 30. *pl. 9–10.*

This genus of diatoms is one of the best defined and most sharply separated of the large genera. Its valves are more or less sigmoid, both as to their outline and in respect to the trend of the raphe. They are evenly marked with delicate striations of great beauty and often of extreme delicacy, either in two directions, transverse and longitudinal, or in three directions, one transverse and two oblique, the three being at angles approximately of 60° to each other. This striation covers the entire valve with a gauzy network, except a very narrow longitudinal space through which runs the raphe and a minute area around the central nodule. The valves are as a rule convex, thin, made up of two or three layers, and therefore strongly prismatic. The zonal view is in most cases extremely narrow compared to the valval view. Their beauty, wide distribution, and importance as tests of the efficiency of microscope objectives have resulted in their being more generally known and carefully studied than most other genera.

William Smith's generic name, Pleurosigma, is very appropriate and has been universally accepted in preference to the earlier one of Hassall. But there can be no question of the validity of Gyrosigma. We find it in his British Algae as a monotypic genus, based on *G. hippocampa* (Ehrenb.) Hass., the description and illustration of which are unmistakable. Hassall also quotes Ehrenberg's excellent reference to this diatom,[a] as *Navicula hippocampus* Ehrenb. The reasons advanced by Brebisson, Ralfs, and others, for preferring Smith's name are wholly inadequate; and although we are indebted to Smith for a most clear and comprehensive analysis of this genus it is necessary to recognize the right of Hassall's name to represent these diatoms.

Several attempts have been made to create new genera out of certain species of Gyrosigma having more or less striking peculiarities. The first was the separation of all species having an arcuate instead of sigmoid raphe, with valves extremely convex on one side and nearly straight on the other (i. e., strongly asymmetrical on their longitudinal axis). These were placed in a genus, Toxonidia, by Donkin.[b] The next separation was by Ralfs of valves with extremely sigmoid raphe, the ridge of the raphe being raised into a keel above the rest of the valve, except at the central nodule.

[a] Ehrenb. Infus. 180. *pl. 13. f. 11.* 1838.

[b] Donk. Trans. Micr. Soc. Lond. n. s. **6**: 19. *pl. 3. f. 1.* 1858. Moeb. Diat.-taf. *pl. 18, f. 1.* 1890.

These he called Donkinia.[a] The third genus to be separated was Rhoicosigma by Grunow,[b] including all species with strongly bent frustules (seen in zonal view) and with valves sometimes, though not always, dissimilar. These distinctions have been accepted by Van Heurck, Peragallo, and De Toni. Cleve rejects them, except Toxonidea, and accepts this, as he admits, on dubious grounds. I think nothing is gained by breaking up the generic unity of this sharply marked genus. The characteristics, as Cleve points out,[c] are variable in each of the above cases. For subgeneric division they can be, at least at present, made use of; but beyond this they only increase the difficulty of assigning diatoms that have the clear Gyrosigma qualities.

Cleve has, however, gone further than others toward obliterating the worth of this genus by dividing it into two genera on the sole basis of the direction of the striation. He includes all forms with transverse-longitudinal striae in Gyrosigma (Hass.) Cleve, and the others, with striae in three directions (excepting Toxonidea) in Pleurosigma (W. Smith) Cleve. It is probably true, as he says, that there are no transitional forms between these two kinds; indeed, it would not be easy to conceive how there could be, for lines in two directions could hardly change to lines in three directions without assuming new angles, and only one of the three lines could possibly remain in the original direction of one of the two lines; and this is just what we find, both the two-line and three-line forms having one of the lines transverse. The lack of transition is, therefore, to my mind an empty argument. If, now, we look at the striking forms, called by Ralfs Donkinia, a genus rejected by Cleve, we find species of both two-line and three-line sculpture that are far too close to put into separate genera, on any reasonable interpretation of a genus; thus *D. recta* (Donk.) Grun. and *D. carinata* (Donk.) Ralfs.[d] Whoever also compares such two-line forms as *G.* (*Pleurosigma*) *littorale* (W. Smith) Griff. & Henf. and *G.* (*Pleurosigma*) *acuminatum* (Kütz.) Grun. with such three-line forms as *G.* (*Pleurosigma*) *latum* Grun. and *G.* (*Pleurosigma*) *affine* Grun. must see that it is artificial to place them in two genera. I do not therefore look upon Cleve's division of this genus as having the merit of the earlier ones.

Gyrosigma aestuarii (Breb.) Griff. & Henf. Micr. Dict. ed. 3. 356. *pl. 11. f. 35.* 1875.
Navicula aestuarii Breb.; Kütz. Sp. Alg. 890. 1849.
Pleurosigma aestuarii W. Smith, Synop. Brit. Diat. **1**: 65. *pl. 31. f. 275.* 1853. Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 52. 1880. Perag. Le Diatomiste **1**[4-5]: 12. *pl. 5. f. 12-13, 15.* 1891. Cleve, Sv. Vet. Akad. Handl. **26**[2]: 42. 1894. Pritch. Hist. Infus. ed. 4. 916. 1861. Rabh. Fl. Eur. Alg. **1**: 234. 1864. Griff. & Henf. Micr. Dict. ed. 3. *pl. 15. f. 35* (*f. 33c*?). 1875. Van Heur. Synop. *pl. 18. f. 8.* 1881. H. L. Smith, Sp. Diat. Typ. no. 304. 1874 (not Cleve, Bih. Sv. Vet. Akad. **1**[1]: 13. *pl. 2. f. 19.* 1873=*P. normanii* Ralfs).
Pleurosigma angulatum W. Smith, variety; Van Heur. Synop. 115. 1881; Treat. Diat. 251. *pl. 6. f. 258.* 1896. De Toni, Syll. Alg. **2**: 232. 1891.
Pleurosigma candidum Schum. Schrift. Phys. Ökon. Ges. Konigsb. **8**: 59. *pl. 2. f. 57.* 1867. Perag. Le Diatomiste **1**[4-5]: 12. *pl. 5. f. 11.* 1891.

The desire of H. L. Smith, Van Heurck, and De Toni to make this a variety of *P. angulatum* W. Smith is not to be commended. Though smaller than the latter, the markings are decidedly coarser, the ends narrower and less gracefully tapered, and in the type form slightly but sharply bent sidewise.

Found at station 2823, Gulf of California.

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[a] Pritch. Hist. Infus. ed. 4. 921. *pl. 8. f. 49.* 1861.
[b] Sv. Vet. Akad. Handl. **17**[2]: 58. 1880. Le Diatomiste **1**[4-5]: 33. *pl. 10. f. 2-3.* 1891.
[c] Sv. Vet. Akad. Handl. **26**[2]: 32, 112. 1894.
[d] Trans. Micr. Soc. Lond. n. s. **6**: *pl. 3. f. 5, 6.* 1858. Le Diatomiste **1**[4-5]: *pl. 9. f. 6, 8.* 1891.

Gyrosigma formosum (W. Smith) Griff. & Henf. Micr. Dict. ed. 3. 355. *pl. 11. f. 25.* 1875.

Pleurosigma formosum W. Smith, Ann. Mag. Nat. Hist. II. **9:** 5. *pl. 1. f. 1–2.* 1852; Synop. Brit. Diat. **1:** 63. *pl. 20. f. 195.* 1853. Rabh. Fl. Eur. Alg. **1:** 231. 1864. Cleve & Grun. Sv. Vet. Akad. Handl. **17²:** 48. 1880. Van Heur. Synop. 116. *pl. 19. f. 4.* H. L. Smith, Sp. Diat. Typ. no. 402. 1874. Pritch. Hist. Infus. ed. 4. 917. *pl. 8. f. 32.* 1861. Griff. & Henf. Micr. Dict. ed. 3. *pl. 11. f. 25.* 1875. Cleve, Sv. Vet. Akad. Handl. **26²:** 45. *pl. 4. f. 21.* 1894. De Toni, Syll. Alg. **2:** 243. 1891. Perag. Le Diatomiste **1⁴⁻⁵:** 4. *pl. 1. f. 1–6.* 1891. Van Heur. Treat. Diat. 254. *pl. 6. f. 268.* 1896.

Pleurosigma decorum W. Smith, Synop. Brit. Diat. **1:** 63. *pl. 21. f. 196.* 1853. Pritch. Hist. Infus. ed. 4. 918. 1861. Rabh. Fl. Eur. Alg. **1:** 232. 1864. H. L. Smith, Sp. Diat. Typ. no. 694. 1874. Cleve in Nordensk. Vega Exped. **3:** 497, 506. 1883. Van Heur. Synop. 116. *pl. 19. f. 1.* 1881. Perag. Le Diatomiste **1⁴⁻⁵:** 5. *pl. 1. f. 9–13* (*pl. 2. f. 6–9* doubtful). 1891. Van Heur. Treat. Diat. 254. *pl. 6. f. 269.* 1896. Griff. & Henf. Micr. Dict. ed. 3. *pl. 11. f. 26.* 1875. De Toni, Syll. Alg. **2:** 243. 1891.

Pleurosigma australicum Witt, Journ. Mus. Godef. **1:** 70. *pl. 8. f. 7.* 1873. De Toni, Syll. Alg. **2:** 246. 1891.

Pleurosigma tahitiense Witt, Journ. Mus. Godef. **1:** 67. *pl. 8. f. 13.* 1873. De Toni, Syll. Alg. **2:** 245. 1891 (not *P. tahitiense* Castr. Rep. Voy. Chall. Bot. **2:** 38. *pl. 28. f. 4.* 1886).

Pleurosigma pulchrum Grun.; H. L. Smith, Sp. Diat. Typ. no. 695. 1874 (not *P. pulchrum* Grun. Verh. Zool. Bot. Ges. Wien **10:** 556. *pl. 4. f. 2.* 1860; not Perag. Le Diatomiste **1⁴⁻⁵:** 4. *pl. 1. f. 81.* 1891.).

The Grunow variety *longissima*, as figured by Peragallo,[a] occurs at station 2848 and an unusually large and robust variety at station 3603; also the *P. decorum* variety at station 3712H.

Found at stations 2848, 2929, 3603, 3691H, 3712H, Okhotsk and Bering seas to southern California.

Gyrosigma inermedium (W. Smith) Griff. & Henf. Micr. Dict. ed. 3. 356. *pl. 11. f. 36.* 1875.

Pleurosigma intermedium W. Smith, Synop. Brit. Diat. **1:** 64. *pl. 21. f. 200.* 1853. Pritch. Hist. Infus. ed. 4. 918. 1861. Van Heur. Synop. 116. *pl. 18. f. 6.* 1881. Treat. Diat. 253. *pl. 6. f. 267.* 1896. H. L. Smith, Sp. Diat. Typ. no. 405. 1874. De Toni, Syll. Alg. **2:** 235. 1891. Perag. Le Diatomiste **1⁴⁻⁵:** 13. *pl. 5. f. 27–28* (*f. 29* doubtful). 1891. Cleve & Grun. Sv. Vet. Akad. Handl. **17²:** 52. 1880. Rabh. Fl. Eur. Alg. **1:** 234. 1864 (not Truan, Anal. Soc. Espan. Hist. Nat. **13:** 49. *pl. 9. f. 2.* 1884).

Pleurosigma nubecula W. Smith, Synop. Brit. Diat. **1:** 64. *pl. 21. f. 201.* 1853. Cleve, Sv. Vet. Akad. Handl. **26²:** 34. 1894. De Toni, Syll. Alg. **2:** 235. 1891. Rabh. Fl. Eur. Alg. **1:** 232. 1864. Perag. Le Diatomiste **1⁴⁻⁵:** 14. *pl. 5. f. 26.* 1891.

Pleurosigma thumii Castr.; Perag. Le Diatomiste **1⁴⁻⁵:** 14. *pl. 5. f. 25.* 1891.

Pleurosigma subrectum Cleve in Cleve & Grun. Sv. Vet. Akad. Handl. **17²:** 14, 53. *pl. 3. f. 72.* 1880. Perag. Le Diatomiste **1⁴⁻⁵:** 14. *pl. 5. f. 30.* 1891.

Pleurosigma elongatum balaericum Perag. Le Diatomiste **1:** 7. *pl. 2. f. 22.* 1891.

Cleve agrees to the practical identity of *P. intermedium* and *P. nubecula*, as do Van Heurck and Peragallo, but for some reason he has selected the less known name *nubecula*, occurring after *intermedium* in Smith's work, instead of *intermedium*.

Found at station 3091, off Oregon.

Gyrosigma normanii (Ralfs) Mann.

Pleurosigma normanii Ralfs; Pritch. Hist. Infus. ed. 4. 919. 1861. Rabh. Fl. Eur. Alg. **1:** 236. 1864. Cleve & Grun. Sv. Vet. Akad. Handl. **17²:** 14, 52. *pl. 3. f. 67.*

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[a] Loc. cit.

1880. De Toni, Syll. Alg. **2:** 237. 1891. Cleve, Sv. Vet. Akad. Handl. **26**^{2}: 40. 1894.

Pleurosigma affine Grun.; Cleve & Grun. Sv. Vet. Akad. Handl. **17**^{2}: 51. 1880. Van Heur. Synop. 115. *pl. 18. f. 9.* 1881; Treat. Diat. 252. *pl. 6. f. 263* (not *f. 264*). 1896. Perag. Le Diatomiste **1**$^{4-5}$: 9. *pl. 4. f. 5–8, 15–18* (not *f. 4; f. 1–3* doubtful). 1891.

Pleurosigma virginicum H. L. Smith, Sp. Diat. Typ. no. 416. 1874.

Van Heurck places here *P. nicobaricum* Grun.,[a] probably basing it on Grunow's *P. affine nicobarica.*[b] I doubt the wisdom of calling this a variety of *P. affine.* Certainly Grunow's type in the above citation and in Peragallo's Monographe should not be forced into this species. As Cleve points out, it is nearer to *P. validum* Shadb.

Found at stations 2844, 3607, Aleutian Islands and Bering Sea.

Gyrosigma rigidum (W. Smith) Griff. & Henf. Micr. Dict. ed. 3, 356. *pl. 11. f. 30.* 1875.

Pleurosigma rigidum W. Smith, Synop. Brit. Diat. **1:** 64. *pl. 20. f. 198. 1853.* Pritch. Hist. Infus. ed. 4. 918. 1861. Rabh. Fl. Eur. Alg. **1:** 232. 1864. H. L. Smith, Sp. Diat. Typ. no. 410. 1874. Van Heur. Synop. *pl. 19. f. 3.* 1881; Treat. Diat. 251. *pl. 6. f. 265.* 1896. Truan, Anal. Soc. Espan. Hist. Nat. **13:** 49. *pl. 9. f. 4.* 1884. De Toni, Syll. Alg. **2:** 237. 1891. Cleve, Sv. Vet. Akad. Handl. **26**^{2}: 39. 1894. Perag. Le Diatomiste **1**$^{4-5}$: 14. *pl. 6. f. 2–7.* 1891. Griff. & Henf. Micr. Dict. ed. 4. *pl. 15. f. 30.* 1883.

Pleurosigma validum Shadb. Trans. Micr. Soc. Lond. n. s. **2:** 16. *pl. 1. f. 8.* 1854. Cleve & Grun. Sv. Vet. Akad. Handl. **17**^{2}: 53. 1880. De Toni, Syll. Alg. **2:** 245. 1891.

Pleurosigma giganteum Grun.; Cleve & Grun. Sv. Vet. Akad. Handl. **17**^{2}: 53. 1880 (not *P. giganteum* Grun. Verh. Zool. Bot. Ges. Wien **10:** 558. *pl. 4. f. 1.* 1860).

In the last name there is a confusion on the part of the author, which is repeated in several other works. The original *P. giganteum* is not only plainly drawn as a transverse-longitudinal striated species, but is so described, the ambiguous sentence "lineolis decussatis subtillimis" not necessarily meaning oblique lined, as any line at right angles to another is strictly "decussating." In the case of oblique striation Grunow in that work uses such expressions as "in lineas obliquas." Moreover, he expressly says of *P. giganteum*, "Am nächsten steht ihm das folgende *Pleurosigma tropicum*, welches jedoch durch kleinere Gestalt und stärkere Biegung wesentlich verschieden ist." This diatom is also figured and described with transverse-longitudinal striæ and is universally recognized as having that character. Yet Grunow in his later works[d] unites *P. giganteum* to *P. validum* Shadb., and says of his own species, "*Pl. giganteum* hat 18 schiefe und 17 Querstreifen," and it is so figured by Peragallo and others.

At station 2807 occurs a small and delicate variety agreeing with a figure[e] which Peragallo erroneously speaks of as typical.

Found at stations 2807, 3520, Galapagos Islands and Bering Sea.

Gyrosigma sagitta (Temp. & Brun) Mann.

Pleurosigma sagitta Temp. & Brun, Mem. Soc. Phys. et Hist. Nat. Geneva **30**^{8}: 49. *pl. 9. f. 19.* 1889. De Toni, Syll. Alg. **2:** 242. 1891.

There is reasonable doubt of this being a synonym of *P. nicobaricum* Grun.,[f] with which it is united by Cleve and others. It not only lacks the double-rowed transverse

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[a] Fenzl, Reise Novara Bot. **1:** 101. *pl. 14. f. 20.* 1870.

[b] Van Heur. Synop. 115; Suppl. *pl. C. f. 34.* 1881–5. Cf. Van Heur. Treat. Diat. 252. *pl. 6. f. 264.* 1896. Perag. Le Diatomiste **1**$^{4-5}$: *pl. 4. f. 10–12.* 1891.

[c] Perag. op. cit. *pl. 4. f. 9.*

[d] Sv. Vet. Akad. Handl. **17**^{2}: 53. 1880.

[e] Le Diatomiste **1**$^{4-5}$: *pl. 6. f. 6.* 1891.

[f] Fenzl, Reise Novara Bot. **1:** 101. *pl. 14. f. 20.* 1870.

markings of the latter (though these Grunow admits are inconstant) but it does not show transverse lines wider and heavier than the oblique, but the three sets about equal and growing finer toward the apices. Nor is there any trace of a rectangular, finely punctate central area. It must be said, however, that both these are close to minute forms of *G. rigidum*. I have with some doubt left it, as De Toni does, as a separate species.

Found at station 4029H, Bering Sea.

Gyrosigma speciosum (W. Smith) Griff. & Henf. Mier. Dict. 356. *pl. 11. f. 28.* 1875.

Pleurosigma speciosum W. Smith, Ann. Mag. Nat. Hist. II. **9:** 6. *pl. 1. f. 3.* 1852; Synop. Brit. Diat. **1:** 63. *pl. 20. f. 197.* 1853. Cleve, Sv. Vet. Akad. Handl. **26**[2]: 44. 1894. De Toni, Syll. Alg. **2:** 236. 1891. Pritch. Hist. Infus. ed. 4. 917. 1861. Rabh. Fl. Eur. Alg. **1:** 232. 1864. Griff. & Henf. Mier. Dict. ed. 4. *pl. 15. f. 28.* 1883. Van Heur. Treat. Diat. 253. *pl. 28. f. 793.* 1896. Cleve. & Grun. Sv. Vet. Akad. Handl. **17**[2]: 49. 1880. Castr. Rep. Voy. Chall. Bot. **2:** 37. *pl. 28. f. 2.* 1886. Perag. Le Diatomiste **1**[4-5]: 6. *pl. 2. f. 13–19* (not *f. 10, 12; f. 11* doubtful). 1891.

Pleurosigma pulchrum Grun. Verh. Zool. Bot. Ges. Wien **19:** 556. *pl. 4. f. 2.* 1869. Perag. Le Diatomiste **1**[4-5]: 4. *pl. 1. f. 8* (doubtful). 1891 (not *P. pulchrum* Grun.; H. L. Smith, Sp. Diat. Typ. no. 695. 1874—*G. formosum*).

There is a fine gradation over from this species to *G. formosum*, though the two are to be viewed as safely distinct. Thus H. L. Smith's *P. pulchrum* is close to *G. formosum* and is best classed there. The real *P. pulchrum* Grun., on the other hand, is a variety of the present species and yet is reasonably close to Smith's form. I do not favor placing here, as is done by Cleve, *P. tortuosum* Cleve;[a] a diatom of the extreme Donkinia type; nor the inclusion suggested by Peragallo, of *P. tahitiense* Castr.[b]

Found at station 3607, Bering Sea.

Gyrosigma thuringicum (Kütz.) Rabh. Sussw. Diat. 47. *pl. 5. f. 4.* 1853.

Navicula thuringica Kütz. Bacill. 102. *pl. 4. f. 27.* 1844.

Navicula angulata Quek. Treat. Mier. 438. *pl. 8. f. 4–7.* 1848.

Pleurosigma angulatum W. Smith, Ann. Mag. Nat. Hist. II. **9:** 7. *pl. 1. f. 7–9.* 1852; Synop. Brit. Diat. **1:** 65. *pl. 21. f. 205.* 1853. Rabh. Fl. Eur. Alg. **1:** 234. 1864. Pritch. Hist. Infus. ed. 4. 918. 1861. H. L. Smith, Sp. Diat. Typ. no. 389–391. 1874. Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 51. 1880. Van Heur. Synop. 115. *pl. 18. f. 2–5.* 1881–85; Treat. Diat. 351. *pl. 6. f. 257, 259–260* (not *f. 258, 261*). 1896. Truan. Anal. Soc. Espan. Hist. Nat. **13:** 48. *pl. 9. f. 1.* 1884. Griff. & Henf. Mier. Dict. ed. 4. 607. *pl. 15. f. 33.* 1883. Perag. Le Diatomiste **1**[4-5]: 11. *pl. 5. f. 3–6.* 1891. De Toni, Syll. Alg. **2:** 231. 1891. Cleve, Sv. Vet. Akad. Handl. **26**[2]: 40. 1894.

Pleurosigma thuringicum Ralfs; Pritch. Hist. Infus. ed. 4. 919. 1861.

Pleurosigma quadratum W. Smith, Synop. Brit. Diat. **1:** 65. *pl. 20. f. 204, 204B.* 1853. Rabh. Fl. Eur. Alg. **1:** 235. 1864. Pritch. Hist. Infus. ed. 4. 918. 1861. Griff. & Henf. Mier. Dict. ed. 4. *pl. 15. f. 34.* 1883. Truan, Anal. Soc. Espan. Hist. Nat. **13:** 45. *pl. 9. f. 3.* 1884. Perag. Le Diatomiste **1**[4-5]: 11. *pl. 5. f. 7–8.* 1891. Van Heur. Synop. *pl. 18. f. 1.*

That this diatom, known almost universally as *Pleurosigma angulatum* W. Smith, is identical with Kützing's *Navicula thuringica* there can be no doubt. Although he omits all data regarding the striation, this is not surprising, as he usually calls most diatoms with as delicate markings as this one "laevis" or "laevissimus," as he does here. Its build is most characteristic. Rabenhorst, Ralfs, Grunow, Van Heurck, De Toni, and in fact nearly every author recognizes the identity of the two. De Toni

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[a] Sv. Vet. Akad. Handl. **18**[5]: 5. *pl. 1. f. 6.* 1881.

[b] Castr. Rep. Voy. Chall. Bot. **2:** 38. *pl. 23. f. 4.* 1886. Perag. Le Diatomiste **1**[4-5]: *pl. 2. f. 10.* 1891.

makes *N. thuringica* Kütz. a synonym of *P. angulatum* (Quek.) W. Smith, but says after the former, "Nomen anterius!!" Grunow[a] gives the following important testimony: "*Navicula thuringica* Kg. ist nach Exemplaren von Arten im Kützing'schen Herbar. identisch mit *Pl. angulatum*, so dass die Art eigentlich *Pl. thuringicum* heissen sollte." Van Heurck, after quoting *N. thuringica* Kütz. as a synonym of *P. angulatum* and following it with an exclamation point, adds this statement; "Cette espèce devrait donc porter le nom de *Pl. thuringica*, ce changement de nom est cependant impossible, car cette diatomée si repandue et si employée comme test, est universellement connue sous le nom donné par W. Smith." There is no question that the change of name here made is an unfortunate necessity, as this particular species is the best known of all the diatoms; and it is with reluctance that the name which should have been accorded to it over fifty years ago is here preferred.

Cleve adds to the above list of synonyms *P. strigosum* W. Smith,[b] *P. normanii* Ralfs,[c] and *P. finnmarchicum* Cleve.[d] These three are alike; but with their blunt apices, smooth outline, coarser markings, and more sigmoid raphe they are very bad examples of varieties of the present species. De Toni, who gives separate rank to *P. normanii*, unites under *P. angulatum* some impossible forms, such as *P. delicatulum* W. Smith.[e]

The variety corresponding to *P. quadratum* W. Smith is very abundant at station 3603.

Found at stations 2919, 3200H, 3603, 3696, 4530H, Honshu Island, Japan, to Bering Sea, southern California, and Santa Cruz Island, West Indies.

PLAGIOTROPIS Pfitz.

Plagiotropis Pfitz. in Hanst. Bot. Abhand. **2**: 93. 1871. Van Heur. Synop. 121. 1881. De Toni, Syll. Alg. **2**: 343. 1891. Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 66. 1880.

Amphiprora Ehrenb. in part; Greg. Trans. Roy. Soc. Edinb. **21**: 505. *pl. 12. f. 58.* 1857.

Tropidoneis Cleve, in part; Sv. Vet. Akad. Handl. **27**[3]: 27. 1895.

I admit this genus with hesitation, as it is very doubtful if anything is gained by separating its forms from Amphiprora. The genus is hard to understand, on account of the contorted and pellucid character of the diatoms. I lean toward a union of all its forms under Amphiprora; but as I have not been able to establish a satisfactory reason for this by an exhaustive study of the different species, I classify the single species found during these investigations under its generally accepted name. If Cleve's contention that this genus should be included in his later genus Tropidoneis is correct, it would have been better to have enlarged and emended this genus instead of creating a new one.

Plagiotropis van heurckii Grun.; Van Heur. Synop. 122. *pl. 22bis. f. 6-8.* 1881. De Toni, Syll. Alg. **2**: 346. 1891.

Tropidoneis van heurckii Cleve, Sv. Vet. Akad. Handl. **26**[2]: 27. 1894. Van Heur. Treat. Diat. 265. *pl. 6. f. 295.* 1896.

Found at station 2807, Galapagos Islands.

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[a] Sv. Vet. Akad. Handl. **17**[2]: 52. 1880.

[b] Ann. Mag. Nat. Hist. II. **9**: 7. *pl. 1. f. 7.* 1852.

[c] Pritch. Hist. Infus. ed. 4. 919. 1861; cf. Sv. Vet. Akad. Handl. **17**[2]: 52. *pl. 3. f. 67.* 1880.

[d] Denkschr. Akad. Wien **48**[2]: 105. 1884.

[e] W. Smith, Synop. Brit. Diat. **1**: 64. *pl. 21. f. 202.* 1853.

AMPHIPRORA Ehrenb.

Amphiprora Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 401, 410. 1843. Kütz. Sp. Alg. 93. 1849. Van Heur. Synop. 120. 1881.
Entomoneis Ehrenb. Phys. Abh. Akad. Wiss. Berl. 154. 1845.
Amphicampa Rabh. Fl. Eur. Alg. **1:** 257. 1864.
Amphitropis Rabh. in Haust. Bot. Abhand. **2:** 94. 1871. Grun. Denkschr. Akad. Wien **48²:** 53. *pl. A. f. 52-53.* 1884.

The complicated figure of these diatoms is due mainly to the fact that they are, as a rule, contorted spirally about their long axis through an arc of 90° or less, making the build, which is naviculoid, difficult to understand. The genus is close to Amphora Ehrenb., Plagiotropis Pfitz., and Auricula Castr.

Amphiprora conspicua Grev. Trans. Micr. Soc. Lond. n. s. **9:** 86. *pl. 10. f. 16.* 1861. Moeb. Diat.-taf. *pl. 40. f. 16.* 1890. Van Heur. Synop. *pl. 22bis. f. 3.* 1881. De Toni, Syll. Alg. **2:** 335. 1891.

Amphiprora pulchra var. B. Lewis, Proc. Acad. Phila. **1863:** 346. *pl. 1. f. 10.* 1864. Van Heurck's figure above represents a doubtful aspect of this species.

Found at station 3604, Bering Sea.

MASTOGLOIA Thwaites.

Mastogloia Thwaites; W. Smith, Synop. Brit. Diat. **2:** 63. *pl. 54. f. 340-341, pl. 62. f. 388-389.* 1856. Grun. Verh. Zool. Bot. Ges. Wien **12:** 574. *pl. 5. f. 4-8.* 1860. De Toni, Syll. Alg. **2:** 313. 1891. Rabh. Fl. Eur. Alg. **1:** 20, 260. *f. 65.* 1864. Pritch. Hist. Infus. ed. 4. 924. *pl. 15. f. 30.* 1861. Van Heur. Synop. 69. *pl. 4. f. 13-28.* 1881-85; Treat. Diat. 153. *f. 28, pl. 2. f. 60-66.* 1896. O'Meara, Proc. Roy. Irish Acad. II. **2:** 323. *pl. 29. f. 9-13.* 1875. Brun, Diat. Alp. 92. *pl. 8. f. 28-29.* 1880. Cleve, Sv. Vet. Akad. Handl. **26²:** 142. 1894.

Pleurosiphonia Ehrenb. Monatsb. Akad. Wiss. Berl. **1853:** 203. 1854, nom. nud.; **1856:** 338 *pl. 1. f. 32.* 1857; Mikrog. 59. 199. *pl. 33. I. f. 14.* 1854. Abh. Akad. Wiss. Berl. **1870:** 52, 58. *pl. 3. III. f. 1-6.* 1871. Pritch. Hist. Infus. ed. 4. 915. 1861. De Toni, Syll. Alg. **2:** 326. 1891.

Stigmaphora Wall. Trans. Micr. Soc. Lond. n. s. **8:** 43. *pl. 2. f. 5-8.* 1860. Moeb. Diat.-taf. *pl. 31. f. 5 8.* 1890. De Toni, Syll. Alg. **2:** 325. 1891. Van Heur. Treat. Diat. 156. *f. 28a.* 1896?

Navicula Bory in part; Grun. Verh. Zool. Bot. Ges. Wien **13:** 151. *pl. 14. f. 12.* 1863; in Fenzl, Reise Novara Bot. **1:** 99. *pl. 14. f. 11.* 1870.

Dickieia Berkeley in part; Thwaites, Ann. Mag. Nat. Hist. II. **1:** 171. *pl. 12. f. K.* 1848.

Cocconeis Ehrenb. in part; Grun. Verh. Zool. Bot. Ges. Wien **10:** 577. *pl. 5. f. 10a d.* 1860.

This genus is of most questionable merit. As a convenience in reducing somewhat the unwieldy genus Navicula, it is of advantage, but it is doubtful whether it deserves generic rank on its own merits. The structure of the frustule displays all the characteristics of Navicula, except in having a more or less evident row of internal loculi along the margins of the valves, from the center toward or to the apices. In this it agrees with certain species of Cocconeis Ehrenb., to which for that reason it was joined by Grunow in his genus, Orthoneis. It differs, however, from Cocconeis in having both valves alike. To admit that this internal plate structure is a generic mark is to invite confusion in some other genera. Leaving out the untenable breaking up of Cocconeis already mentioned, there is *Navicula cuspidata* Kütz. This diatom I have found at Farmingdale, New Jersey marl pits, both with and without the large internal craticular plates, which when separated from the frustule were known for a long time as *Surirella craticula* Ehrenb. They are more pronounced structures than the marginal plates of

Mastogloia, but we can not for that reason divide *N. cuspidata* into two genera. In fact in some species of Mastogloia we find a close approximation to the craticular plate by the extension of the marginal plates toward or to the center of the valve, as in M. *smithii* Thwaites,[a] a form called for that reason *Navicula biscalaris* by Brebisson.[b]

There is, however, some reason, despite the foregoing objections, for admitting the genus, namely, that true examples of Mastogloia always have, so far as I know, these marginal internal loculi and are thereby rendered widely distinct in appearance from any Navicula. As for their mode of growth, i. e., the individuals being embedded in gelatinous masses, this can not be taken into account here for the reasons mentioned under Cocconema. Besides, as Grunow points out,[c] living specimens of Mastogloia are often found without this gelatinous matrix. It seems best, on the whole, to recognize the genus subject to the foregoing remarks.

The admission of Ehrenberg's genus Pleurosiphonia as a synonym is also open to question. Most authors overlook it entirely. Thus I can find no reference to it in Cleve's extensive work on the naviculoid diatoms.[d] De Toni[e] recognizes it as a distinct genus with seven species. Ralfs,[f] though giving it a place in his classification, says: "The characters of this genus are unknown to us (they were not given by Ehrenberg till ten years later--1870); but from Ehrenberg's figure of *P. affinis* we think it is probably identical with Mastogloia." Even the diagnosis does not quite settle this doubt. There is no exact mention of marginal loculi, but of "siphons" (whence the name), on either side as lateral lines. These, which Ehrenberg states are "saepe aere repleto," are so figured in all the above citations, and in every case they are drawn as within the marginal space occupied by the loculi of Mastogloia; that is, nearer the center of the valve; and invariably as unbroken tubes, not as rows of chambered loculi, a fact emphasized in the diagnosis by the word "simplice." But no such diatoms have ever been met with. The nearest thing known is Mastogloia, and it is reasonable to suppose with Ralfs that Ehrenberg was dealing with specimens of Mastogloia. Pleurosiphonia appears in literature three years prior to the making of Mastogloia; that, is in 1853. But this is without figure or description, a nomen nudum. Ehrenberg's figure precedes Thwaites's publication by two years, but the diagnosis does not occur till 1870, under the title "Nova Genera." (See citation above.) The generally recognized rule of botanists that the date of a name shall rest on its diagnosis rather than on an undescribed figure should not be used too strictly with the Diatomaceae; for, as a rule, figures are worth much more than any diagnosis, as the intricate sculpture of the diatoms, on which their genus and species depend, is possible to figure but well-nigh impossible to describe. Besides, the reason for this rule in higher plants, seed catalogues, and similar non-scientific publications, plays no part with the diatoms. I would not, therefore, as a rule, make the diagnosis the chief factor in fixing the date of a genus or species in the Diatomaceae. But in this case, where the figures are at best indefinite and the diagnosis does not appear till four years later than Thwaites's accurate figures and description, I give preference to the latter.

Mastogloia lemnisca Leud.-Fort. Mem. Soc. Emul. St. Brieuc 35. *pl. 3. f. 29.* 1879. Schmidt, Atlas *pl. 186. f. 14–15.* 1893. De Toni, Syll. Alg. **2:** 324. 1891. Cleve, Sv. Vet. Akad. Handl. **27**[3]: 159. *pl. 2. f. 26.* 1895.

My specimen exhibits the markings of the variety represented by Schmidt's figure 14 above.

Found at station 3013H, Hawaiian Islands.

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[a] W. Smith, Synop. Brit. Diat. **2:** *pl. 34. f. 341B.* 1856.
[b] In lit. January, 1853.
[c] Verh. Zool. Bot. Ges. Wien **10:** 575. 1860.
[d] Sv. Vet. Akad. Handl. **26**[2]: 1894; **27**[3]: 1895.
[e] De Toni, Syll. Alg. **2:** 326. 1891.
[f] Pritch. Hist. Infus. ed. 4. 915. 1861.

GOMPHONEMA C. Ag.

Gomphonema C. Ag. Syst. Alg. 15. 1824. Pritch. Hist. Infus. ed. 4. 886. 1861. W. Smith, Synop. Brit. Diat. **1**: 77. *pl. 27–29.* 1853. Rabh. Fl. Eur. Alg. **1**: 22. 282. *f. 71.* 1864. Van Heur. Synop. 122. *pl. 23–25.* 1881; Treat. Diat. 268. *f. 58.* 1896. De Toni, Syll. Alg. **2**: 419. 1891. Brun, Diat. Alp. 33. 1880. Griff. & Henf. Micr. Dict. ed. 3. 346. *pl. 12. f. 34.* 1875. Cleve, Sv. Vet. Akad. Handl. **26**[2]: 178. 1894, char. emend.

Meridion C. Ag. in part: Ehrenb. Infus. 208. *pl. 16. f. 3.* 1838.

Sphenosira Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841**: 402. *pl. 3. I. f. 27. IV. f. 12.* 1843. Pritch. Hist. Infus. ed. 4. 892. 1861. Kütz. Bacill. 88. *pl. 29. f. 47.* 1844.

Sphenella Kütz. Bacill. 83. 1844.

Gomphonella Rabh. Sussw. Diat. 61. *pl. 9. f. 1–3.* 1853.

Gomphoneis Cleve, Sv. Vet. Akad. Handl. **26**[2]: 73. 1894.

The inadequate ground for constituting a genus—namely, the matter of its being provided with a gelatinous attachment or being free—discussed under the genus *Cocconema* Ehrenb., is responsible for some of the above synonyms. Thus Gomphonella Rabh. is the form of Gomphonema C. Ag. that is found in gelatinous masses, while Sphenella Kütz. is made up of the forms that are free. Heiberg[a] showed that both forms occur in the same species. Cleve's Gomphoneis is based on a fine line near the margin and a slight difference in the punctation of the costae. Cleve is consistent, in that he breaks up other genera, as Navicula, on just such grounds; but, as is shown under that name, the distinctions are too trivial to separate generically forms that are otherwise so nearly related. The genus Rhoicosphenia Grun. is sometimes spoken of as differing but slightly from this genus. It is much nearer to Achnanthes Bory by reason of the totally unlike valves of the frustule. Gomphonema is closer to Cocconema Ehrenb. than to any other valid genus.

Gomphonema herculeanum Ehrenb. Ber. Akad. Wiss. Berl. **1845**: 78. 1846; Mikrog. *pl. 37 A. f. 9, pl. 35 A. VII. f. 12–13.* 1854. Van Heur. Synop. *pl. 23. f. 2.* Pritch. Hist. Infus. ed. 4. 890. 1861. De Toni, Syll. Alg. **2**: 420. 1891.

Gomphoneis herculeana Cleve, Sv. Vet. Akad. Handl. **26**[2]: 73. 1894. Schmidt, Atlas *pl. 215. f. 4–14.* 1899; *pl. 233. f. 1–2.* 1902.

De Toni gives as reference H. L. Smith's type no. 177. Smith labels it "*Gomphonema capitatum herculaneum*" (not *herculeanum*). It is an unimportant variety of that species and does not at all resemble this one.

Found at station 3694H, Okhotsk Sea.

Gomphonema mammilla Ehrenb. Mikrog. *pl. 37. II. f. 10.* 1854; Phys. Abh. Akad. Wiss. Berl. **1870**: 56. 1871. Van Heur. Synop. *pl. 23. f. 1.* 1881. Ralfs in Pritch. Hist. Infus. ed. 4. 890. 1861.

Gomphoneis mamilla Cleve, Sv. Vet. Akad. Handl. **26**[2]: 73. 1894.

Gomphonema oregonicum Ehrenb. Mikrog. *pl. 37. II. f. 12–13.* 1854?

Gomphonema (*oregonicum* var.?) *maximum* Grun.; Van Heur. Synop. *pl. 23. f. 3.* 1881.(?)

I am not satisfied of the specific identity of Ehrenberg's *G. mammilla* and *G. oregonicum*. As Ralfs points out, there are some considerable differences. It is, however, doubtful if they can be held separate. I do not agree with De Toni in looking upon all the above as synonymous with *G. herculeanum* Ehrenb. It should be here noted that the figure of Van Heurck is misleading in having an unsymmetrical curvature of the costae on opposite sides of the median line.

Found at station 2882, off Oregon.

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[a] Heib. Krit. Overs. Danske Diat. 1863.

COCCONEMA Hemp. & Ehrenb.

Cocconema Hemp. & Ehrenb. in Ehrenb. Symb. Phys. Evertebr. 9. *pl. 2. IV. f. 10.* 1828. Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1829:** 15. 1830; Infus. 223. *pl. 19. f. 7.* 1838; Mikrog. *pl. 10. I. f. 18.* 1854. Kütz. Bacill. 80. *pl. 6. f. 1.* 1844. Pritch. Hist. Infus. ed. 3. 877. *pl. 10. f. 194–198.* 1861. Hass. Hist. Brit. Alg. **1:** 425. *pl. 101. f. 1.* 1845. Schmidt, Atlas *pl. 10. f. 1–35.* 1875. W. Smith, Synop. Brit. Diat. **1:** 75. *pl. 23. f. 219.* 1853. Grun. Denkschr. Akad. Wien **48**[2]: 97. *pl. 1. f. 8.* 1884. Griff. & Henf. Micr. Dict. ed. 3. 180. *pl. 12. f. 19–20.* 1875. H. L. Smith, Sp. Diat. Typ. no. 80–85. 1874. Wolle, Diat. N. A. *pl. 6. f. 1–5. 8–9, 11, 14.* 1890

Bacillaria Gmel. in part; Hemp. & Ehrenb. in Ehrenb. Symb. Phys. *pl. 2. IV. f. 10.* 1828.

Cymbella C. Ag. Consp. 1. 1830. Kütz. Bacill. 79. *pl. 6. f. 11.* 1844. Rabh. Fl. Eur. Alg. **1:** 10, 77. *f. 20.* 1864. Brun. Diat. Alp. 55. *pl. 3. f. 1 8, 10–19.* 1880. Van Heur. Synop. 59. *pl. 2. f. 1–19.* 1881. Truan, Anal. Soc. Espan. Hist. Nat. **13:** 336. *pl. 7. f. 5–12.* 1884. W. Smith, Synop. Brit. Diat. **2:** 84. 1856. Pritch. Hist. Infus. ed. 4. 875. *pl. 7. f. 45–46.* 1861. H. L. Smith, Sp. Diat. Typ. no. 115–123. 1874. H. L. Smith, The Lens **1:** 76. 1872. Greg. Quart. Journ. Micr. Sci. **3:** 4. *pl. 1. f. 17–21.* 1856. De Toni, Syll. Alg. **2:** 349. 1891. Wolle, Diat. N. A. *pl. 7. f. 1–35.* 1890. Cleve, Sv. Vet. Akad. Handl. **26**[3]: 156. 1894. Heib. Krit. Overs. Danske Diat. 107. 1863.

Gomphonema Ag., in part; C. Ag. Consp. 33. 1830. Kütz. Linnaea **8:** 564. *pl. 4. f. 52.* 1833.

Frustulia Ag. in part; Kütz. Linnaea **8:** *f. 10.* 1833. Menegh. in Kütz. Sp. Alg. 59. 1849.

Encyonema Kütz. Linnaea **8:** 589. *f. 73.* 1833. Rabh. Fl. Eur. Alg. **1:** 11,85. *f. 23.* 1864. Van Heur. Synop. 65. *pl. 3. f. 9–23.* 1881. Kütz. Bacill. 82. *pl. 22. f. 1.* 1844. Pritch. Hist. Infus. ed. 4. 879. *pl. 7. f. 49, pl. 14. f. 22.* 1861. W. Smith, Synop. Brit. Diat. **2:** 67. *pl. 54. f. 345.* 1856. Schmidt, Atlas *pl. 10. f. 42–66.* 1875. Hass. Hist. Brit. Alg. **2:** 439. *pl. 100. f. 10.* 1845. De Toni, Syll. Alg. **2:** 371. 1891.

Syncyclia Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1835:** 174. 1837; Infus. 233. *pl. 20. f. 11.* 1838. Kütz. Bacill. 81. *pl. 22. f. 2.* 1844. Pritch. Hist. Infus. ed. 4. 879. *pl. 7. f. 53, pl. 10. f. 206.* 1861. Rabh. Fl. Eur. Alg. **1:** 11, 97. *f. 24.* 1864. Griff. & Henf. Micr. Dict. ed. 3. 759. *pl. 14. f. 14.* 1875. De Toni, Syll. Alg. **2:** 375. 1891.

Navicula Bory, in part; Ehrenb. Infus. 184. *pl. 13. f. 18.* 1838.

Cymbophora Breb. in part; Breb. & God. Consid. Diat. 14. 1838 (cf. Van Heur. Synop. *pl. 3. f. 19.* 1881).

Pinnularia Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 133, in part; Mikrog. *pl. 5. II. f. 11.* 1854.

The claim of Heiberg[a] that Cocconema and Cymbella should be united is quite generally conceded. They differ solely in that the former grows attached to a gelatinous stipe. This is, of course, as truly a morphological characteristic as anything connected with the siliceous frustule. But to admit such a distinction is impossible in this group of plants. Even in living forms Cocconema is certain to become detached in large masses from the stipes; and when found in that condition, it is manifestly absurd to attempt a distinction. In fossil forms all question of gelatinous connections must plainly be eliminated. In the same way diatoms are Schizonema C. Ag. while in their gelatinous tubes, but clearly Navicula Bory when set free; and Eunotia Ehrenb. is identical with Himantidium Ehrenb. when the latter is out of its gelatinous investment. But in the selection of a generic name Heiberg, for utterly trivial reasons, passed over the older name Cocconema and chose Cymbella, and his selection has been generally followed. The older name is, therefore, here restored and Cymbella made its synonym. In the case of Encyonema Kütz., whose mode of growth is different from the other two, the frustule being inclosed in gelatinous tubes, its union here is more

[a] Heib. Krit. Overs. Dansk. Diat. 107. 1863.

open to question; for aside from its mode of growth, which may be neglected, it offers a general distinction in having its raphe stop short of the apices of the frustule and in its terminations being peculiarly bent. But these qualities are very inconstant, and by an examination of many species it is made certain that no distinction is possible between it and the members of the genus Cocconema. Synecelia Ehrenb. is even more strikingly dissimilar in its mode of growth, the frustules being embedded in gelatinous masses and grouping themselves therein by division into cylindrical communities, whence the name. So far as the figures are concerned, they also show some dissimilarity from the present genus in their strongly truncate ends,[a] but this must be looked upon as of little significance when we compare them with the drawings of the evident Cocconema[b] in Pritchard. It is, therefore, best to ignore in the foregoing four genera their differences of attachment and unite them in a single genus.

Cocconema inaequale (Ehrenb.) Mann.

Navicula inaequalis Ehrenb. Ber. Akad. Wiss. Berl. **1836:** 53. 1837, nom. nud.; Infus. 184. *pl. 13. f. 18.* 1838.

Cymbella ehrenbergii Kütz. Bacill. 79. *pl. 6. f. 11.* 1844. Pritch. Hist. Infus. ed. 4. 875. *pl. 7. f. 46, pl. 9. f. 154.1.* 1861. Schmidt, Atlas *pl. 9. f. 6–9, 16–18, pl. 71. f. 74, 80.* 1875. Griff. & Henf. Micr. Dict. ed. 3. *pl. 13. f. 31.* 1875. W. Smith, Synop. Brit. Diat. **1:** 17. *pl. 2. f. 21.* 1853. Van Heur. Synop. 60. *pl. 2. f. 1, 2.* 1881. H. L. Smith, Sp. Diat. Typ. no. 117. 1874. Brun, Diat. Alp. 59. *pl. 2. f. 30.* 1880. Cleve, Sv. Vet. Akad. Handl. **26**[2]**:** 165. 1894. De Toni, Syll. Alg. **2:** 349. 1891. Wolle, Diat. N. A. *pl. 7. f. 3, 21, 25.* 1890.

Stauroneis inaequalis Ehrenb. Mikrog. *pl. 16. I. f. 6.* 1854.

Pinnularia inaequalis Ehrenb. Mikrog. *pl. 16. II. f. 6.* 1854.

Cymbella delicata Schmidt, Atlas *pl. 9. f. 17.* 1875.

Kützing recognizes the identity of his form and Ehrenberg's *Navicula inaequalis.* It is possible *Stauroneis inaequalis* Ehrenb. and *Pinnularia inaequalis* Ehrenb. can be assigned to some other species as well as to this, as their exact character is rather hard to determine. But they agree fairly well with this species: and it is probable Ehrenberg looks upon them as the same, as he uses the three generic names interchangeably. In fact, the name Stauroneis Ehrenb.[c] is probably a misprint, for the form shows no trace of a stauros.

Found at station 3013H, Hawaiian Islands.

Cocconema kamtschatica (Grun.) Mann.

Cymbella kamtschatica Grun.; Schmidt, Atlas *pl. 10. f. 31.* 1875. Wolle, Diat. N. A. *pl. 7. f. 11.* 1890. Möll. types 3. 2. 10.

Cleve[d] makes this a variety of *Cocconema mexicanum* Ehrenb.[e] De Toni,[f] on the other hand, places it as a variety of *Cymbella gastroides* Kütz. Both of these resemble the above. In fact, few species of this genus have hard and fast boundaries; and we might add to the above resembling forms *Cymbella maculata* Kütz., especially as figured by Van Heurck.[g] I, however, think that Grunow's form, on account of its smaller size than in the above, its finer markings, its blunt apices, and its breadth at the middle of the valve, together with its tumid outline on the ventral side, can be safely left in a species by itself.

Found at station 2882, off Oregon.

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[a] Cf. Pritch. Hist. Infus. ed. 4. *pl. 7. f. 53.* 1861.

[b] Pritch. op. cit. *pl. 14. f. 18–20.*

[c] Ehrenb. Mikrog. *pl. 16. I. f. 6.* 1854.

[d] Sv. Vet. Akad. Handl. **26:** 177. 1894.

[e] Cf. Ber. Akad. Wiss. Berl. **1844:** 342. 1845. Ehrenb. Mikrog. *pl. 33. VII. f. 6–7.* 1854. Schmidt, Atlas *pl. 10. f. 32–33, pl. 71. f. 82.* 1875–81.

[f] De Toni, Syll. Alg. **2:** 362. 1891.

[g] Synop. *pl. 2. f. 16.* 1881.

Cocconema lanceolatum (C. Ag.) Ehrenb. Infus. 224. *pl. 19. f. 6.* 1838; Mikrog. *pl. 8. I. f. 8, pl. 10. I. f. 18, pl. 14. f. 82, pl. 15A. f. 96, pl. 17. II. f. 32, pl. 38A. II. f. 10, pl. 39. II. f. 16.* 1854. Schmidt, Atlas *pl. 10. f. 8–10.* 1875; *pl. 72. f. 22–25.* 1881. H. L. Smith, Sp. Diat. Typ. no. 83. 1874. Hass. Hist. Brit. Alg. 426. *pl. 101. f. 1.* 1845. Pritch. Hist. Infus. ed. 4. 877. *pl. 10. f. 194–195.* 1861. Kütz. Bacill. 81. *pl. 6. f. 3.* 1844. Rabh. Fl. Eur. Alg. **1**: 83. 1864. W. Smith, Synop. Brit. Diat. **1**: 75. *pl. 23. f. 219.* 1853. Griff. & Henf. Micr. Dict. 180. *pl. 12. f. 19–20.* 1875. W. Smith, Ann. Mag. Nat. Hist. II. **19**: 8. *pl. 1. f. 8* (not *f. 7*). 1857. Thw. Ann. Mag. Nat. Hist. **20**: 343. *pl. 22. f. C, 1–3.* 1847. Wolle, Diat. N. A. *pl. 6. f. 1–3, 11, 14–16.* 1890.

Gomphonema lanceolatum C. Ag. Consp. Diat. 34. 1830. Kütz. Linnaea **8**: 38. 1833 (not *G. lanceolatum* Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841**: 306. *pl. 2. I. f. 37.* 1843).

Cocconema asperum Ehrenb. Ber. Akad. Wiss. Berl. **1840**: 206. 1841; Mikrog. *pl. 5. I. f. 1. II. f. 1. III. f. 27, pl. 6. I. f. 30, pl. 9. I. f. 42, pl. 16. III. f. 39.* 1854. Kütz. Bacill. 81. 1844. Pritch. Hist. Infus. ed. 4. 877. 1861. Bail. Amer. Jour. Sci. 124. *pl. 2. f. 2* (unnamed). 1838; cf. Hab. Cat. 85. 1877.

Cocconema cornutum Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841**: 124. 1843; Mikrog. *pl. 5. II. f. 3. III. f. 28, pl. 14. f. 80, pl. 15A. f. 94, pl. 39. III. f. 12.* 1854.

Cocconema cymbiforme Ehrenb. err. det. Bail. in Fremont, Rep. Expl. Exped. 1842 4. 302. *pl. 5. f. 8* (not *f. 7, 9*). 1845.

Cymbella lanceolata Kirchn. in Cohn, Krypt. Flora Schles. 188. 1878. Brun, Diat. Alp. 57. *pl. 3. f. 19, pl. 9. f. 16.* 1880. Van Heur. Synop. 63. *pl. 2. f. 7.* 1881. Truan, Anal. Soc. Espan. Hist. Nat. **13**: 337. *pl. 7. f. 6.* 1884. De Toni, Syll. Alg. **2**: 362. 1891. Pant. Beitr. Bacill. Ung. **2**: 41. 1889; **3**: *pl. 24. f. 344, 350.* 1893 (not *C. lanceolata* C. Ag. Consp. Diat. 9. 1830).

Cymbella aspera Cleve, Sv. Vet. Akad. Handl. **26**[2]: 175. 1894, in part.

Although I agree with De Toni in making *Cocconema cornutum* Ehrenb. synonymous with the present species, I recognize that there is ground for questioning this, *C. cornutum* being more suddenly attenuated on either side of the middle and, therefore, with narrower apices than *C. lanceolatum*, whence the name. But I do not think this is sufficient to separate them. I have no question in regard to *C. asperum* Ehrenb., which Cleve holds as a distinct species. Ehrenberg's own figures of this are indistinguishable from his *C. lanceolatum*. Cleve has evidently a somewhat different conception of this diatom, as is shown by his uniting with it such forms as Pantocsek's *Cymbella gigantea*,[a] which seems to me quite distinct from Ehrenberg's *C. asperum*. I therefore make Cleve's species synonymous only in part. Doubtless this species and *C. gastroides* Kütz. interlock.

Found at station 2882, off Oregon.

AMPHORA Ehrenb.

Amphora Ehrenb. Ber. Akad. Wiss. Berl. **1840**: 205. 1841. Kütz. Bacill. 107. 1844. Rabh. Fl. Eur. Alg. **1**: 86. 1864. H. L. Smith, The Lens, **2**: 64. 1873. Van Heur. Synop. 55. 1881. Brun, Diat. Alp. 53. 1880.

Navicula Ehrenb. Infus. 188. *pl. 14. f. 3.* 1838, in part.

Frustulia Agardh, in part; Kütz. Linnaea **8**: 535. 1833. Agardh, Flora **10**: 627. 1827.

Cymbella Agardh, in part; Kütz. Bacill. 80. *pl. 5. f. 8, pl. 6. f. 7.* 1844.

Cocconeis Ehrenb. in part; Neup. Math. Termesz. Közlem. **5**: *pl. 2. f. 40.* 1867

Amphora baccata Mann, sp. nov. PLATE XLIV, FIGURE 2.

Valves straight or slightly convex on the ventral side; convex by a broad, even arc on the dorsal side; ends blunt, rounded; raphe beginning somewhat toward the dorsal

[a] Pant. Beitr. Bacill. Ung. **3**: *pl. 21. f. 321.* 1893.

side of each apex, curving slightly to that side, then recurving toward the ventral side in a long, graceful arc and terminating at a small, rectangular, hyaline central area, close to the ventral side; markings of closely set, moniliform striae, transverse except toward the apices, where they are slightly incurved; beading of the striae alike on both sides of the raphe, which is bordered on each side by a narrow hyaline space; a hyaline line, the width of one row of beads, forming a narrow stauros transversely across the center, from the rectangular central area to the dorsal side.

Length of valve, 0.135 mm.; width of valve, 0.023 mm. Striae, 76 in 0.1 mm.

Type in the U. S. National Museum, no. 590153, from station 3688H, Okhotsk Sea, August 27, 1896; 1,562 fathoms, bottom of brown mud and fine sand.

There is some resemblance between the above and *A. elegans* Gregory;[a] but Gregory's species is more attenuated, especially as to the apices, and is much more delicately marked. Thus De Toni says of it,[b] "Valvis gracilibus, semilunatis, levibus (striis obsoletis)." It resembles more strongly *A. leeis* Gregory,[c] a similarity which is, however, accidental to Schmidt's figure, as can be seen by comparing it with the original description and figures,[d] Gregory saying that his form is "very hyaline," and that "the striae are very fine, about 60 in 0.001, very hyaline and hardly to be seen with a power of 400 diam." Schmidt's figure is therefore quite deceptive.

Amphora crescens Mann, sp. nov. PLATE XLIV, FIGURE 3.

Amphora crassa punctata Grun.? Schmidt, Atlas *pl. 28, f. 32*, 1875.

Valve slightly convex on the dorsal side, more rapidly curving toward the rounded and incurved ends; the margin appearing ribbed because of the transverse striae; ends bent inward into rounded wings extending beyond the ventral line of the rest of the valve and hyaline along their inner edges; raphe beginning near the ends, close to the dorsal margin, almost straight until near the middle, then curving ventrally to the two central nodules, which are distant from the ventral side one-fourth the width of the valve; ventral margin slightly convex at the center, straight or slightly concave between this and the rounded ends; transverse striae obscure, except where seen in relief along the dorsal margin; markings different on the two sides of the raphe; on the dorsal side consisting of rows of beads, three to five in a row, the smallest next to and touching the raphe, increasing regularly in size to the last at the dorsal margin; these rows alternating with the striae visible at the margin, equidistant, 44 in 0.1 mm., transverse at the center of the valve, thence outward gradually inclining toward the ends; on the ventral side the rows shorter, of two or three beads of nearly equal size, those nearest the raphe slightly larger; not touching the raphe, but uniformly distant the width of one bead, thus leaving a hyaline line along the raphe on the ventral side only; rows absent at the middle for the width of two rows, thence at first inclining from the central area, halfway to their becoming transverse, from there outward gradually inclined from the ends, thus making them at this point confluent with those on the dorsal side of the raphe; at the rounded ends of the valve the ventral rows not reaching the margin, but leaving these hyaline on their inner edges.

Length of valve, 0.09 mm.; width of valve, 0.013 mm. Beaded striae, 44 in 0.1 mm.

Type in the U. S. National Museum, no. 590158, from station 4516H, Gulf of California, December 22, 1904; 1,627 fathoms.

This species bears a significant general resemblance to the figure in Schmidt's Atlas,[e] named *A. crassa punctata* Grun. The figure is very poor, making it impossible to see whether or not there are beaded striae present, though the varietal name implies that

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[a] Trans. Micr. Soc. Lond. n. s. **5:** 70. *pl. 1, f. 30*. 1857. Moeb. Diat.-taf. *pl. 12, f. 30*. 1890.

[b] De Toni, Syll. Alg. **2:** 381. 1891.

[c] Schmidt, Atlas, *pl. 26, f. 9*. 1875.

[d] Trans. Roy. Soc. Edinb. **21:** 514. *pl. 12, f. 74, b–c*. 1857.

[e] *Pl. 28, f. 32*. 1875.

there are. At any rate, it is clear Grunow has overlooked Gregory's clear characterization of his species,[a] in which he expressly states that his former figure[b] is incorrect and probably denotes another species. He goes on to say: "The markings are entire, coarse, subdistant, about 12 in 0.001. Between the lateral segments are from five to eight converging bars, marked with the same subdistant entire striae. 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." He then refers to various localities where he has found this form, showing that it is constant in its characters. If the contour of Amphora, independent of its markings, were to be considered the specific mark of distinction, then my species and the figure in Schmidt's Atlas [c] might be classed as broad varieties of Gregory's form; and to these would have to be added many other otherwise valid species, as this winged contour is not at all uncommon in the genus. But such is not the case; and the above, together with the figure Gregory excludes from his *crassa* in the citation already made, must rank separately. Prof. H. L. Smith in his Conspectus of Amphora,[d] correctly described and figured *A. crassa* Greg. He there favors its union with *A. sulcata* Breb., according to Grunow's suggestion, but the merits of this question do not enter into the present case, as my form is equally unlike both of these. It is certain that whatever be the interpretation of Schmidt's blurred figure, the specimen here named and figured can not be referred to Gregory's *A. crassa*.

Amphora honshuensis Mann, sp. nov. PLATE XLIV, FIGURE 1,

Valves broadly rounded, the margin on the ventral side concave and parallel to the convex dorsal margin, until, near the ends, they both converge to form the broad, rounded apices; raphe beginning at the center, close to the ventral margin, curving sharply backward toward the dorsal side and terminating in two large beads close to the dorsal margin, but some distance from the rounded apices; striae of very fine beading, extending from the dorsal and ventral margins to the raphe, leaving no hyaline band on either side of it; a small lunate, hyaline area between the two central nodules of the raphe and the ventral margin; valve depressed at the center in a broad shallow transverse hollow, the two halves on either side rising above this like lobes; on account of this central depression and the elevation of the two halves the lines of beading on the dorsal side of the raphe, although approximately transverse, appearing in the hollow to bend convexly from each other, then halfway toward the ends to become transverse, and near the broad, rounded extremities to again become curved with the concave curvature inward; on the ventral side of the raphe the lines of beading, which are equally minute, beginning at the hyaline lunate area before mentioned, somewhat inclined toward the center and transverse only on nearing the rounded ends; these lines on the ventral side somewhat irregular, producing a wavy appearance; valves very delicate and diaphanous. Name referring to proximity to Honshu Island, Japan.

Length of valve, 0.16 mm.; width of valve, 0.04 mm. Striae, 85 to 88 in 0.1 mm.

Type in the U. S. National Museum, no. 590154, from station 3698, off Honshu Island, Japan, May 5, 1900; 153 fathoms, bottom of green mud, volcanic ashes, and sand.

Amphora mexicana Schmidt, Atlas *pl. 27. f. 47 48* (not *f. 49*). 1875. De Toni, Syll. Alg. **2:** 409. 1891. Cleve, Sv. Vet. Akad. Handl. **26**[2]: 105. *pl. 4. f. 15.* 1895.

Amphora vachenhusenii Jan.: Schmidt, Atlas *pl. 40. f. 38.* 1876. Diat. Gaz. Exped. *pl. 22. f. 47.*

Amphora boryana Pant. Bacill. Ung. **2:** 36. 1889; **3:** *pl. 48. f. 541.* 1893.

There is no appreciable difference between the above. It may also be that *A. oculus* Schmidt [e] should be added to the synonyms; although the absence of the curved

[a] Trans. Roy. Soc. Edinb. **21:** 524. *pl. 14. f. 94a-d.* 1857.
[b] Trans. Micr. Soc. Lond. n. s. **5:** *pl. 1. f. 35.* 1857.
[c] *Pl. 28. f. 32.* 1875.
[d] The Lens **2:** 76. *pl. 2. f. 5.* 1873.
[e] Schmidt, Atlas *pl. 27. f. 52.* 1875.

expansions on the ventral side of the raphe in *A. oculus* and its more massive build make this union doubtful. It is so united by Fricke.[a] *A. proteus kariana* Grun.,[b] has also a strong resemblance to the above. I see no reason for uniting with these, under the general name *A. oculus* Schmidt, the quite different *A. farcimen* Grun., *A. weissflogii* Schmidt, and *A. kamorthensis* Grun., as seems to be done by Fricke.[c] It may be said that Cleve[d] also unites *A. boryana* Pant. with the above, and De Toni[e] includes it as variety *boryana*, but with a question mark.

My specimens agree best with Cleve's figure,[f] though they are smaller forms, their average length being 0.079 mm. and their width 0.023 mm. I look upon the diatom figured in Schmidt's Atlas[g] bearing the above name, as a quite distinct species.

Found at stations 3698, 3712H, off Honshu Island and in Okhotsk Sea.

Amphora pellucida Greg. Trans. Roy. Soc. Edinb. **21**: 513. *pl. 13. f. 73.* 1857. Schmidt, Atlas *pl. 27. f. 11, 36–37, 65.* 1875. H. L. Smith, The Lens **2**: 78. *pl. 2. f. 15.* 1873. De Toni, Syll. Alg. **2**: 405. 1891.

It is possible this is a delicate variety of *A. ovalis* Kütz., as treated by Rabenhorst,[h] a view also seemingly favored by H. L. Smith and De Toni above. Cleve[i] says it is "too imperfectly described and figured for admitting of identification" (which is not the case); and then he proceeds to identify it by putting it in *A. marina* (W. Smith?) Van Heur. Again[j] he places it, as figured in Schmidt's Atlas at above reference, exclusive of figure 65, in *A. commutata* Grun. If it is to be included in any other species, it should be in *A. ovalis* Kütz., but I think there is sufficient doubt about this to justify its being allowed to stand.

Found at station 2920H, Hawaiian Islands.

Amphora spectabilis Greg. Trans. Roy. Soc. Edinb. **21**: 516. *pl. 13. f. 80a, d, e* (not *f. 80b, c*). Schmidt, Atlas *pl. 40. f. 20–23.* 1876. H. L. Smith, The Lens **2**: 80. *pl. 3. f. 3.* 1873. Cleve, In Nordensk. Vega Exped. **3**: 462. 1883; Sv. Vet. Akad. Handl. **27**[3]: 132. 1895. De Toni, Syll. Alg. **2**: 408. 1891.

Amphora furcata Leud.-Fort. Mem. Soc. Emul. St. Brieuc 20. *pl. 1. f. 11.* 1879. De Toni, Syll. Alg. **2**: 402. 1891.

The claim made by Leuduger-Fortmorel, above, that Schmidt's figures, above, are not Gregory's *spectabilis*, but a distinct species, which he also figures and to which he gives the specific name *furcata*, is supported by De Toni, above. I do not agree with this view, but take the position stated by Cleve[k] that Schmidt's and Leuduger-Fortmorel's forms are only a variety of Gregory's species. A careful reading of Gregory's long description of this diatom will make it evident that the only particular in which it fails to correspond with Schmidt's figures is in the forking of the inner ends of the striae on the dorsal side. Gregory says his specimens were very dimly striated on that side, so much so that though the striae were evident near the dorsal margin, they faded away toward the inner ends. Without doubt this fact prevented his noting the forking of these striae; though it ought to be added that this forking is by no means invariable, as is to be seen by comparing Schmidt's figure 20 with his figure 21. So far as my experience goes, the figure of Leuduger-Fortmorel seems overdrawn in the irregularity of the striae.

Found at station 3698, off Honshu Island, Japan.

[a] Fricke, Verzeichniss zu Schmidt's Atlas 10. 1902.
[b] Cleve & Grunow, Sv. Vet. Akad. Handl. **17**[2]: 24. *pl. 1. f. 7.* 1880.
[c] Cleve. Sv. Vet.-Akad. Handl. **27**[3]: 105. 1895.
[d] Op. cit. 8.
[e] Syll. Alg. **2**: 409. 1891.
[f] Op. cit. *pl. 4. f. 15.*
[g] *Pl. 27. f. 49.* 1875.
[h] Fl. Eur. Alg. **1**: 92. 1864.
[i] Cleve, op. cit. 103.
[j] Cleve, op. cit. 119.
[k] Cleve, op. cit. 132.

CYSTOPLEURA Breb.

Cystopleura Breb.; Kütz. Sp. Alg. 3. 1849, as synonym. Kuntze, Rev. Gen. Pl. **2**: 890. 1891

Frustulia C. Ag. in part; Kütz, Linnaea **8**: 16. *pl. 1. f. 18.* 1833.

Eunotia Ehrenb. Infus. 190. *pl. 14. f. 5.* 1838, in part.

Navicula Bory, in part; Ehrenb. Infus. 184. *pl. 13. f. 19.* 1838.

Epithemia Kütz. Bacill. 33. 1844. Rabh. Fl. Eur. Alg. **1**: 9, 62. *f. 15.* 1864. W. Smith, Synop. Brit. Diat. **1**: 11. *pl. 1. f. 1.* 1853. Brun, Diat. Alp. 42. *pl. 2. f. 10–18.* 1880. Van Heur. Synop. 138. *pl. 31–32.* 1881. H. L. Smith, Thé Lens **1**: 80. 1872. Pritch. Hist. Infus. ed. 4. 759. *pl. 12. f. 24–25.* 1861. Eng. & Pr. Pflanzenfam. **1**[1b]: 140. *f. 256.* 1896, not Blume, 1826.

Cymbella Hass. Hist. Brit. Alg. **1**: 428. *pl. 100. f. 7–8.* 1845, in part, not C. Ag.

The name Epithemia Breb. is a homonym of Epithemia Blume, 1826, a genus of the Primulaceae. The genus Cystopleura Breb. is first technically published by Kuntze, all previous references to it being in synonomy.

Cystopleura gibba (Ehrenb.) Kuntze, Rev. Gen. Pl. **2**: 891. 1891. De Toni, Syll. Alg. **2**: 780. 1892.

Navicula gibba Ehrenb. Infus. 184. *pl. 13. f. 19.* 1838.

Eunotia gibba Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841**: 3. *pl. I. f. 39.* 1843. Bail. in Fremont. Rep. Explor. Exped. 1842–4. 302. *pl. 5. f. 4–5.* 1845.

Eunotia jastrabensis Ehrenb. Mikrog. *pl. 8. f. 3.* 1854.

Epithemia gibba Kütz. Bacill. 35. *pl. 4. f. 22.* 1844. W. Smith, Synop. Brit. Diat. **1**: 15. *pl. 1. f. 13.* 1853. Rabh. Sussw. Diat. *pl. 1. f. 3.* 1853. Grun. Verh. Zool. Bot. Ges. Wien **12**: 327. *pl. 6. f. 7.* 1862. Pritch. Hist. Infus. ed. 4. 759. *pl. 12. f. 27.* 1861. Brun, Diat. Alp. 44. *pl. 2. f. 14.* 1880. Van Heur. Synop. 139. *pl. 32. f. 1–5.* 1881. H. L. Smith, Sp. Diat. Typ. no. 150. 1874. Wolle, Diat. N. A. *pl. 35. f. 1–3, 8–9.* 1890. Thwaites, Ann. Mag. Nat. Hist. **20**: 344. *pl. 22. f. F1–2.* 1847. Griff. & Henf. Micr. Dict. ed. 3. 287. *pl. 51. f. 6.* 1875. Van Heur. Treat. Diat. 296. *pl. 9. f. 351–354.* 1896. Grun. Denkschr. Akad. Wien **48**[2]: 100. 1884.

Epithemia ventricosa Kütz. Bacill. 35. *pl. 30. f. 9.* 1844. W. Smith, Synop. Brit. Diat. **1**: 15. *pl. 1. f. 14.* 1853.

It is impossible to unite with this species Ehrenberg's *Navicula uncinata*,[a] though subsequent to its publication he refers to it in this connection.[b] Without a figure and more accurate description there is nothing gained by placing this name in the synonymy.

The specimens from station 3346 are a variety in which hardly a trace of the granulation of the striae is visible.

Found at stations 2690H, 2848, 2917H, 3013H, 3346, Bering Sea to central California and Hawaiian Islands.

Cystopleura turgida Kuntze, Rev. Gen. Pl. **2**: 891. 1891. De Toni, Syll. Alg. **2**: 777, 1892.

Navicula turgida Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1830**: 64. 1831.

Navicula granulata Ehrenb.; Poggend. Annal. Phys. u. Chem. **38**: 220. *pl. 3. f. 2.* 1836.

Eunotia turgida Ehrenb. Infus. 190. *pl. 14. f. 5, pl. 21. f. 20a.* 1838.

Eunotia westermani Ehrenb. Infus. 190. *pl. 14. f. 6.* 1838.

Eunotia granulata Ehrenb. Infus. 191. *pl. 21. f. 20.* 1838. Kütz. Bacill. 36. 1844.

Eunotia faba Ehrenb. Infus. 191. *pl. 21. f. 21.* 1838.

Eunotia librile Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841**: 126. *pl. 3. I. f. 38.* 1843.

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[a] Phys. Abh. Akad. Wiss. Berl. **1828**: 64. 1830.

[b] Ehrenb. Infus. 184. 1838.

Epithemia turgida Kütz. Bacill. 34. *pl. 5. f. 14.* 1844. Rabh. Fl. Eur. Alg. **1:** 62. 1864. Rabh. Süssw. Diat. 18. *pl. 1. f. 11.* 1853. W. Smith, Synop. Brit. Diat. **1:** 12. *pl. 1. f. 2.* 1853. Pritch. Hist. Infus. ed. 4. 761. *pl. 4. f. 1, pl. 9. f. 156–161, pl. 11. f. 1–8.* 1861. H. L. Smith, Sp. Diat. Typ. no. 155. 1874. Brun, Diat. Alp. 43. *pl. 2. f. 17.* 1880. Van Heur. Synop. *pl. 31. f. 1–2, 5–7.* 1881. Grun. Verh. Zool. Bot. Ges. Wien **12:** 324. *pl. 6. f. 2.* 1862.

Epithemia westermanii Kütz. Bacill. *pl. 30. f. 4.* 1844 (not *pl. 5. f. 13;* not W. Smith, Synop. Brit. Diat. **1:** 14. *pl. 1. f. 11.* 1853; not H. L. Smith, Sp. Diat. Typ. no. 157. 1874; not Pritch. Hist. Infus. ed. 4. 760. *pl. 4. f. 2, pl. 9. f. 157.* 1861). Van. Heur. Synop. *pl. 31. f. 8.* 1881.

Epithemia librile Kütz. Bacill. 35. *pl. 29. f. 45* (poor). 1844. Pritch. Hist. Infus. ed. 4. 761. *pl. 12. f. 24–25.* 1861.

Epithemia vertagus Kütz. Bacill. 36. *pl. 30. f. 20.* 1844?

Epithemia granulata Kütz. Bacill. 35. *pl. 5. f. 20.* 1844. Pritch. Hist. Infus. ed. 4. 761. *pl. 9. f. 165.* 1861.

Epithemia faba Kütz. Bacill. 36. *pl. 5. f. 21.* 1844.

Cymbella turgida Hass. Hist. Brit. Alg. **1:** 428. *pl. 100. f. 7.* 1845.

It is doubtful if *E. westermanii* (Ehrenb.) Kütz., included above, should be attributed to Kützing. His first figure and description represent a totally different diatom, as do some of the subsequent copies of it and exsiccati so determined and cited above, which I have also excluded. The figure on plate 30 is, however, a good representation of this species, as is that cited by Van Heurck. There is very close similarity between the present species and *E. hyndmanii* W. Smith,[a] so much so that their separation, though upheld by De Toni and others, appears to me decidedly doubtful. In fact, my specimen is about midway between the two, having the strongly bowed dorsal outline and broad rounded apices of *E. hyndmannii* together with the beading of *E. turgida*, especially the large beading along the ventral margin as seen in the zonal view.

Found at station 2882, off Oregon.

NITZSCHIA Hass.

Nitzschia Hass. Hist. Brit. Alg. **1:** 435. 1845. W. Smith, Synop. Brit. Diat. **1:** 37. *pl. 13–14.* 1853. Cleve & Grun. Sv. Vet. Akad. Handl. **17²:** 67. 1880. Van Heur. Synop. 169. *pl. 57–70.* 1881; Treat. Diat. 382. *pl. 15–16.* 1896. Pritch. Hist. Infus. ed. 4. 779. 1861. De Toni, Syll. Alg. **2:** 495. Eng. & Pr. Pflanzenfam. **1¹ᵇ:** 142. 1896.

Navicula Bory, in part; Ehrenb. Infus. 182. *pl. 13. f. 15.* 1838.

Synedra Ehrenb. in part; Kütz. Bacill. 67. *pl. 4. f. 36–37.* 1844.

Surirella Turp. in part; Bail. Smithson. Contr. Knowl. **2⁸:** 40. *pl. 2. f. 36.* 1851.

Amphipleura Kütz. in part; W. Smith, Synop. Brit. Diat. **1:** 45. *pl. 15. f. 128.* 1853.

Tryblionella W. Smith, Synop. Brit. Diat. **1:** 35. 1853.

Denticula Kütz. in part; W. Smith, Synop. Brit. Diat. **2:** 21. *pl. 34. f. 295.* 1856.

Dimeregramma Ralfs, in part; Pritch. Hist. Infus. ed. 4. 790. *pl. 4. f. 12.* 1861.

Nitzschiella Rabh. Fl. Eur. Alg. **1:** 163. 1864.

Grunowia Rabh. Fl. Eur. Alg. **1:** 146. 1864.

Pritchardia Rabh. Fl. Eur. Alg. **1:** 162. 1864.

Perrya Kitton, Mo. Micr. Journ. **12:** 218. *pl. 81. f. 1–3.* 1874.

Bacillaria Gmel. in part; De Toni, Syll. Alg. **2:** 493. 1891.

Hantzschia Grun. in Cleve & Grun. Sv. Vet. Akad. Handl. **17²:** 103. 1880. Van Heur. Synop. 168. *pl. 56.* 1881; Treat. Diat. 280. 1896.

The original genus of Hassall was extensively emended by William Smith in 1853 and by Grunow in 1880. In the latter instance the genus Hantzschia was set off by

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[a] W. Smith, Synop. Brit. Diat. **1:** 12. *pl. 1. f. 1.* 1853, and Van. Heur. Synop. *pl. 31. f. 3–4.* 1881.

Grunow, but on too unimportant distinctions. The rather sharp constriction of the valves at the center on the dorsal side, and especially the heavier beading of the dorsal margin, sometimes extending as ridges part way across the valve, are the marks of distinction. The apices are liable to be slightly curved ventrally. These characters of Hantzschia singly or together are more or less to be seen in other species of Nitzschia, and are not good generic marks. Van Heurck retains the genus. It is instructive on this point to compare *Nitzschia bilobata* W. Smith with *Hantzschia amphioxys* (Ehrenb.) Grun.[a]

Nitzschia amphibia Grun. Verh. Zool.-Bot. Ges. Wien **12:** 574. *pl. 12. f. 23.* 1862. Cleve, Sv. Vet. Akad. Handl. **17**[2]: 98. 1880. Van Heur. Synop. 184. *pl. 68. f. 15–17.* 1881–85. Rabh. Fl. Eur. Alg. **1:** 157. 1864. H. L. Smith, Sp. Diat. Typ. no. 688. 1874. De Toni, Syll. Alg. **2:** 543. 1891.

Bacillaria frauenfeldii Grun. Verh. Zool. Bot. Ges. Wien **10:** 584. *pl. 12. f. 1.* 1862. De Toni, Syll. Alg. **2:** 545. 1891.

Nitzschia frauenfeldii Grun. in Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 98. 1880. Van Heur. Synop. *pl. 68. f. 18.* 1881.

Nitzschia actinastroides Grun.; Van Heur. Synop. *pl. 68. f. 19–23.* 1881.

Although the original figures of *B. frauenfeldii* are much more tapering than those of *N. amphibia*, a comparison of the two as figured by Van Heurck will show their identity. In fact, Grunow says:[b] "Nahe verwandt mit *N. amphibia* und wohl nur eine langere Form derselben." The species is also too close to some other forms, as *N. fossilis* Grun.,[c] and *N. liebetruthii* Rabh.[d] The former differs merely in much greater attenuation, but as I have not seen the diatom I do not include it with the above.

Found at station 3091, off Oregon.

Nitzschia angustata (W. Smith) Grun. in Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 70. 1880. Van Heur. Synop. 172. *pl. 57. f. 22–24.* 1881. Cleve & Möll. Typ. no. 154-155. De Toni, Syll. Alg. **2:** 500. Van Heur. Treat. Diat. 385. *pl. 15. f. 498.* 1896.

Tryblionella angustata W. Smith, Synop. Brit. Diat. **1:** 36. *pl. 30. f. 262.* 1853. Rabh. Fl. Eur. Alg. **1:** 148. 1864. Pritch. Hist. Infus. ed. 4. 792. 1861. Brun, Diat. Alp. 103. *pl. 4. f. 28.* 1880.

Nitzschia marina Grun. in Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 70. 1880. Van Heur. Synop. *pl. 57. f. 26–27.* 1881. De Toni, Syll. Alg. **2:** 500. 1891. Cleve in Nordensk. Vega Exped. **3:** 507. 1883. Wolle, Diat. N. A. *pl. 44. f. 16* (not *f. 17*). 1892.

Both Brun and Habirshaw add to the above list *Tryblionella acuminata* W. Smith.[e] This is incorrect. Nor can Habirshaw's union of *Synedra praemorsa* Ehrenb.[f] be admitted. The measurements of *N. marina* vary considerably in the first and fourth citations above, the latter being much larger.

Found at stations 2929, 4516H, off southern California and in Gulf of California.

Nitzschia insignis Greg. Trans. Micr. Soc. Lond. n. s. **5:** 80. *pl. 1. f. 46, 46*.* 1857. Van Heur. Synop. *pl. 61. f. 1.* 1881; Treat. Diat. 391. *pl. 32. f. 835, 836.* 1896. Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 83. 1880. De Toni, Syll. Alg. **2:** 521. 1892 (not H. L. Smith, Sp. Diat. Typ. no. 349. 1874 = *N. scalaris* (Ehrenb.) W. Smith).

Pritchardia insignis Rabh. Fl. Eur. Alg. **1:** 163. 1864.

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[a] Van Heur. Treat. Diat. *pl. 15. f. 484b, 513.* 1896.
[b] Sv. Vet. Akad. Handl. **17**[2]: 99. 1880.
[c] Van Heur. Synop. *pl. 68. f. 24.* 1881.
[d] Van Heur. Synop. *pl. 68. f. 25–26.* 1881.
[e] W. Smith, Synop. Brit. Diat. **1:** 36. *pl. 10. f. 77.* 1853.
[f] Phys. Abh. Akad. Wiss. Berl. **1841:** *pl. 3. VI. f. 11.* 1843.

Nitzschia smithii Ralfs in Pritch. Hist. Infus. ed. 4. 781. Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 84. 1880. Grun. Verh. Zool. Bot. Ges. Wien **12**: 564. 1862. De Toni, Syll. Alg. **2**: 521. 1892. Van Heur. Synop. *pl. 61. f. 4.* 1881.

Pritchardia smithii Rabh. Fl. Eur. Alg. **1**: 163. 1864.

Nitzschia spectabilis W. Smith, Synop. Brit. Diat. **1**: 39. *pl. 14. f. 116.* 1853 (not Ehrenb.).

Nitzschia insignis marginifera Grun. in Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 84. *pl. 6. f. 105.* 1880?

Ralfs changed William Smith's name *N. spectabilis* to *N. smithii* because of the *N. spectabilis* of Ehrenberg. There is no difference between this and *N. insignis*, the sigmoid shape of the frustules in *N. smithii* being a vanishing quantity in many cases and of no specific importance when present. As Grunow saw only the zonal view of the last-named synonym above, it remains doubtful whether it was this or *N. scalaris* (Ehrenb.) W. Smith. H. L. Smith's type referred to above is misnamed, being a true *N. scalaris* and identical with his type no. 365, except that it is a little smaller. The two species which Van Heurck considers as possible varieties of *N. insignis*,[a] namely, *N. adriatica* Grun.,[b] and *N.* (*adriatica* var. ?) *spathulifera* Grun.[c] are rather varieties of *N. scalaris*. It is more difficult to include with *N. scalaris* *N.* (*insignis* var. ?) *notabilis* Grun., which Grunow[b] makes an unquestioned variety of the present species. It is certain it does not belong here.

Found at station 2823, Gulf of California.

Nitzschia panduriformis Greg. Trans. Roy. Soc. Edinb. **21**: 529. *pl. 14. f. 102.* 1857. Van Heur. Synop. 172. *pl. 58. f. 1–4* (*f. 5–6* doubtful). 1881. Cleve, Bih. Sv. Vet. Akad. Handl. **1**[11]: 12. 1873. Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 71. (*pl. 5. f. 92* ?). 1880. De Toni, Syll. Alg. **2**: 501. 1892. Van Heur. Treat. Diat. 386. *pl. 15. f. 500.* 1896. Wolle, Diat. N. A. *pl. 44. f. 3–4, 9.* 1890. Pritch. Hist. Infus. ed. 4. 780. 1861.

Tryblionella lata Witt, Journ. Mus. Godef. **1**: 66. *pl. 8. f. 6.* 1873. Lagers. Bih. Sv. Vet. Akad. Handl. **3**[5]: 27. *pl. 1. f. 2.* 1876.

Nitzschia lata Cleve, Bih. Sv. Vet. Akad. Handl. **5**[8]: 12. 1878.

Witt's *T. lata* is a very much more finely marked variety than the type, otherwise quite typical; the form of it which Lagerstedt calls "var. *elegans*" stands midway between it and the type. His superb figure is, like all his figures in the same work, a good approach to the ideal in depicting the diatoms. The *N. panduriformis nicobarica* Grun.[d] does not belong to this species, but is a form of his *N. littoralis*, which in turn is a variety of *N. tryblionella* Hantzsch. There is some doubt with regard to the two forms of Van Heurck's cited above, which also correspond to Cleve's figure, their entire lack of the hyaline area, the so-called "sulcus," making them questionable. Van Heurck[e] drops them out from the above category.

Found at stations 2807, 2808, 2823, 2835, 3008H, Galapagos Islands to Gulf of California and Hawaiian Islands.

Nitzschia plana W. Smith, Synop. Brit. Diat. **1**: 42. *pl. 15. f. 114.* 1853. Van Heur. Synop. *pl. 58. f. 10–11.* 1881; Treat. Diat. 387. *pl. 15. f. 503.* 1896. De Toni, Syll. Alg. **2**: 503. 1892. Rabh. Fl. Eur. Alg. **1**: 153. 1864. Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 72. 1880 (not H. L. Smith, Sp. Diat. Typ. no. 363. 1874).

Nitzschia marginulata didyma Grun. in Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 72. 1880. Van Heur. Synop. *pl. 58. f. 14.* 1881. De Toni, Syll. Alg. **2**: 504. 1892.

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[a] Van Heur. Synop. *pl. 61. f. 2, 3.* 1881.

[b] Sv. Vet. Akad. Handl. **17**[2]: 84. 1880.

[c] Op. cit. 85.

[d] Fenzl, Reise Novara Bot. **1**: 97. *pl. 14. f. 4.* 1870.

[e] Treat. Diat. 1896.

It is probable that the other forms of Grunow's *N. marginulata* also belong to this species. He says, regarding its relation to *N. plana*, "Aehnlich, aber mit breiterem, stets bis zu den Schaalenenden reichendem fast ganz glattem Mittelraume." The specimen found by me has the characteristics of both; it has the practically hyaline central space of Grunow's form instead of the irregularly punctate space of Smith's type, but, as in the latter, stopping short of the apices instead of extending to these, as Grunow points out. There is, therefore, no doubt of this variety of *N. marginulata* being the same species as *N. plana;* and, as already suggested, it might be well to add the other varieties also. H. L. Smith's type no. 363 is misnamed. It is a small variety of *N. dubia* W. Smith as figured by that author and as shown in H. L. Smith's type no. 341.

Found at station 2823, Gulf of California.

Nitzschia punctata (W. Smith) Grun. in Cleve & Grun. Sv. Vet. Akad. Handl. **17**[2]: 68. 1880. Van Heur. Synop. 171. *pl. 57. f. 2–3.* 1881; Treat Diat. 384. *f. 125, pl. 15. f. 491–492.* 1896. De Toni, Syll. Alg. **2:** 496 1892 (not Bail.).

Tryblionella punctata W. Smith, Synop. Brit. Diat. **1:** 36. *pl. 10. f. 76a'* (not *f. 76a*), *pl. 30. f. 261.* 1853. Rabh. Fl. Eur. Alg. **1:** 148. 1864.

The specimens found by me have markings nearly as coarse as those of *N. granulata* Grun.;[a] they, however, have the decided marginal loculi on the dorsal side of the valve and are clearly in all respects coarsely marked examples of *N. punctata.* The diatom given this name by L. W. Bailey[b] is *N. brightwellii* Kitton and has no relation with the above.

Found at station 3698, off Honshu Island, Japan.

Nitzschia scabra Cleve in Nordensk. Vega Exped. **3:** 480. *pl 38. f. 73a–b.* 1883. De Toni, Syll. Alg. **2:** 532. 1892.

My specimen agrees with the above perfectly, except that the puncta are set wider apart. It has the peculiar "shagreen-like appearance" referred to by Cleve. It is 0.183 mm. long. I do not favor uniting this with *N. sigma* W. Smith, although Cleve brackets that name with a question mark.

Found at station 3696, off Honshu Island, Japan.

Nitzschia sigma (Kütz.) W. Smith, Synop. Brit. Diat. **1:** 39. *pl. 13. f. 108.* Pritch. Hist. Infus. ed. 4. 781. *pl. 4. f. 21.* 1861. Rabh. Fl. Eur. Alg. **1:** 156. 1864. Grun. Journ. Roy. Micr. Soc. **2:** 681, 1879. Brun, Diat. Alp. 105. *pl. 5. f. 24.* 1880. H. L. Smith, Sp. Diat. Typ. no. 367. 1874. Van Heur. Synop. *pl. 65. f. 7–8, pl. 66. f. 1–9.* 1881; Treat. Diat. 396. *pl. 16. f. 541–545.* 1896. Cleve in Nordensk. Vega Exped. **3:** 480, 506. 1883. Lewis, Proc. Acad. Phila. **1861:** 71. 1862. De Toni, Syll. Alg. **2:** 530. 1892.

Synedra ? sigma Kütz. Bacill. 67. *pl. 30. f. 14.* 1844 ?

Amphipleura rigida Kütz. Bacill. 104. *pl. 4. f. 30.* 1844 ?

Amphipleura sigmoidea W. Smith, Synop. Brit. Diat. **1:** 45. *pl. 15. f. 128.* 1851 (not *N. sigmoidea* (Nitzsch) W. Smith).

Nitzschia anguillula Schum. Schrift. Phys. Ökon. Ges. Konigsb. **5:** 53. *pl. 1. f. 12.* 1867;

N. sigma anguillula Grun. in Schneider, Beitr. Kennt. Kauk. 119. 1878.

Nitzschia sigmoidea H. L. Smith, Sp. Diat. Typ. no. 369. 1874.

Nitzschia habirshawii Feb.; H. L. Smith, Sp. Diat. Typ. no. 346. 1874.

N. sigma habirshawii Van Heur. Synop. *pl. 66. f. 4.* 1881.

Nitzschia (sigma var. ?) *validа* Cleve & Grun. Bih. Sv. Vet. Akad. Handl. **5**[3]: 12. *pl. 3. f. 19.* 1878. Van Heur. Synop. *pl. 65. f. 4–5.* 1881. De Toni, Syll. Alg. **2:** 532. 1892.

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[a] Loc. cit.

[b] Bost. Journ. Nat. Hist. **7:** 344. *pl. 8. f. 76.* 1862.

Nitzschia (*sigma* var. ?) *major* Grun.; Van Heur. Synop. *pl. 65. f. 6.* 1881.
Nitzscha (*sigma* var. ?) *latiuscula* Grun.; Van Heur. Synop. *pl. 65. f. 3.* 1881.

I leave out of the above list *Navicula lamprocampa* Ehrenb.,[a] here included by De Toni,[b] and *Nitzschia clausii* Hantzsch[c] placed here by Grunow.[d] H. L. Smith, by changing *Amphipleura sigmoidea* W. Smith, to *Nitzschia sigmoidea* has confused it with the real *Nitzschia sigmoidea* W. Smith,[e] a diatom that can not be included here. Regarding *N. sigmatella* Greg.[f] I can see no reason for including it here, as is done by De Toni and others. There can be no doubt of the *N. sigma sigmatella* Grun.,[g] included above, which is a quite different diatom.

Found at station 3712H, about 100 miles off Oregon.

SPHINCTOCYSTIS Hass.

Sphinctocystis Hass. Hist. Brit. Alg. **1**: 436. *pl. 102. f. 3.* 1845.
Frustulia C. Ag. in part; Kütz. Linnaea **8**: 554. 1833.
Navicula Bory, in part; Ehrenb. Infus. 185, *pl. 13. f. 22.* 1838.
Denticula Kütz. in part; Bacill. 44. *pl. 3. f. 60.* 1844.
Surirella Turp. in part; Ehrenb. Mikrog. *pl. 15A. f. 50–51.* 1854.
Cymatopleura W. Smith, Ann. Mag. Nat. Hist. II. **7**: 12. *pl. 3. f. 8–9.* 1851; Synop. Brit. Diat. **1**: 36. *pl. 10. f. 78–81.* 1853. H. L. Smith, The Lens **1**: 85. 1872. Ralfs, Pritch. Hist. Infus. ed. 4. 793. 1861. Van Heur. Synop. 167. 1881; Treat. Diat. 366. *f. 119.* 1896. Brun, Diat. Alp. 96. 1880. De Toni, Syll. Alg. **2**: 598. 1892.

Although this genus shows close relation to Surirella Turp., and even closer to the forms of Nitzschia Hass., which were formerly included in Tryblionella W. Smith, its distinctness is generally conceded.[h]

The older name of Hassall is here restored. Smith, in rejecting this name, says: "I should have been glad to have adopted Mr. Hassall's genus 'Sphinctocystis,' but as this term refers merely to a peculiarity in the external form of one species, I am obliged to reject it." If the failure of a name to be accurately descriptive were valid cause for its rejection, Smith's substitution would also have to go.

Sphinctocystis librile (Ehrenb.) Hass. Hist. Brit. Alg. **1**: 436. *pl. 102. f. 3.* 1845.
Navicula librile Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1831**: 81. 1833; **1833**: 267. 1835; Ber. Akad. Wiss. Berl. **1836**: 53. 1837; Infus. 185. *pl. 13. f. 22.* 1858.
Frustulia quinquepunctata Kütz. Linnaea **8**: 554. *pl. 14. f. 28.* 1833.
Surirella solea Breb. in Breb. & God. Consid. 17. 1838. Kütz. Bacill. 60. *pl. 3. f. 61.* 1844. Rabh. Sussw. Diat. 28. *pl. 3. f. 7b–c.* 1853. Kütz. Sp. Alg. 34. 1844. Weisse, Mel. Biol. Acad. Sci. St. Petersb. **4**: 660. *pl. 1. f. 18.* 1865.
Surirella librile Ehrenb. Mikrog. *pl. 6. I. f. 19, pl. 14. f. 58.* 1854.
Cymatopleura solea W. Smith, Ann. Mag. Nat. Hist. II. **7**: 12. *pl. 3. f. 8–9.* 1851; Synop. Brit. Diat. **1**: 36. *pl. 10. f. 78.* 1853. Pritch. Hist. Infus. ed. 4. 793. *pl. 9. f. 155* (figure poor), *pl. 16. f. 9.* 1861. Rabh. Fl. Eur. Alg. **1**: 60. 1864. Grun. Verh. Zool.-Bot. Ges. Wien **12**: 466. 1862. H. L. Smith, Sp. Diat. Typ. no. 114. 1874. Brun, Diat. Alp. 97. *pl. 1. f. 10.* 1880. Cleve & Möll. type no. 226–227. Van Heur. Synop. *pl. 55. f. 5–7.* 1881; Treat. Diat. 367. *pl. 12. f. 482b.* 1896.

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[a] Kütz. Bacill. 102. *pl. 4. f. 5.* 1844.
[b] De Toni, Syll. Alg. **2**: 530. 1892.
[c] Hedwigia **2**: 40. 1860.
[d] Journ. Roy. Micr. Soc. **2**: 22. 1879.
[e] W. Smith, Synop. Brit. Diat. **1**: 38. *pl. 13. f. 104.* 1853.
[f] Quart. Journ. Micr. Sci. **3**: 38. *pl. 4. f. 2.* 1855.
[g] Van Heur. Synop. *pl. 66. f. 6.* 1881.
[h] See remarks under Cymatopleura by W. Smith, and by Ralfs in the above citations.

De Toni, Syll. Alg. **2:** 599. 1892. Griff. & Henf. Micr. Dict. ed. 4. 227. *pl. 16. f. 23.* 1883. Wolle Diat. N. A. *pl. 60. f. 1–4, 13.* 1890.

Cymatopleura apiculata W. Smith, Synop. Brit. Diat. **1:** 37. *pl. 10. f. 79.* 1853. Wolle, Diat. N. A. *pl. 60. f. 9, 12.* 1890. Belloc, Rev. de Comm. **3:** 52. *pl. 1. f. 20.* 1887.

Hassall's writing of the species name as *S. libilis* is erroneous. He evidently assumed that Ehrenberg had used the wrong gender of the Latin adjective in his *Navicula libile*, and as Sphinctocystis is feminine, he wrote *S. libilis*. But Ehrenberg used the noun *libile*, meaning a scale-beam, because of the long, notched appearance of this species when seen from the zonal side. Kützing's *F. quinquepunctata* is a practically indefinable form as figured and described by him, but as he refers to it under *Surirella solea* as the same thing, I include it in the synonymy.

Found at station 2885, off Oregon.

Sphinctocystis undulata (Ehrenb.) Mann.

Navicula ? undulata Ehrenb. Infus. 187. *pl. 21. f. 16.* 1838.

Surirella oophaena Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 136. *pl. 3. V. f. 1.* 1843.

Denticula undulata Kütz. Bacill. 44. *pl. 3. f. 60.* 1844.

Surirella elliptica Breb.: Kütz. Bacill. 61. *pl. 28. f. 28.* 1844.

Surirella undulata Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1847:** 442. 1849; Mikrog. *pl. 14. f. 59, pl. 33. II. f. 111, pl. 35A. VII. f. 25–26, pl. 37. I. f. 25.* 1854.

Surirella ovum Naeg.; Kütz. Sp. Alg. 889. 1849.

Cymatopleura hibernica W. Smith, Ann. Mag. Nat. Hist. II. **7:** 13. *pl. 3. f. 12.* 1851; Synop. Brit. Diat. **1:** 37. *pl. 10. f. 81.* 1851. Van Heur. Synop. *pl. 55. f. 3-4.* 1881. H. L. Smith, Sp. Diat. Typ. no. 113. 1874. Rabh. Fl. Eur. Alg. **1:** 61. 1864. De Toni, Syll. Alg. **2:** 600. 1892.

Cymatopleura elliptica W. Smith, Ann. Mag. Nat. Hist. II. **7:** 13. *pl. 3. f. 10–11.* 1851; Synop. Brit. Diat. **1:** 37. *pl. 10. f. 80a c.* 1853. Rabh. Fl. Eur. Alg. **1:** 89. 1864. Van Heur. Synop. 168. *pl. 53. f. 1–4.* 1881; Treat. Diat. 367. *pl. 12. f. 480b–481b, pl. 51. f. 863.* 1896. Pritch. Hist. Infus. ed. 4. 793. *pl. 9. f. 149, pl. 16. f. 7–8.* 1861. Brun, Diat. Alp. 96. *pl. 1. f. 8, pl. 9. f. 15.* 1880. Grun. Verh. Zool. Bot. Ges. Wien **12:** 463. *pl. 11. f. 13.* 1862. H. L. Smith, Sp. Diat. Typ. no. 112. 1874. De Toni, Syll. Alg. **2:** 598. 1892. Griff. & Henf. Micr. Dict. ed. 4. 227. *pl. 16. f. 24* 1883. Wolle, Diat. N. A. *pl. 60. f. 5–7.* 1890. Cleve & Moll. type no. 2, 4, 11–12.

Surirella undata Ehrenb. Mikrog. *pl. 35A. I. f. 20, 21, 21*.* 1854.

Surirella plicata Ehrenb. Mikrog. *pl. 35A. f. 50. f. 51a–b.* 1854. Weisse, Mel. Biol. Acad. Sci. St. Petersb. **5:** 107. *pl. 1. f. 10.* 1865.

Cymatopleura nobilis Hantzsch, Hedwigia **2:** 36. *pl. 6. f. 6.* 1860.

Cymatopleura hibernica rhombica Chase; De Toni, Syll. Alg. **2:** 601. 1892.

This long list of synonyms might be increased by *Cymatopleura angulata* Grev.[a] It stands midway between this and the former species *S. libile*, the form variety of the latter called *C. apiculata* being very close to it.

Found at station 4505H, near Santa Cruz light-house, Monterey Bay, Cal.

SURIRELLA Turp.

Surirella Turp. Mem. Mus. Paris **16:** 361. *pl. 15. f. 1–7, 9–10, 14.* 1828 (exclusive of the other figures). Rabh. Fl. Eur. Alg. **1:** 9, 51. *f. 12.* 1864. Pritch. Hist. Infus. ed. 4. 794. 1861. W. Smith, Synop. Brit. Diat. **1:** 30. *pl. 8 9.* 1853. Van Heur. Synop. 186. *pl. 71–74.* 1881; Treat. Diat. 368. *f. 120. pl. 12–13.* 1896. Brun, Diat. Alp. 97. 1880. Castr. Rep. Voy. Chall. Bot. **2:** 59. *pl. 10.* 1886.

[a] Trans. Micr. Soc. Lond. n. s. **10:** 89, *pl. 9. f. 1.* 1862.

Suriraya Turp. Hanst. Bot. Abhand. **2:** 107. 1871. De Toni, Syll. Alg. **2:** 567. 1892.
Novilla Heib. Krit. Overs. Danske Diat. 24. 1863. Cleve, Bih. Sv. Vet. Akad. Handl. **1**[11]: 11. 1873.
Stenopterobia Breb.; Grun. in Cleve, Ofv. Kgl. Vet. Akad. **38**[9]: 7. 1882. Möll. type nos. 2, 5, 15, as subgenus.
Plagiodiscus Grun. Mo. Micr. Journ. **18:** 172. *pl. 194. f. 8–9a–b.* 1877 (cf. Schmidt, Atlas *pl. 56. f. 1.* 1877).
Navicula Bory, in part Ehrenb. Infus. 186. *pl. 14. f. 1–2. pl. 21. f. 15.* 1838.
Nitzschia Hass. in part: Kütz. Bacill. 60. *pl. 3. f. 46.* 1844.
Coconeis Ehrenb. in part: Grun. Verh. Zool. Bot. Ges. Wien **12:** 456. *pl. 9. f. 10.* 1862.

William Smith in discussing the relations of this genus, considers it to be close to those robust forms of Nitzschia which he calls Tryblionella; its nearer affinity is, however, Campylodiscus Ehrenb., from which it differs simply in the circular outline and uniform saddle shape of the latter. These differences are so constant that an unnecessary loss to classification would result from uniting the two genera. The nearest approach to an intermediate form is to be found in *Surirella spiralis* Kütz. (*Campylodiscus spiralis* (Kütz.) W. Smith [a]). The genus has a more remote resemblance to Sphinctocystis Hass. (*Cymatopleura* W. Smith), but except in a few forms no confusion can arise between the two.

The separation of the greatly elongated forms into the genus Stenopterobia of the kidney-shaped sports into the genus Plagiodiscus and of the forms showing a wedge-shaped appearance from the zonal side into the genus Novilla are utterly useless distinctions. The attempt of Pfitzer and De Toni to change the name into Suriraya so as to make it fit better the name of the French physician, Doctor Suriray, in whose honor Turpin formed the name, is inexcusable, as Turpin had a right to call his genus whatever name he wished.

Surirella bifrons Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1841:** 388. *pl. 3. V. f. 5, pl. 4. III. f. 1.* 1843; Mikrog. *pl. 14. f. 36, pl. 15. A. f. 46. B. f. 17* (*pl. 7. I. f. 2* and *pl. 7. III. A. f. 17–20* are indeterminate). 1854. Schmidt, Atlas *pl. 22. f. 5. 10–12, pl. 22. f. 6* (unnamed), *pl. 23. f. 1–2.* 1875; *pl. 245. f. 8–10.* 1904. Griff. & Henf. Micr. Dict. ed. 4. 746. *pl. 17. f. 22.* 1883. Kütz. Bacill. 61. *pl. 7. f. 10, pl. 28. f. 29.* 1844. Rabh. Süssw. Diat. 29. *pl. 3. f. 21.* 1853.
Navicula bifrons Ehrenb. Phys. Abh. Akad. Wiss. Berl. **1832:** 259. 1834. Ber. Akad. Wiss. Berl. **1836:** 53. 1837; Infus. 186. *pl. 14. f. 2.* 1838.
Surirella biseriata Breb. Consid. Diat. 53. *pl. 7.* 1838. Hass. Hist. Brit. Algae 438. *pl. 102. f. 1.* 1845. W. Smith, Ann. Mag. Nat. Hist. II. **7:** 8. *pl. 2. f. 1.* 1851; Synop. Brit. Diat. **1:** 30. *pl. 8. f. 57.* 1853. Grun. Verh. Zool. Bot. Ges. Wien **12:** 454. *pl. 10. f. 7.* 1862. Rabh. Fl. Eur. Alg. **1:** 9, 53. *f. 12b c.* 1864. Pritch. Hist. Infus. ed. 4. 794. *pl. 16. f. 20–26.* 1861. Schmidt, Atlas *pl. 22. f. 13–14.* 1875. H. L. Smith, Sp. Diat. Typ. no. 514. 1874. Brun, Diat. Alp. 99. *pl. 4. f. 3* (not *f. 9*). *pl. 9. f. 17.* 1880. Belloc, Rev. de Comm. **3:** 52. *pl. 3. f. 21.* 1887. Van Heur. Synop. 186. *pl. 72. f. 1–3.* 1881; Treat. Diat. 368–369. *f. 120, pl. 12. f. 575.* 1896.
Suriraya biseriata Breb.; De Toni, Syll. Alg. **2:** 567. 1892.

Kützing, Griffith and Henfrey, and Rabenhorst have rightly united *S. bifrons* and *S. biseriata* under the former name. Most authors give preference to Brebisson's name, though nearly all except Schmidt in his Atlas recognize that the two are synonymous. Ehrenberg's name, accompanied by a clear diagnosis, is prior to that of Brebisson. It is found in the volume of the Abhandlungen for 1833, which is dated 1835; but on the fascicle in which it occurs is printed, "Gelesen in der Akademie der Wissenschaft am 2 Juli 1832, revidirt und mit einigen Zusätzen gedruckt im Mai 1834."

Found at station 3607, Bering Sea.

[a] W. Smith, Synop. Brit. Diat. **1:** 29. *pl. 7. f. 54.*

Surirella fastuosa Ehrenb. Ber. Akad. Wiss. Berl. **1840:** 214. 1841; Phys. Abh. Akad. Wiss. Berl. **1841:** 388. *pl. 2. IV. f. 7. VI. f. 14, pl. 3. VII. f. 11–12.* 1843. Kütz. Bacill. 62. *pl. 28. f. 19a d.* 1844. W. Smith, Ann. Mag. Nat. Hist. II. **7:** 10. *pl. 3. f. 3.* 1851; Synop. Brit. Diat. **1:** 32. *pl. 9. f. 66.* 1853. Greg. Quart. Journ. Micr. Sci. **3:** 40. *pl. 4. f. 12.* 1855. Moeb. Diat.-taf. *pl. 5. f. 12, pl. 43. f. 1.* 1890. Pritch. Hist. Infus. ed. 4. 797. 1861. Rabh. Fl. Eur. Alg. **1:** 58. 1864. Jan. & Rabh. in Rabh. Beitr. **1:** 13. *pl. 1. f. 15.* 1863. Jan. Abh. Schles. Ges. Vaterl. Cult. **1862**[2]**:** 14. *pl. 14. f. 37.* 1862. Grun. Verh. Zool. Bot. Ges. Wien **12:** 461. *pl. 9. f. 11* (*f. 12* doubtful). 1862. Grev. Trans. Micr. Soc. Lond. n. s. **10:** 18. *pl. 3. f. 1.* 1862. Van Heur. Synop. 188. *pl. 73. f. 18.* 1881; Treat. Diat. 372. *pl. 13. f. 583–584.* 1896. Pant. Beitr. Bacill. Ung. **2:** 71. 1889; **3:** *pl. 31. f. 450.* 1893. Schmidt, Atlas *pl. 4. f. 1–2, 8, pl. 5. f. 4, 7–15, pl. 19. f. 1, 8, 12, 13, pl. 20. f. 1.* 1875; *pl. 56. f. 7.* 1877; *pl. 206. f. 1–11, 21.* 1897. Truan, Anal. Soc. Espan. Hist. Nat. **14:** 76. *pl. 5. f. 11–12.* 1885. Wolle, Diat. N. A. *pl. 55. f. 5* (not *pl. 52. f. 10*). 1890.

Surirella lata W. Smith, Synop. Brit. Diat. **1:** 31. *pl. 9. f. 61.* 1853. Van Heur. Synop. 188. *pl. 72. f. 17.* 1881. Rabh. Fl. Eur. Alg. **1:** 59. 1864. Schmidt, Atlas *pl. 5. f. 1.* 1874; Jahresb. Komm. Deut. Meere **2:** *pl. 3. f. 9* (3 fig.). 1874.

Surirella hohenackerii Rabh. Hedwigia **1:** 103. *pl. 13. f. 2.* 1859.

Surirella cuneata Schmidt, Atlas *pl. 4. f. 1–2.* 1875.

Suriraya fastuosa Ehrenb.; De Toni, Syll. Alg. **2:** 582. 1892.

This diatom is one of the commonest of the genus; at the same time it is very variable. In consequence of both facts it runs gradually into a number of other species, so that the list of synonyms given above could be easily increased. I have confined myself to evident cases of identity, as the specific lines here are most difficult to fix with exactness.[a]

Found at stations 2807, 2808, 2823, 2923, 2929, 2635II, 3688II, Galapagos Islands to central California and Okhotsk Sea.

Surirella formosa Cleve, Bih. Sv. Vet. Akad. Handl. **18**[3]**:** 17. *pl. 4. f. 49.* 1881. Schmidt, Atlas *pl. 205. f. 8.* 1897.

Suriraya formosa Cleve; De Toni, Syll. Alg. **2:** 584. 1892.

My specimens, which are exceedingly abundant in the one dredging mentioned, differ from Cleve's figure and description in some important particulars. The markings are much more elaborate than he indicates, which may have been due to inadequate material, as he says his form is "very rare." The border of my specimens is much narrower and more strongly ribbed and is without the beads. The branching of the forked tips on the inner side of the row of processes with swollen ends is more pronounced. There are other minor differences but not sufficient to indicate a new species. The great points of resemblance are the swollen processes and the ring of beads in the otherwise hyaline central area.

Found at station 2807, Galapagos Islands.

Surirella patens Schmidt, Atlas *pl. 4. f. 16–17.* 1875; *pl. 56. f. 10–11.* 1877. Jan. Diat. Gaz. Exped. *pl. 21. f. 28–29.*

Suriraya patens Schmidt; De Toni, Syll. Alg. **2:** 597. 1892.

This diatom is of the *S. fastuosa* type, but hardly near enough to be united. To the above references might be added the unnamed figures of Schmidt and Janisch.[b]

Found at station 2807, Galapagos Islands.

Surirella robusta Ehrenb. Ber. Akad. Wiss. Berl. **1840:** 215. 1841; Mikrog. *pl. 15A. f. 43; pl. 17, I. f. 14; II. f. 1a b* (*pl. 11. f. 31* and *pl. 16. III. f. 31* indeterminate). 1854. Kütz. Bacill. 61. 1844. Pritch. Hist. Infus. ed. 3. 795. 1861. Schmidt,

[a] Cf. Schmidt, Atlas *pl. 4–5.* 1875, for illustration of this difficulty.

[b] Schmidt, Atlas *pl. 56. f. 12.* 1876. Jan. Diat. Gaz. Exped. *pl. 21. f. 30.*

Atlas *pl. 22. f. 3-4.* 1875. Van Heur. Synop. 187. *pl. 71. f. 1, 2* (exclusive of variety). 1881; Treat. Diat. 371. *pl. 12. f. 577* (exclusive of variety). 1896.

Suriraya robusta Ehrenb.; De Toni, Syll. Alg. **2:** 571. 1892.

Surirella nobilis W. Smith. Synop. Brit. Diat. **1:** 32. *pl. 8. f. 63.* 1853. Rabh. Fl. Eur. Alg. **1:** 55. 1864. Pritch. Hist. Infus. ed. 4. 795. 1861. Grun. Verh. Zool. Bot. Ges. Wien **12:** 456. 1862.

Surirella splendida W. Smith, in Ann. Mag. Nat. Hist. II. **7:** 9. *pl. 2. f. 3.* 1851 (not *f. 2;* not Synop. Brit. Diat. **1:** 32. *pl. 8. f. 62.* 1853; not Ehrenb.; not Kütz.).

Surirella valida Schmidt, Atlas *pl. 23. f. 3.* 1875.

Van Heurck unites *S. splendida* Ehrenb. with the above, and also *S. tenera* Greg. Both of these I consider distinct, as do De Toni and others. Schmidt gives his name *valida*, though expressing doubt of its not being a variety of *S. robusta*. Despite his very assertive specific name, I think the doubt is well founded. It is the variety most common in the following dredging.

Found at station 2871, off Washington.

CAMPYLODISCUS Ehrenb.

Campylodiscus Ehrenb. Ber. Akad. Wiss. Berl. **1840:** 207. 1841. Rahh. Fl. Eur. Alg. **1:** 45. 1864. Pritch. Hist. Infus. ed. 4. 798. 1861. Grun. Verh. Zool. Bot. Ges. Wien **12:** 431. 1862. Van Heur. Synop. 1^{16}: 189. 1881. Castr. Rep. Voy. Chall. Bot. **2:** 62. 1886. De Toni, Syll. Alg. **2:** 603. 1892. Eng. & Pr. Pflanzenfam. 1^{1b}: 146. *f. 267.* 1896.

Coronia Ehrenb. Ber. Akad. Wiss. Berl. **1840:** 206. 1841, as subgenus.

Calodiscus Rabh. Süssw. Diat. 12. *pl. 3.* 1853. Pritch. Hist. Infus. ed. 4. 802. *pl. 8. f. 50.* 1861.

Surirella Turp. in part; Brun, Diat. Alp. 101. *pl. 1. f. 16-17.* 1880.

Campylodiscus concinnus Grev. Trans. Micr. Soc. Lond. n. s. **8:** 30. *pl. 1. f. 2.* 1860. Schmidt, Atlas *pl. 18. f. 16 17.* 1875; *pl. 53. f. 9.* 1877. Pritch. Hist. Infus. ed. 4. 800. 1861.

Campylodiscus marginatus Johnst. Quart. Journ. Micr. Sci. **8:** 13. *pl. 1. f. 11.* 1860. Grev. Trans. Micr. Soc. Lond. n. s. **8:** 30. *pl. 1. f. 2.* 1860. Moeb. Diat.-taf. *pl. 30. f. 2.* 1890 (not Ehrenb. 1845).

Campylodiscus imperialis Grev. Trans. Micr. Soc. Lond. n. s. **8:** 30. *pl. 1. f. 3.* 1860 (?).

Campylodiscus lineatus Grun.; Schmidt, Atlas *pl. 18. f. 18.* 1875.

Campylodiscus samoensis Grun.; Schmidt, Atlas *pl. 15. f. 18–20.* 1875.

Campylodiscus crebrecostatus Grev. err. det. Eulen.; Schmidt, Atlas *pl. 15. f. 16–17.* 1875.

My specimen agrees perfectly with the figures by Schmidt, named by Eulenstein "*C. crebrecostatus* Grev." This identification is false, as can be seen by comparing with Greville's original figure and description.[a] Greville recognizes the probability of this species being identical with Johnston's *C. marginatus*, and he so names it in his illustration. The identity is a fact, but Johnston's name is inadmissible, having been preempted by Ehrenberg[b] for a quite different species. I am not satisfied with making the above species synonymous with *C. imperialis* Grev., as is done by De Toni.[c] Greville's figure and description show marked differences, especially in the border. But whether synonymous or not, De Toni's selection of the name *imperialis* is wrong, as both the above name and that of Johnston hold priority. De Toni

[a] Trans. Micr. Soc. Lond. n. s. **11:** 14. *pl. 1. f. 6.* 1863; also Moeb. Diat.-taf. *pl. 49. f.* 6. 1890.

[b] Ber. Akad. Wiss. Berl. **1845:** 362. 1846.

[c] De Toni, Syll. Alg. **2:** 609. 1892.

also includes *C. radiatus* Leud.-Fort.,[a] a diatom that does not in the least resemble this species.

Found at station 2923, off southern California.

Campylodiscus ecclesianus Grev. Quart. Journ. Micr. Sci. **5:** 10. *pl. 3. f. 5.* 1857. Pritch. Hist. Infus. ed. 4. 801. 1861. Schmidt, Atlas *pl. 16. f. 8–11, pl. 17. f. 16.* 1875; *pl. 208. f. 3.* 1897; also *pl. 16. f. 3, 5* (unnamed). 1875. Moeb. Diat.-taf. *pl. 11. f. 5.* 1890. Pant. Beitr. Bacill. Ung. **1:** 40. *pl. 3. f. 26.* 1886; **2:** 71. 1889. De Toni, Syll. Alg. **2:** 623. 1894.

Campylodiscus fenestratus Grev. Quart. Journ. Micr. Sci. **5:** 9. *pl. 3. f. 4.* 1857. ? Moeb. Diat.-taf. *pl. 11. f. 4.* 1890. Grun. Verh. Zool. Bot. Ges. Wien **12:** 433. 1862. Pritch. Hist. Infus. ed. 4. 801. 1861.

Campylodiscus rabenhorstii Jan. in Rabh. Beitr. **1:** 6. *pl. 1. f. 6–7.* 1863. Schmidt, Atlas *pl. 53. f. 12–14.* 1877. Grun. Verh. Zool. Bot. Ges. Wien **12:** 435. 1862.

Campylodiscus weissflogi Deby; Fricke. Verzeich. 23. 1902.

Campylodiscus taenoides Deby; Fricke. Verzeich. 23. 1902.

Although specimens of this species do show something like the "four-square windows" mentioned by Greville in his description of *C. fenestratus*,[b] it is difficult to believe that Greville was misled by an illusion of two superposed valves and gave a name to that illusion when he had both forms before him; especially as he describes the border of *C. fenestratus* so differently from that of *C. ecclesianus*, and that, too, in a way that could not result from two superposed valves. For in *C. fenestratus* it is of narrow continuous costae, while *C. ecclesianus* has a strong double row. However ingenious this deduction of Greville's mistake is, I am not at all certain it is correct. I have, therefore, left the name as above, whereas if the two be actually synonymous the first-mentioned name, *C. fenestratus*, should be used.

The form found by me has the lines of the central area so very faint that they are practically invisible; a variation somewhat like that shown in another figure by Schmidt.[c]

Found at station 4516H, Gulf of California.

Campylodiscus galapagensis, Mann, sp. nov. PLATE LI, FIGURE 3.

Frustule comparatively flat, the double bend of the valves, characteristic of the genus, being considerably below the average; rim divided into compartments by very thin cross septa formed by continuations of the sides of the costae, the costae making a double ring within the rim; the compartments of the rim thus being of the same width as, and continuous with, the costae; each compartment ornamented with a stout process projecting inward from the outer margin or edge; within the rim or border two rows of costae; outer row consisting of smooth, large costae, three times as long as broad, their outer ends being slightly notched, their inner ends rounded; costae of the second row continuous (not alternate) with those of the outer row and of about the same length, partly cleft, however, or in some cases wholly divided longitudinally by a thin median line, so that they appear to be double the number and half the width of the costae of the outer row; central area large and marked, first, by a few shadowy indistinct radiating lines, and, second, by a single row on each side of large oval beads, irregularly placed, but generally parallel to the margin.

Diameter of valve, 0.19 mm.; width of costae at margin, 28 in 0.1 mm.

Type in the U. S. National Museum, No. 590155, from station 2807, Galapagos Islands, April 4, 1888; 812 fathoms, bottom of Globigerina ooze and coral mud.

There is enough similarity between this and *C. peramplus* Cleve,[d] to note here the possibility of the two being the same; especially as Cleve's form was also found

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[a] Mem. Soc. Emul. St. Brieuc 48. *pl. 5. f. 57.* 1879.

[b] Cf. also Schmidt, Atlas *pl. 16. f. 8.* 1875.

[c] Op. cit. *pl. 17. f. 16.*

[d] Sv. Vet. Akad. Handl. **18**[3]: 17. *pl. 4. f. 53.* 1881.

at the Galapagos Islands. If this be the case, my name must give way to Cleve's. But if his poor figure and meager description are to be trusted, the double row of costae are not present and the ornamentation of the border is totally different. Cleve remarks that his form is perhaps a variety of *C. ecclesianus* Grev., and refers to the double row of alternating costae in the latter. It will be seen that the costae in my form are not *alternating* and are of very different construction. They are also relatively much stouter than Cleve's, there being 28 in 0.1 mm. on a valve with a diameter of 0.19 mm., whereas Cleve's has 40 to 50 costae in 0.1 mm. on a valve with a diameter of 0.12 to 0.16 mm. At any rate, this form needs to be accurately defined; and I therefore figure and name it, subject to the foregoing remarks.

Campylodiscus horologium Williamson, Ann. Mag. Nat. Hist. II. **1:** 321. 1848. W. Smith Synop. Brit. Diat. **1:** 28. *pl. 6. f. 51.* 1853. Pritch. Hist. Infus. ed. 4. 799. 1861. Grun. Verh. Zool. Bot. Ges. Wien **12:** 437. 1862. Schmidt, Atlas *pl. 17. f. 17.* 1875; *pl. 51. f. 7.* 1877; *pl. 207. f. 23–25.* 1897. De Toni, Syll. Alg. **2:** 616. 1892.

Campylodiscus mediterraneus Grun.; Cleve & Möll. type no. 154. 1878. Cf. also Schmidt, Atlas *pl. 17. f. 7.* 1875.

Campylodiscus pfitzeri Schmidt, Atlas *pl. 17. f. 5 6.* 1877.

Campylodiscus lepidus Castr. Rep. Voy. Chall. Bot. **2:** 63. *pl. 11. f. 7.* 1886.

Campylodiscus orbicularis Castr. Rep. Voy. Chall. Bot. **2:** 64. *pl. 16. f. 10.* 1886.

Schmidt's *C. pfitzeri* is a slightly more robust, but unimportant variety of the above. Found at station 3696, off Honshu Island, Japan.

Campylodiscus kinkeri Schmidt, Atlas *pl. 207. f. 16.* 1897.

This species is closely related to *C. triumphans* Schmidt,[a] and *C. brightwellii* Grun.;[b] but these two, together with several other named forms, are certainly varieties of *C. undulatus* Grev.[c] In the case, however, of *C. kinkeri* there is a massiveness in the large double row of costae and a distinctness in the border which lead me tentatively to classify my specimen as above, the agreement with Schmidt's figure being exact.

Found at station 2920II, Hawaiian Islands.

A similar form from station 3696 corresponds exactly to *C. crosus* Castr.,[d] but both that and my form are inner or eroded valves of some of the foregoing.

Campylodiscus latus Shadb. Trans. Mier. Soc. Lond. n. s. **2:** 16. *pl. 1. f. 13.* 1854. Moeb. Diat.-taf. *pl. 3. f. 13.* 1890. Grun. Verh. Zool. Bot. Ges. Wien **12:** 436. 1862. Schmidt, Atlas *pl. 18. f. 21–22.* 1875; *pl. 207. f. 6–11.* 1897. De Toni, Syll. Alg. **2:** 617. 1892.

Campylodiscus ambiguus Grev. Trans. Mier. Soc. Lond. n. s. **8:** 31. *pl. 1. f. 5.* 1860. Moeb. Diat.-taf. *pl. 30. f. 5.* 1890. Schmidt, Atlas *pl. 18. f. 23–26.* 1875; *pl. 51. f. 14.* 1897. Pritch. Hist. Infus. ed. 4. 801. 1861.

Campylodiscus contiguus Schmidt, Atlas *pl. 18. f. 19–20.* 1875.

Campylodiscus aemulus Schmidt, Atlas *pl. 207. f. 12.* 1897.

The specific identity of the above four forms is unquestionable. I do not, however, see the necessity of adding to this list *C. centralis* Greg.[e] or the long and dissimilar list by Leuduger-Fortmorel[f] which De Toni[g] looks upon as also synonymous. It may be that an examination of the diatoms themselves would show such identity in some

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[a] Schmidt, Atlas *pl. 15. f. 4, 5.* 1877.
[b] Schmidt, Atlas *pl. 15. f. 6, 7.* 1877.
[c] Quart. Journ. Mier. Sci. **11:** 229. *pl. 9. f. 4.* 1863.
[d] Castr. Rep. Voy. Chall. Bot. **2:** *pl. 11. f. 5.* 1886.
[e] Trans. Roy. Soc. Edinb. **21:** 501. *pl. 11. f. 51.* 1857.
[f] Mem. Soc. Emul. St. Brieuc 44–46. 1879.
[g] Syll. Alg. **2:** 617. 1892.

of these forms, for Leuduger-Fortmorel's drawings in this work are not very accurate; but the drawings, judged in the light of the descriptions, are certainly not all of one species, and, so faras it is possible to make out, none of them belong here.

Found at station 2920H, Hawaiian Islands.

Campylodiscus noricus Ehrenb. Ber. Akad. Wiss. Berl. **1840**: 205. 1841; **1845**: 154. 1846. Rabh. Hedwigia **1**: 52. *pl. 9. f. 2.* 1854. Kütz. Bacill. 59. 1844. ed. 3. 799. 1861. Grun. Verh. Zool. Bot. Ges. Wien **12**: 438. *pl. 10. f. 4, 5.* 1862. Schmidt, Atlas *pl. 55. f. 8.* 1877. H. L. Smith, Sp. Diat. Typ. no. 64. 1874. Van Heur. Synop. *pl. 77. f. 4 6.* 1881. Strose, Bacillarienlager 13. *pl. 1. f. 30.* 1884. Pant. Beitr. Bacill. Ung. **3**: *pl. 14. f. 215.* 1893. De Toni, Syll. Alg. **2**: 627. 1892.

Campylodiscus hibernicus Ehrenb. Ber. Akad. Wiss. Berl. **1845**: 154. 1846; Mikrog. *pl. 15A. f. 9.* 1854. Pritch. Hist. Infus. ed. 4. 799. *pl. 4. f. 38.* 1861. Schmidt, Atlas *pl. 55. f. 9–16.* 1877. Van. Heur. Synop. 190. *pl. 77. f. 3.* 1881. Grun. Verh. Zool. Bot. Ges. Wien **12**: 439. 1862.

Campylodiscus costatus W. Smith, Ann. Mag. Nat. Hist. II. **7**: 6. *pl. 1. f. 1.* 1851; Synop. Brit. Diat. **1**: 29. *pl. 6. f. 52.* 1853. Griff. & Henf. Micr. Dict. ed. 3. *pl. 12. f. 16.* 1875. Grun. Verh. Zool. Bot. Ges. Wien **12**: 439. *pl. 10. f. 6.* 1862. Hedwigia **2**: 29. *pl. 5. f. 1–2.* 1860.

Surirella norica Kütz.; Brun. Diat. Alp. 101. *pl. 1. f. 16–17; pl. 9. f. 30.* 1880.

Grunow[a] claims that *C. noricus* Ehrenb. can be provisionally held separate from *C. hibernicus* Ehrenb. because of its more numerous and more delicate ribs. This is hardly to be conceded. On the same basis the specimens I have found could be constituted a separate species. They correspond closely to Pantocsek's figure[b] in having the costae delicately striated with soft, wavy lines, broad at the margin and narrowing to a thread at the center; and especially in all reaching the center, so that the central hyaline space, like an obscure square, is obliterated.

Found at station 3635H, Bering Sea.

Campylodiscus taeniatus Schmidt, Atlas *pl. 16. f. 2.* 1875; *pl. 51. f. 1.* 1877. De Toni, Syll. Alg. **2**: 623. 1892.

Two varieties, even more contrasted than those figured by Schmidt, were found by me; the first without a prominent row of beads bordering the inner line of the first ring of costae, from station 3698, and the second with such a row, two beads to each costa, from station 2920H.

Found at stations 3698 and 2920H, off Honshu Island, Japan, and Hawaiian Islands.

XANTHIOPYXIS Ehrenb.

Xanthiopyxis Ehrenb. Ber. Akad. Wiss. Berl. **1844**: 273. 1845; Mikrog. *pl. 33. XVII. f. 17.* 1854.

As was stated under Chaetoceros, this genus is invalid, being made up principally, if not wholly, of internal cases from the frustules of Chaetoceros. It is placed here merely to enable the reader to trace the following widely figured form, as it occurs abundantly in the hydrographic soundings mentioned.

Xanthiopyxis oblonga Ehrenb. Mikrog. *pl. 33. XVII. f. 17.* 1854. Cleve, Journ. Quek. Micr. Club II. **2**: 175. *pl. 13. f. 18.* 1885.

Lithostylidium hirtum Ehrenb. Mikrog. *pl. 34. VII. f. 15.* 1854.

Xanthiopyxis panduriformis Pant. Beitr. Bacill. Ung. **1**: 43. *pl. 29. f. 7.* 1886.

Found at station 4029H, Bering Sea.

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[a] Schmidt, Atlas *pl. 55. f. 9–16.* 1877.

[b] Pant. Beitr. Bacill. Ung. **3**: *pl. 14. f. 215.* 1893.

DATA OF THE STATIONS AT WHICH DIATOMS WERE COLLECTED BY THE ALBATROSS.

HYDROGRAPHIC STATIONS.

All stations marked "H" are hydrographic soundings; all others are regular dredging and trawling stations. For complete list of stations to 1900 with data see Report of the U. S. Comm. Fish. **1900**: 387–562. 1901.

Use is made of the following abbreviations of terms expressing characters of bottoms, with a few names of instruments:

bk.....black.
br.....brown.
brk.....broken.
bu.....blue.
c.....clay.
co.....coral.
crs.....coarse.
dk.....dark.
fne.....fine.
g.....gravel.
glob.....globigerina.
gn.....green.
gy.....gray.
lav.....lava.
lt.....light.
m.....mud.
oz.....ooze.
p.....pebbles.
part.....particles.
r.....rock.
s.....sand.
sh.....shells.
sp.....specks.
vol.....volcanic.
wh.....white.
yl.....yellow.
L. B. T.....large beam trawl.
S. B. T.....small beam trawl.
8′ Tnr.....8-foot Tanner beam trawl.
R. D.....rake dredge.

Station.	Date.	Locality.	Lat. N.	Long. W.	Surface temperature.	Bottom temperature.	Depth.	Kind of bottom.	Remarks.
	1895.		° ′ ″	° ′ ″	° F.	° F.	Fms.		
2287H	May 23		54 23 45	166 38 30	43	38.2	320	gn. m.....	Bering Sea.
	1890.								
2604H	Sept. 25		39 12 10	123 50 50	54	49.4	60	gn. m.....	Off west coast United States.
	1891.								
2680H	Oct. 11		36 44 40	122 09 30	55	37.0	864	br. m. s.....	Cable survey, California to Hawaiian Islands and return.
2685H	....do....		36 39 30	122 41 00	55	35.1	1,424	br. m.....	Do.
2686H	....do....		36 37 00	122 54 00	55	35.0	1,597	br. m.....	Do.
2687H	Oct. 12		36 35 00	123 06 00	55	35.0	1,661	br. m.....	Do.
2688H	....do....		36 32 30	123 19 00	54	35.0	1,907	br. m. s.....	Do.
2690H	....do....		36 28 00	123 44 00	54	35.0	2,061	gy. oz.....	Do.
2691H	....do....		36 25 30	124 02 50	56	34.8	2,112	gy. oz.....	Do.
2694H	....do....		36 09 00	124 55 30	59	35.0	2,434	br. & gy. oz...	Do.
2695H	....do....		36 03 00	125 13 00	57	35.0	2,430	br. oz.....	Do.
2696H	Oct. 13		35 58 00	125 31 00	57	35.0	2,547	br. & gy. oz...	Do.
2698H	....do....		35 47 30	126 05 00	62	35.0	2,566	br. oz.....	Do.
2706H	Oct. 23		36 47 10	122 07 55	58	44.8	202	gn. m. s.....	Do.
2708H	....do....		36 47 10	122 08 20	58	.....	373	gn. m. s.....	Do.
2774H	....do....		36 47 10	122 15 50	56	.....	469	gn. m. s.....	Do.
2775H	....do....		36 47 10	122 17 05	56	37.7	607	gn. m. s.....	Do.
2776H	....do....		36 46 10	122 18 20	57	.....	621	gn. m. s.....	Do.
2844H	Nov. 13		28 33 30	144 37 00	71	.....	2,821	br. oz.....	Do.
2848H	Nov. 14		28 12 20	145 13 00	72	.....	2,728	br. oz.....	Do.
2851H	....do....		27 54 00	145 45 30	72	35.2	2,782	br. oz.....	Do.
2913H	Nov. 20		22 11 00	156 09 00	77	35.4	2,640	br. m.....	Do.
2915H	....do....		22 55 30	156 29 30	77	.....	2,868	br. m.....	Do.
2916H	....do....		21 47 30	156 39 00	77	35.3	2,878	br. m.....	Do.
2917H	Nov. 21		21 39 00	156 48 30	77	.....	2,615	br. m. fne. s...	Do.
2919H	....do....		21 29 30	156 59 30	77	35.5	2,056	br. m. fne. s...	Do.
2920H	....do....		21 21 00	157 09 00	77	.....	570	br. m. fne. s...	Do.
2921H	....do....		21 19 00	157 13 30	77	.....	347	br. m. fne. s...	Do.
2922H	....do....		21 18 30	157 19 00	77	44.8	268	gy. s.....	Do.
2995H	Dec. 5		21 18 00	157 29 00	76	.....	308	fne. wh. s.....	Do.
2996H	....do....		21 20 30	157 25 00	76	.....	407	fne. gy. s.....	Do.
2998H	....do....		21 26 00	157 17 00	76	.....	508	fne. gy. s.....	Do.
2999H	....do....		21 27 00	157 15 00	76	.....	549	fne. gy. s.....	Do.
3000H	....do....		21 29 30	157 12 00	76	.....	1,557	gy. m. fne. s...	Do.
3001H	....do....		21 32 30	157 08 00	74	35.0	11,792	gy. m. fne. s...	Do.
3007H	Dec. 12		21 20 00	157 19 00	74	.....	323	fne. gy. s.....	Do.
3008H	....do....		21 23 00	157 14 30	74	.....	547	gy. m. fne. s...	Do.
3009H	....do....		21 24 00	157 12 00	74	.....	603	gy. m. fne. s...	Do.
3010H	....do....		21 25 00	157 10 00	74	36.0	11,116	gy. m. fne. s...	Do.
3012H	....do....		21 28 30	157 04 00	73	.....	2,067	br. m. fne. s...	Do.
3013H	....do....		21 32 30	156 54 00	73	35.0	31,807	br. m. s.....	Do.
3015H	....do....		21 41 00	156 32 30	73	.....	2,966	br. m. fne. s...	Do.
3018H	Dec. 13		21 56 00	155 57 30	74	.....	2,915	br. oz.....	Do.
	1892.								
3190H	Jan. 14		35 42 00	124 33 30	59	34.0	92,312	br. & gy. oz...	Do.
3191H	Jan. 15		35 47 30	124 21 30	54	.....	2,223	br. & gy. oz...	Do.
3192H	....do....		35 53 00	124 09 30	54	.....	2,149	br. & gy. oz...	Do.

Hydrographic stations—Continued.

Station.	Date.	Locality.	Surface temperature.	Bottom temperature.	Depth.	Kind of bottom.	Remarks.
		Lat. N. Long. W.					
	1892.	° ′ ″ ° ′ ″	° F.	° F.	Fms.		
3193H	Jan. 15	35 58 30 123 57 30	54	34.0	92.169	gy. oz.....	Cable survey, California to Hawaiian Islands and return.
3194H	....do...	36 04 00 123 46 00	55	.....	2.107	gy. oz.....	Do.
3195H	....do...	36 09 30 123 34 00	54	.....	1.974	gy. oz.....	Do.
3196H	....do...	36 15 00 123 22 00	52	35.0	1,895	gy. oz.....	Do.
3198H	....do...	36 25 00 123 00 00	52	.....	1.725	gy. oz.....	Do.
3199H	....do...	36 29 30 122 50 30	52	35.0	1.066	gy. oz.....	Do.
3200H	....do...	36 34 00 122 41 00	52	.....	1,513	gn. m.....	Do.
3201H	....do...	36 38 00 122 31 00	52	.....	1.417	gn. m.....	Do.
3202H	....do...	36 40 00 122 26 00	52	36.0	11,053	gn. m. fne. s...	Do.
	1893.						
3263H	July 6	51 00 00 176 04 00	44	37.0	32.039	gy. m. s.....	Off Alaska.
3267H	July 7	50 03 00 174 30 00	49	35.0	2.802	gy. oz.....	Do.
3361H	Aug. 7	58 01 00 175 41 00	46	35 0	21,367	gn. m. fne. s...	Do.
3399H	Aug. 20	54 38 00 175 27 00	49	35.0	12,041	gn. m. s.....	Do.
	1895.						
3565H	July 6	56 56 00 169 06 00	44	35.0	1,866	bn. m. oz.....	Bering Sea, between Pribilof and Commander islands.
3568H	....do...	57 35 00 170 24 00	43	38.0	1,537	br. oz. g.....	Do.
3569H	....do...	57 41 00 170 39 00	42	38.0	609	br. oz. s.....	Do.
3571H	....do...	57 53 00 171 09 00	42	36.0	5,496	gn. m. oz.....	Do.
3604H	Aug. 12	54 46 00 169 29 00	45	35.0	21,355	gn. oz.....	Bering Sea, between Pribilof and Aleutian islands.
3635H	Aug. 21	55 44 00 168 47 00	45	37.8	141	gy. s.....	Do.
	1896.						
3663H	Aug. 10	54 51 00 163 46 00	49	35.2	3.117	br. m. fne. dk. s.	Between Bering Island and Kamchatka.
3666H	....do...	54 32 30 161 58 30	44	37.4	586	br. m. fne. s. p.	Do.
3669H	Aug. 21	48 43 00 151 31 00	41	36.7	425	ers. dk. s.....	Along Kuril Chain.
3671H	Aug. 22	48 32 00 154 55 00	37	.....	106	brk. sh.....	Do.
3683H	Aug. 26	47 33 00 152 07 00	39	35.2	1.712	fne. gy. s.....	Sea Okhotsk.
3684H	... do...	47 36 00 151 46 00	53	.....	1,830	br. m. dk. s...	Do.
3687H	Aug. 27	47 50 00 149 42 00	50	36.0	1,843	bn. y. m. fne s	Do.
3688H	....do...	47 55 30 148 56 00	55	35 8	1,562	br. m. fne. s...	Do.
3689H	....do...	48 01 30 148 16 30	55	36 0	1.426	bn. m. fne. s..	Do.
3690H	....do...	48 08 00 147 34 00	56	36.0	964	lt. m. qtz. s...	Do.
3693H	Aug. 28	48 27 45 145 20 30	56	33.0	155	bn. m. vol. s..	Do.
3694H	....do...	48 31 48 144 54 51	48	35 0	27	fne. g. r. sh...	Do.
3699H	Sept. 3	47 20 30 145 54 00	56	35.9	1,584	gn. m. fne. s...	Do.
3701H	....do...	46 35 00 146 49 00	55	36 0	1.820	lt. br. m. s....	Do.
3702H	....do...	46 15 00 147 07 00	55	35 8	1.817	br. m. fne. s...	Do.
3703H	Sept. 4	45 48 00 147 22 00	54	36.0	1.825	gn. m. fne. s...	Do.
3704H	....do...	45 40 00 147 28 00	53	35.9	1,761	gn. m. fne. s...	Do.
3705H	....do...	45 31 30 147 32 30	54	36.0	1,078	br. m. fne. s...	Do.
3706H	....do...	45 23 00 147 39 30	54	36.0	1,107	br. m. fne. s...	Do.
3712H	Sept. 6	45 21 00 146 27 00	58	35 8	1,744	gn. m. fne. s...	Do.
3714H	Sept. 7	45 25 00 145 02 00	57	35.9	1.649	gn. m. s.....	Do.
	1900.						
4013H	June 3	Inuboe Saki light, S. 74° W. 76 miles.	72	.....	1.759	vol. s. part....	East coast Honshu Island. Japan.
4014H	....do...	Inuboe Saki light, S. 73° W. 96 miles.	75	.....	3,800	vol. s. part....	Do.
4019H	June 24	Cape Kosloff, N. 15° W. and Cape Tschipunski, S. 82° W., each about 72 miles.	45	35.0	2,991	gn. m. vol. s..	Cape Tschipunski, Kamchatka, east across Bering Sea.
4020H	....do...	SE. end Bering Island NE. and Cape Kronotski NW., each about 108 miles.	47	35.0	1,804	gy. vol. s.....	Do.
4021H	June 26	W. end Attu Island S. 90 miles.	45	35.0	2,166	fne. yl. vol. s..	Do.
4022H	June 27	54 31 00 179 21 00	45	38.0	282	gn. m. fne. vol. s.	Do.
4023H	....do...	54 31 00 179 30 00	45	37.0	636	gn. m. vol. s. wh. sp.	Do.
4024H	....do...	54 24 20 179 24 00	54	37.7	454	gn. m. fne. vol. s.	Do.

Hydrographic stations—Continued.

Station.	Date.	Locality.	Surface temperature.	Bottom temperature.	Depth.	Kind of bottom.	Remarks.
	1900.	*Lat. N.* ° ′ ″ *Long. W.* ° ′ ″	°*F.*	°*F.*	*Fms.*		
4025H	June 27	54 18 00 179 14 00	45	37.2	536	gy. m. fne. vol. s.	Cape Tschipunski, Kamchatka, east across Bering Sea.
4027H	....do....	54 22 00 179 08 00	45	.....	708	gy. s	Do.
4028H	....do....	54 40 00 179 08 00	45	.....	310	gy. vol. s. wh. sp.	Do.
4029H	....do....	54 47 20 179 08 00	45	.....	913	gy. s. c	Do.
4430H	Gulf Inlet, S. coast Santa Cruz Island. N. 40° E. 2.7′.				197	.....	
4442H	Point Pinos light-house S. 67° W. 4.6′ distant.				26	.....	
4447H	Point Pinos light-house S. 21° W. 4.5′ distant.				52	.....	
4457H	Point Pinos light-house S. 21° W. 6.1′ distant.				46	.....	
4476H	Point Pinos light-house S. 22° W. 9.4′ distant.				39	.....	
4502H	Santa Cruz light-house N. 65° W. 8.9′ distant.				11	.....	
4503H	Santa Cruz light-house S. 81° W. 3.8′ distant.				7	.....	
4504H	Santa Cruz light-house S. 89° W. 4.6′ distant.				10	.....	
4505H	Santa Cruz light-house N. 85° W. 5.8′ distant.				10	.....	
4506H	Santa Cruz light-house N. 81° W. 6.9′ distant.				9	.....	
		Lat. S. *Long. W.*					
4507H	Nov. 12	5 43 06 81 43 08	.....	.....	2,312	.....	
4508H	....do....	5 46 05 81 26 09	.....	.....	685	.....	
4516H	Dec. 22	26 54 08 109 16 04	.....	.....	1,627	.....	
4517H	....do....	26 50 09 109 12 05	.....	.....	1,723	.....	
4555H	Point Pinos light-house S. 63° E. 3.4′ distant.				66	.....	
		Lat. N. *Long. W.*					
4567H	Oct. 6	37 25 00 122 26 00	.....		28	.....	
4568H	....do....	36 45 00 122 02 00	.....		486	.....	
4571H	Oct. 7	33 40 00 119 35 00	.....		825	.....	
4590H	Oct. 13	18 50 00 104 50 00	.....		1,038	.....	

The above stations, 4430 to 4590, represent material obtained during the California coast survey of 1904. Part of the material was destroyed by fire. The residue came into my hands after the other work of this report had been tabulated and is therefore given separately. In most instances the position is given by the true bearing of some shore object taken from the vessel.

DREDGING AND TRAWLING STATIONS.

Station.	Date.	Locality.	Surface temperature.	Bottom temperature.	Depth.	Kind of bottom.	Remarks.	Instrument used.
			Lat. S. *Long. W.*					
	1888.		° ′ ″ ° ′ ″	° F. ° F.	*Fms.*			
2807	Apr. 4		00 24 00 89 06 00	79 38.5	812	glob. oz. co. m.	Galapagos Island.	L. B. T.
2808	....do....		00 36 30 89 19 00	79 39.9	634	co. s.....	....do.....	Do.
			Lat. N. *Long. W.*					
2823	Apr. 30		24 18 00 110 22 00	73	26.5	brk. sh.....	Gulf of California.	L. B. T.
2835	May 4		26 42 30 113 34 15	56	5.5	gn. m.....	Off Lower California.	Ship dredge.
2844	July 28		53 56 00 165 40 00	48 42.0	54	gy. s.....	Off Alaska.....	L. B. T.
2848	July 31		55 10 00 160 18 00	49 41.0	110	gn. m.....	....do.....	Do.
2851	Aug. 4		54 55 00 159 52 00	51 44.8	35	gy.s. brk. sh.	....do.....	Do.
2859	Aug. 29		55 20 00 136 20 00	60 34.9	1,569	gy. oz.....	....do.....	Do.
2860	Aug. 31		51 23 00 130 34 00	58 36.5	876	gn. m.....	....do.....	Do.
2866	Sept. 20		48 09 00 125 03 00	59 43.2	171	gy. s.....	British Columbia.	Do.
2871	Sept. 23		46 55 00 125 11 00	62 38.4	559	br. oz.....	Off Washington..	Do.
2882	Oct. 13		46 09 00 124 22 30	60 45.8	68	gy. s.....	Off Oregon.....	Do.
2885	Oct. 18		45 56 00 124 02 00	60 49.0	30	fne. gy. s.....	....do.....	Do.
	1889.							
2919	Jan. 17		32 17 00 119 17 00	59 38.0	984	gy. m.....	Off southern California.	Do.
2923	Jan. 19		32 40 30 117 31 30	59 39.0	822	gn. m.....	....do.....	Do.
2929	Jan. 26		32 27 30 117 26 30	58	623	gn. m.....	....do.....	S. B. T.
3091	Sept. 8		45 32 00 124 19 30	56	87	gn. m.....	Off Oregon.....	L. B. T.
	1890.							
3097	Mar. 5		37 59 08 122 25 45	51	12	bu. m.....	Off central California.	Do.
3346	Sept. 22		45 30 00 124 52 00	54 37.3	786	gn. m.....	Off Washington..	Do.
	1891.							
3361	Feb. 25		6 10 00 83 06 00	82 36.6	1,471	gn. oz.....	Off Panama.....	Do.
	1893.							
3513	Aug. 1		58 27 00 169 01 00	43	35	fne. s. gn. m.	Bering Sea.....	B. T. mud bag.
3520	Aug. 3		59 28 00 170 57 00	43 32.2	38	fne. s. gn. m.	....do.....	Do.
3526	Aug. 5		57 31 00 170 57 00	44 38.9	49	fne. s. dk. m.	....do.....	R. D.
	1894.							
3570	Mar. 21	San Diego Bay, Cal.		57	2	fne. s. oysters.	San Diego Bay....	Boat dredge.
	1895.							
3603	Aug. 11		55 23 00 170 31 00	45 35.1	1,771	bu. oz.....	Bering Sea.....	L. B. T., surface and intermediate nets.
3604	Aug. 12		54 54 00 168 59 00	45 35.2	1,401	gn. oz.....	....do.....	Do.
3607	Aug. 18		54 11 30 167 25 00	45 35.9	987	gn. m. bk. lav. s.	....do.....	Do.
3611	Aug. 22		56 45 00 167 25 00	46 34.6	50	gn. m. s.....	....do.....	Do.
	1897.							
3671	Apr. 21		37 00 00 122 20 00	50	56	gn. m. s.....	Monterey Bay....	L. B. T.
	1900.							
3696	May 5	Tsuragi Saki light, S. 80° W., 4.3 miles.		64	259 110	gn. m. fne. s.	Off Honshu Island, Japan.	8′ Tnr.
3698	....do...	Manazuru Zaki, N. 8° W. 4.5 miles.			153	gn. m. vol.. a. s.	....do.....	Do.
		Lat. N.	*Long. E.*					
3784	June 27	54 32 00	178 31 00	45	85	gn. m. fne. gy. s.	N. of Aleutian Islands.	Do.
3785	....do...	Rat Island, Aleutian Chain, S. 150 miles.		45	270	gy.s.brk.sh.	....do.....	Do.
		Lat. N.	*Long. W.*					
3786	....do...	54 47 20	178 54 00	46	2,106	gy. s. yl. m..	....do.....	Do.

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AGR. Department of Agriculture Library.
FISH. Bureau of Fisheries Library.
GS. Geological Survey Library.
LC. Library of Congress.
MANN. Library of Dr. Albert Mann, George Washington University.
NM. National Museum Library.
NW. U. Northwestern University Library, Evanston, Ill.
PAT. Patent Office Library.
SC. Smithsonian Collection, Library of Congress.
SM. Smithsonian Institution Library.
SURG. Surgeon-General's Library.

For the location of serials containing articles included in the bibliography consult the abbreviation of the serial in its alphabetical sequence. An asterisk (*) after an abbreviation for a library indicates that only the separate of the accompanying article is included in that library.

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	Heft	9.	pl. 33– 36.	1 Ja	1886.
	Heft	10.	pl. 37– 40.	1 Mr	1886.
	Heft	11.	pl. 41– 44.	1 Ap	1886.
	Heft	12.	pl. 45– 48.	1 My	1886.
Series II.	Heft	13.	pl. 49– 52.	15 Ag	1886.
	Heft	14–17.	pl. 53– 68.	1 S	1886.
	Heft	18–20.	pl. 69– 80.	15 Mr	1887.
	Heft	21–22.	pl. 81– 88.	Jl	1885.
	Heft	23–24.	pl. 89– 96.	1 Ja	1886.
Series III.	Heft	25–26.	pl. 97–104.	1 Ag	1886.
	Heft	27–28.	pl. 105–112.	1 N	1886.
	Heft	29–30.	pl. 113–120.	[Ap	1888.]
	Heft	31–32.	pl. 121–128.	1 Ag	1888.
	Heft	33–34.	pl. 129–136.	[N	1888.]
	Heft	35–36.	pl. 137–144.	[	1889.]
Series IV.	Heft	37–38.	pl. 145–152.	[Fe	1890.]
	Heft	39–40.	pl. 153–160.	N	1890.[a]
	Heft	41–42.	pl. 161–168.	Je	1891.]
	Heft	43–44.	pl. 169–176.	[My	1892.]
	Heft	45.	pl. 177–180.	[N	1892.]
	Heft	46.	pl. 181–184.	1 Jy	1893.
	Heft	47.	pl. 185–188.	15 O	1893.
	Heft	48.	pl. 189–192.	[S	1894.]
Series V.	Heft	49.	pl. 193–196.	[S	1894.]
	Heft	50.	pl. 197–200.	[Ap	1895.]
	Heft	51.	pl. 201–204.	[O	1896.]
	Heft	52–53.	pl. 205–212.	[Mr	1897.]
	Heft	54.	pl. 213–216.	[Mr	1899.]
	Heft	55.	pl. 217–220.	[N	1899.]
	Heft	56.	pl. 221–224.	N	1900.
	Heft	57.	pl. 225–228.	S	1901.
	Heft	58.	pl. 229–232.	Ap	1902.
	Heft	59–60.	pl. 233–240.	O	1902.
Series VI.	Heft	61.	pl. 241–244.	S	1903.
	Heft	62–63.	pl. 245–252.	Mr	1904.
	Heft	64.	pl. 253–256.	Ag	1905.
	Heft	65.	pl. 257–260.	S	1905.
	Heft	66.	pl. 261–264.	Je	1906.
	Heft	67.	pl. 265–268.	D	1906.

These dates were worked out by the author a few months before their publication by B. B. Woodward, Journ. Bot. **44**: 384–386. 1906. Mr. Woodward has recorded the exact date of receipt of heft 48–65 at the Botanical Department of the British Museum, which may be an additional advantage in some cases since only the month of publication is recorded on the plate or in Friedländer's Naturae Novitates.

[a] Date at bottom of explanation of plate 153 overlooked by Mr. Woodward.

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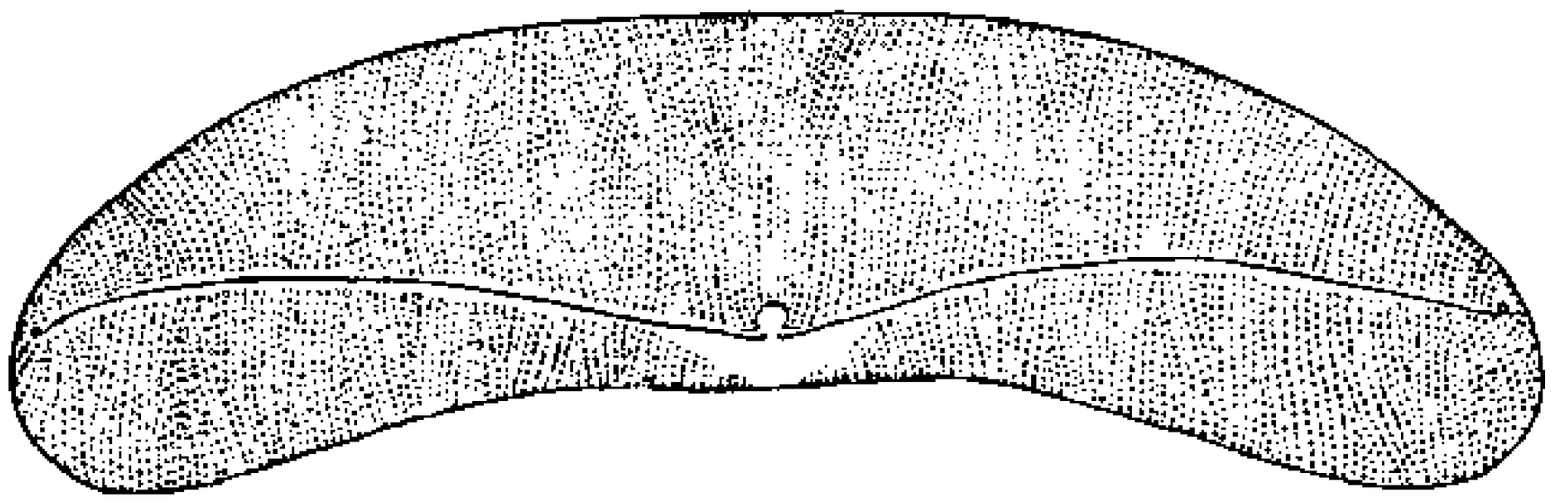
PLATE XLIV.

PLATE XLIV.

FIG. 1.—*Amphora honshuensis* Mann. Enlarged 500 diameters. Description, p. 375.
FIG. 2.—*Amphora baccata* Mann. Enlarged 575 diameters. Description, p. 373.
FIG. 3.—*Amphora crescens* Mann. Enlarged 600 diameters. Description, p. 374.
FIG. 4.—*Achnanthes dispar* Mann. Enlarged 800 diameters. Description, p. 327.
FIG. 5.—*Achnanthes dispar* Mann. Enlarged 800 diameters. Description, p. 327.
FIG. 6.—*Dimeregramma inflatum* Mann. Enlarged 1,000 diameters. Description, p. 327.



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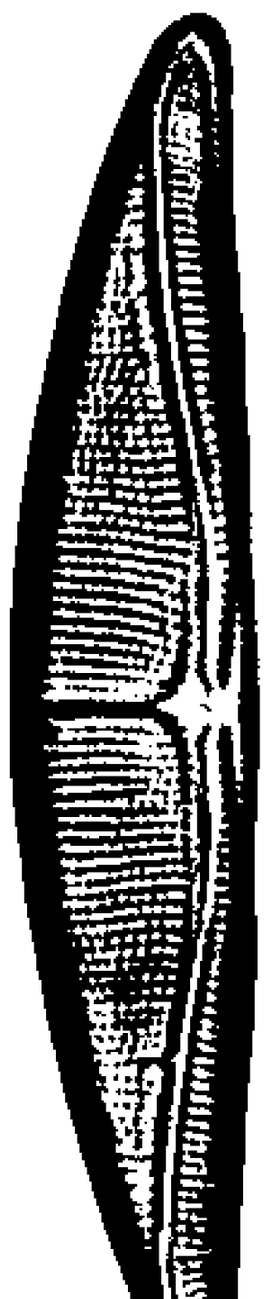

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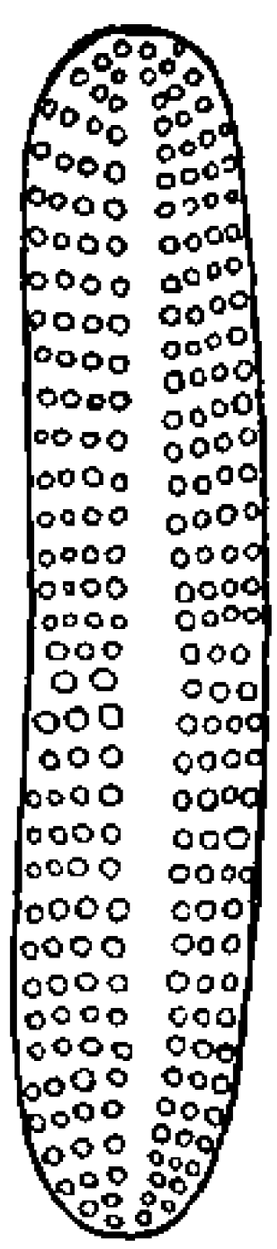

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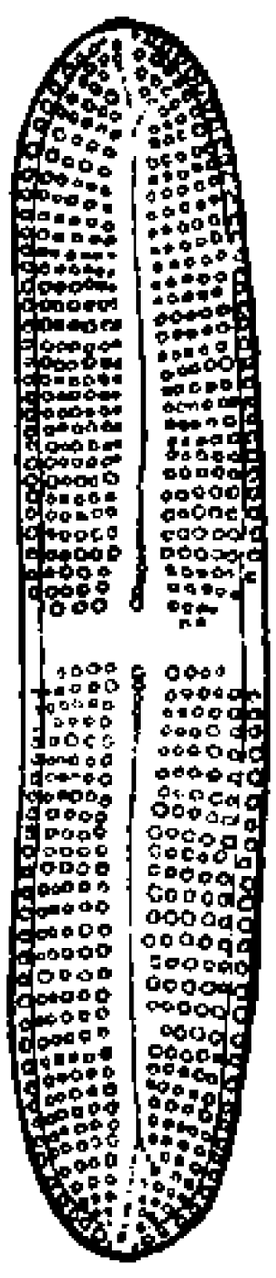

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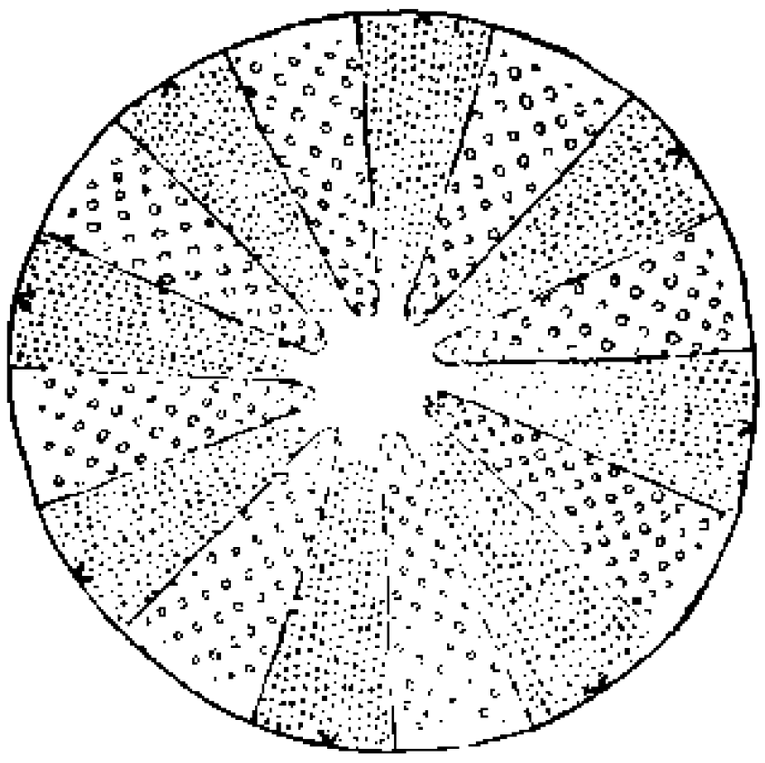
6

DIATOMS OF THE GENERA AMPHORA, ACHNANTHES, AND DIMEREGRAMMA.

PLATE XLV.

PLATE XLV.

FIG. 1.—*Actinoptychus alternans* Mann. Enlarged 1,000 diameters. Description, p. 270.
FIG. 2.—*Actinoptychus planus* Mann. Enlarged 740 diameters. Description, p. 271.
FIG. 3.—*Actinoptychus radulus* Mann. Enlarged 575 diameters. Description, p. 271.
FIG. 4.—*Asteromphalus nanus* Mann. Enlarged 612 diameters. Description, p. 276.
FIG. 5.—*Asteromphalus van heurckii* Mann. Enlarged 660 diameters. Description, p. 276.
FIG. 6.—*Stephanopyxis triscalpta* Mann. Enlarged 550 diameters. Description, p. 245.



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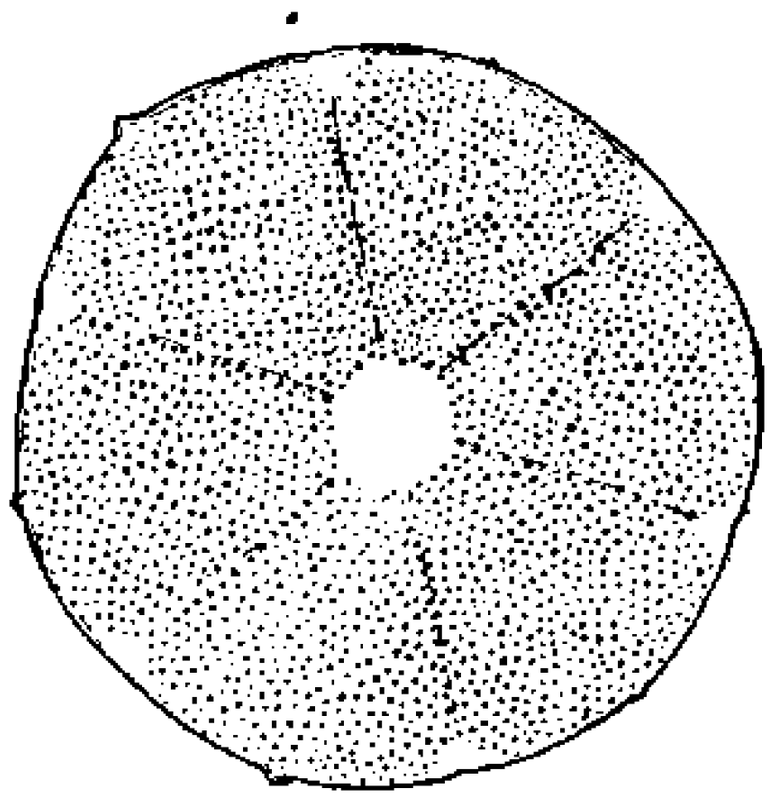

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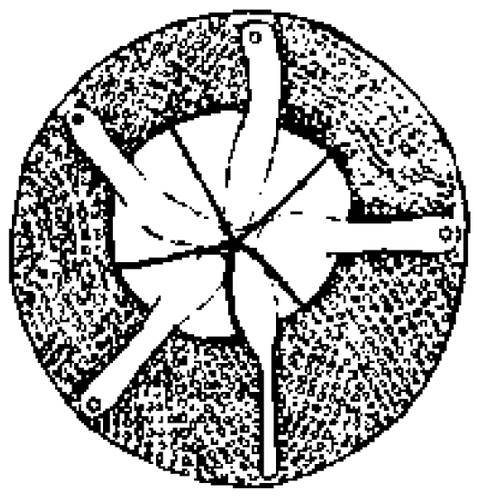

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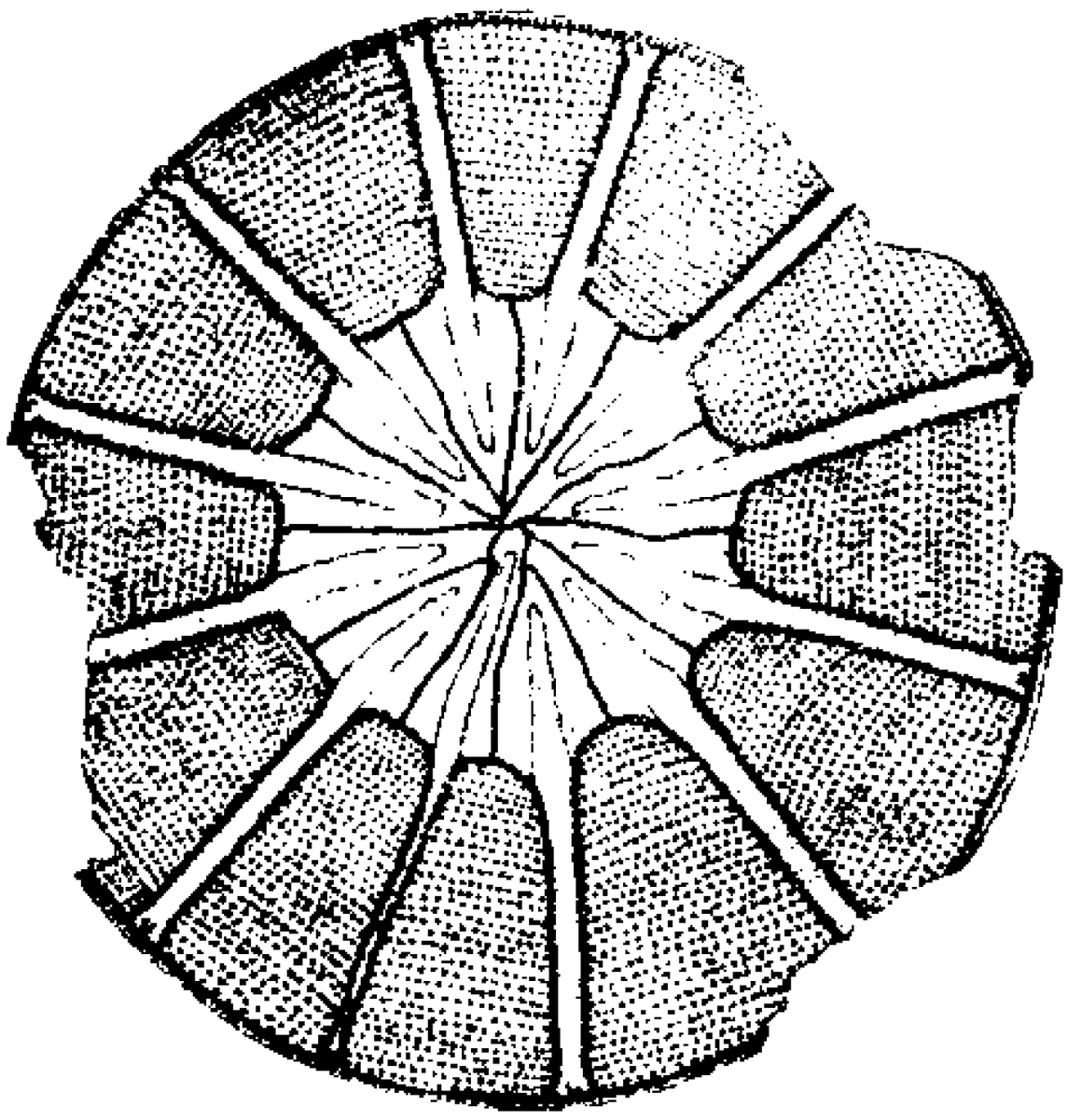

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6

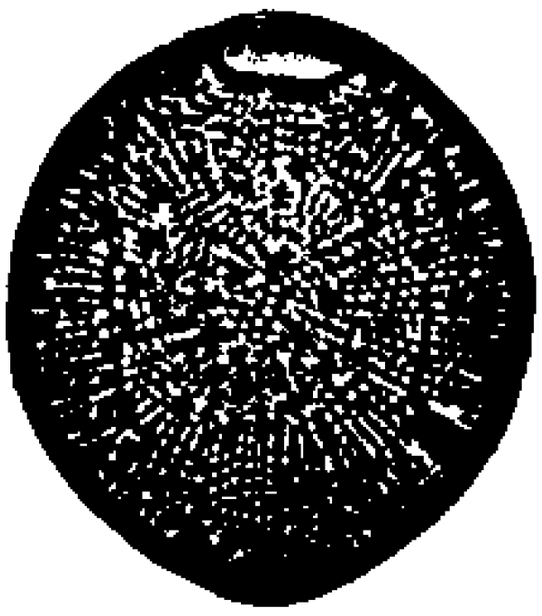
DIATOMS OF THE GENERA ACTINOPTYCHUS, ASTEROMPHALUS, AND STEPHANOPYXIS.

PLATE XLVI.

PLATE XLVI.

FIG. 1.—*Biddulphia alaskiensis* Mann. Enlarged 550 diameters. Description, p. 298.
FIG. 2.—*Biddulphia roperiana* Grev. (a smooth variety). Enlarged 400 diameters. Description, p. 308.
FIG. 3.—*Biddulphia cuticella* Mann. Enlarged 660 diameters. Description, p. 300.
FIG. 4.—*Biddulphia subjuncta* Mann. Enlarged 660 diameters. Description, p. 311.
FIG. 5.—*Biddulphia luminosa* (Temp. and Br.) Mann. Enlarged 660 diameters. Description, p. 305.

PLATE XLVI.



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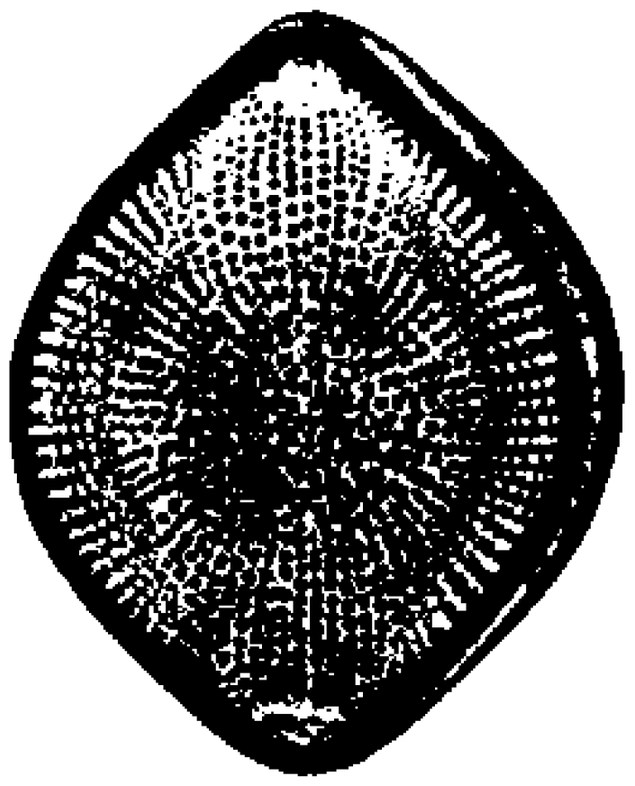

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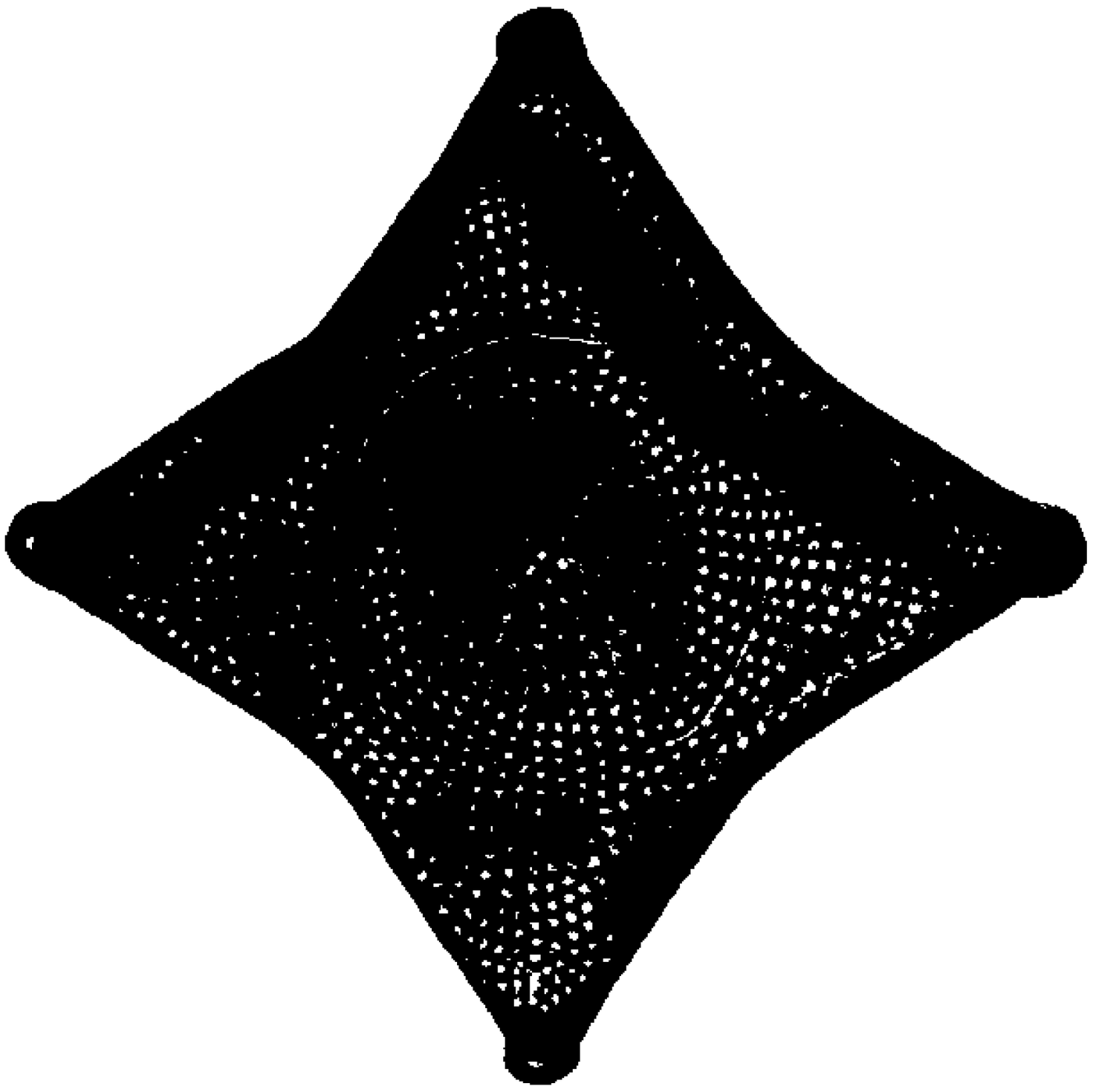

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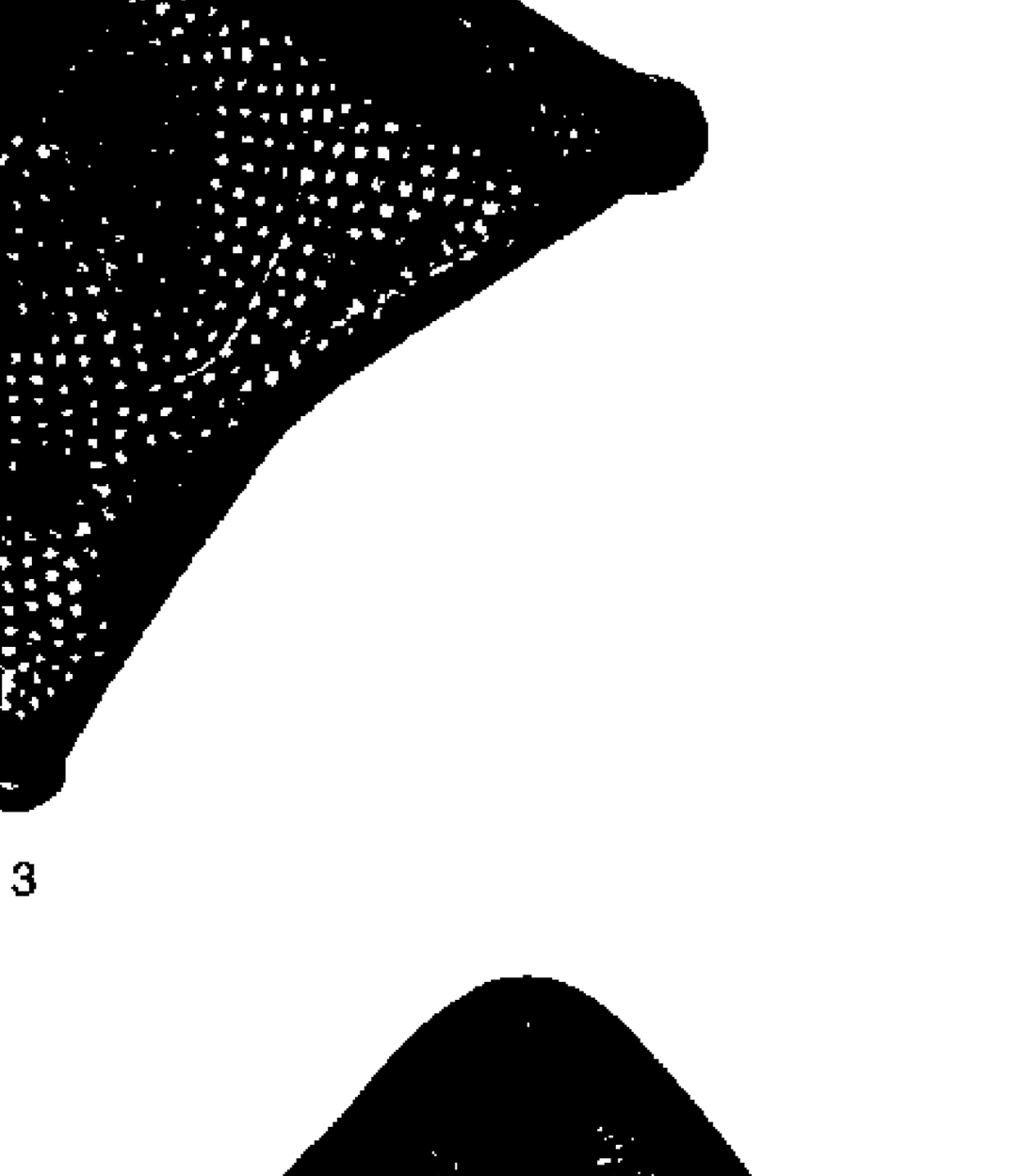


5

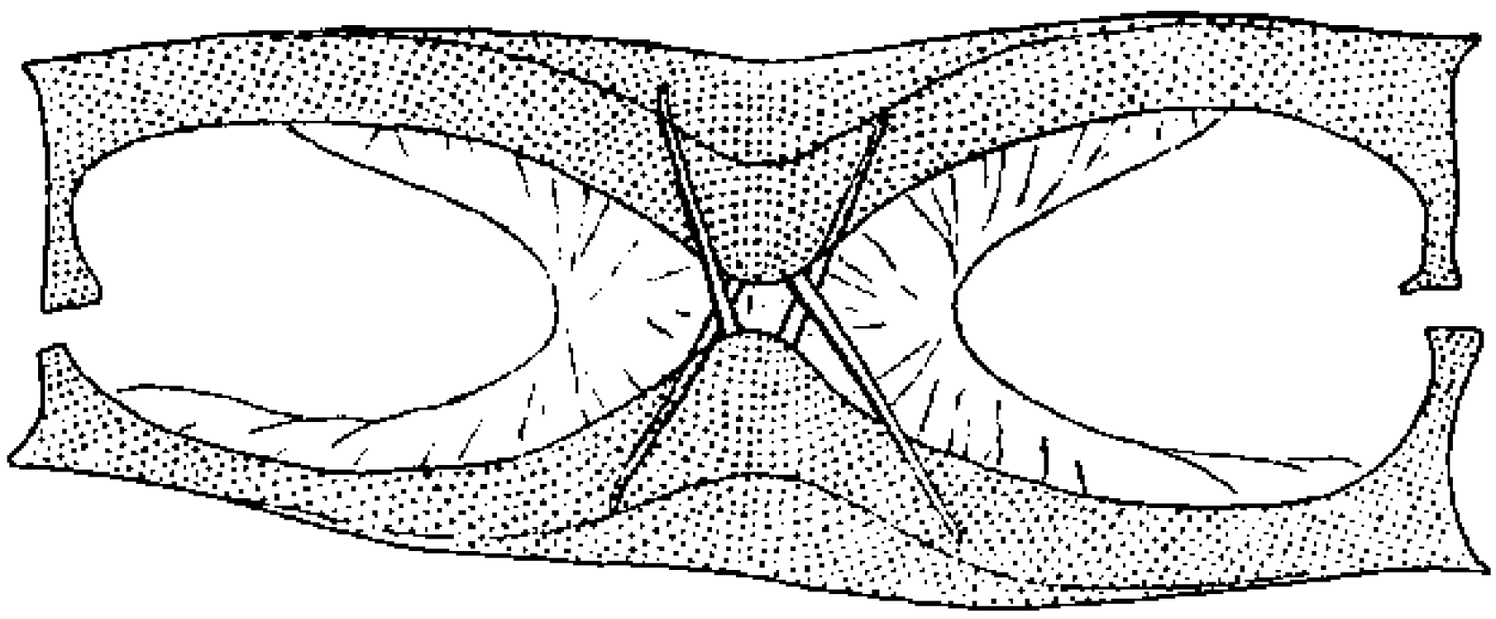
DIATOMS OF THE GENUS BIDDULPHIA.

PLATE XLVII.

PLATE XLVII.

FIG. 1.—*Biddulphia extensa* Mann (zonal view). Enlarged 575 diameters. Description, p. 302.
FIG. 2.—*Biddulphia extensa* Mann (valval view). Enlarged 575 diameters. Description. p. 302.
FIG. 3.—*Biddulphia scutellum* Mann. Enlarged 375 diameters. Description, p. 309.
FIG. 4.—*Biddulphia gladiorum* Mann. Enlarged 750 diameters. Description, p. 304.

PLATE XLVII.



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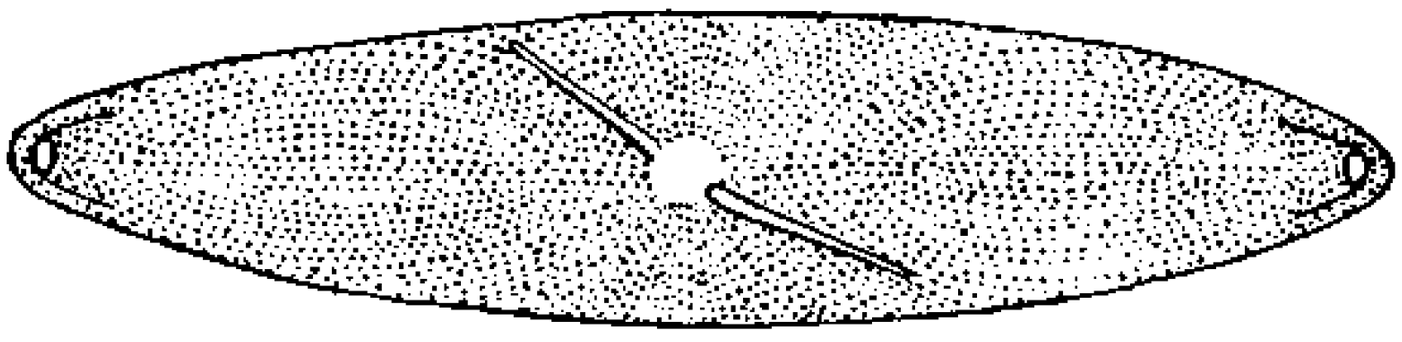

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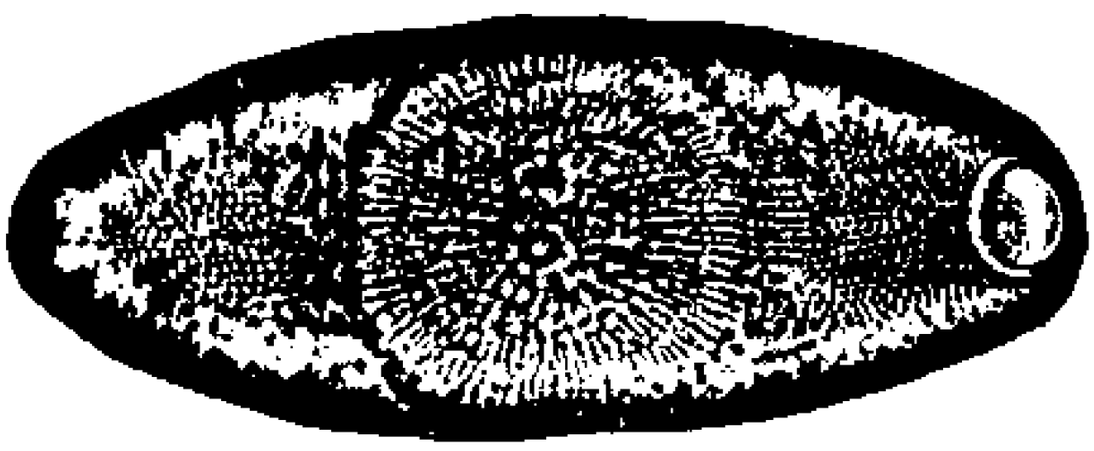

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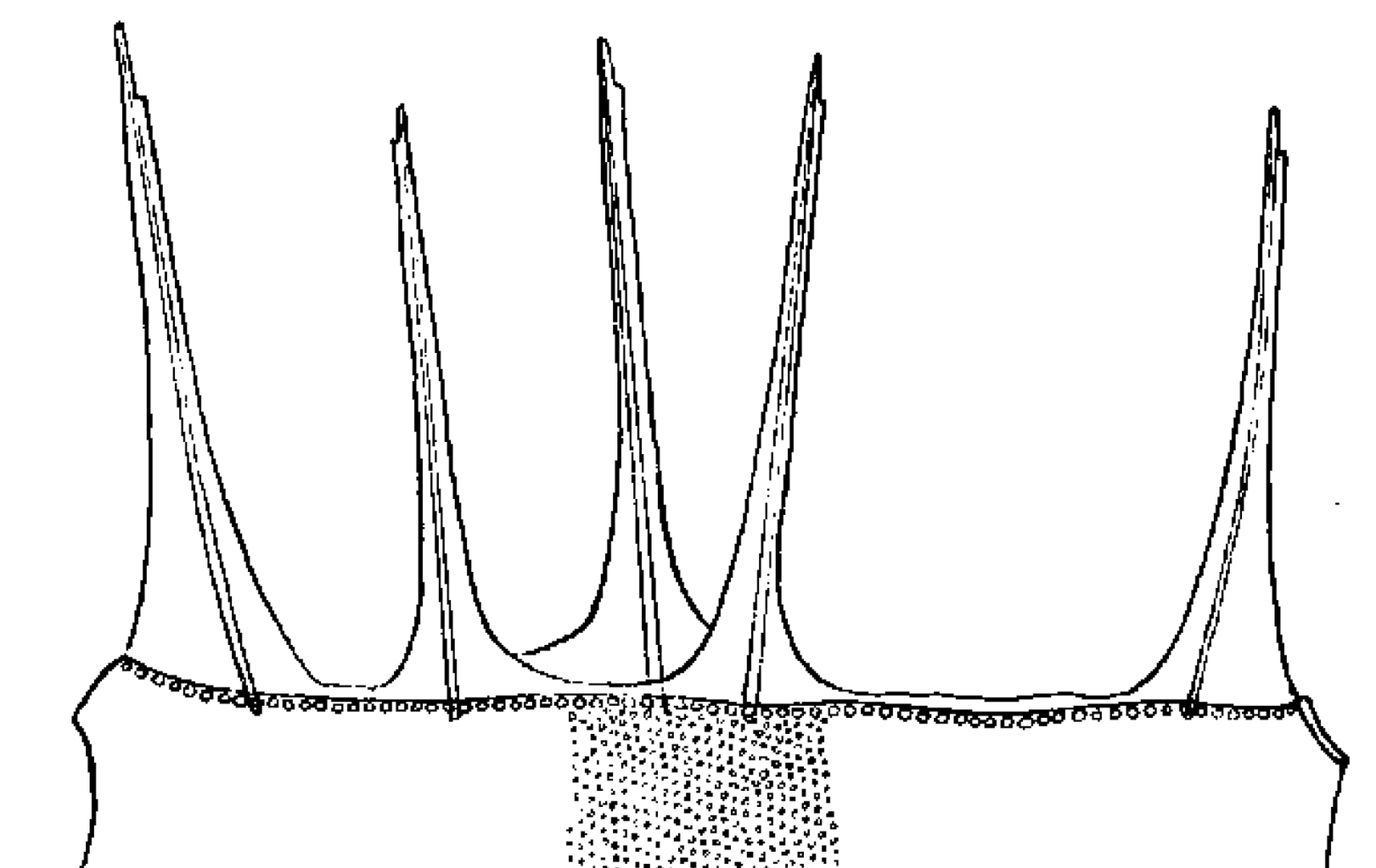


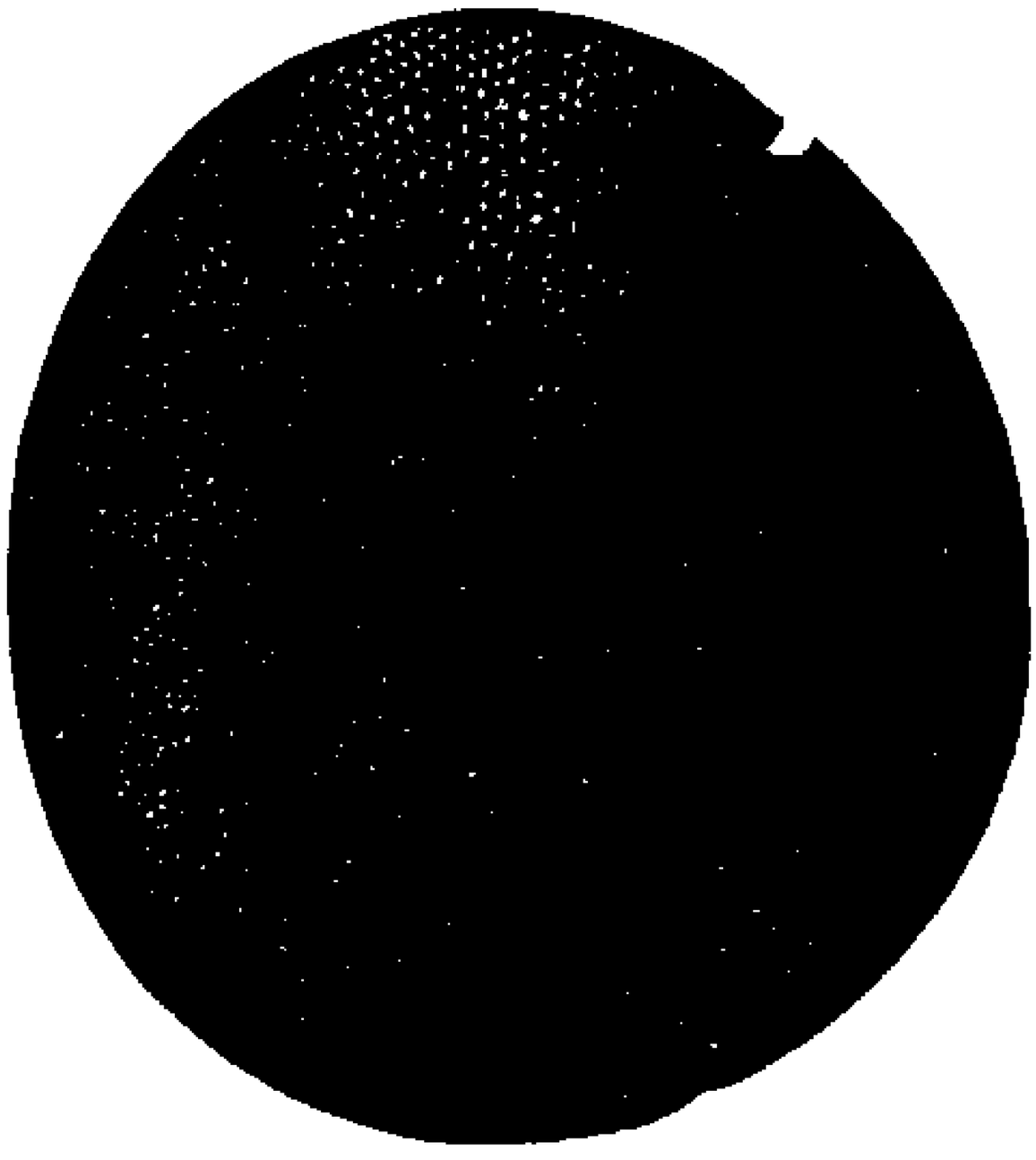
4

DIATOMS OF THE GENUS BIODULPHIA.

PLATE XLVIII.

PLATE XLVIII.

FIG. 1.—*Coscinodiscus deformatus* Mann. Enlarged 550 diameters. Description, p. 250.
FIG. 2.—*Coscinodiscus deformatus* Mann. Enlarged 550 diameters. Description, p. 250.
FIG. 3.—*Coscinodiscus pustulatus* Mann. Enlarged 375 diameters. Description, p. 257.
FIG. 4.—*Coscinodiscus robustus* Grev. (variety with open girdle). Enlarged 375 diameters. Description, p. 258.



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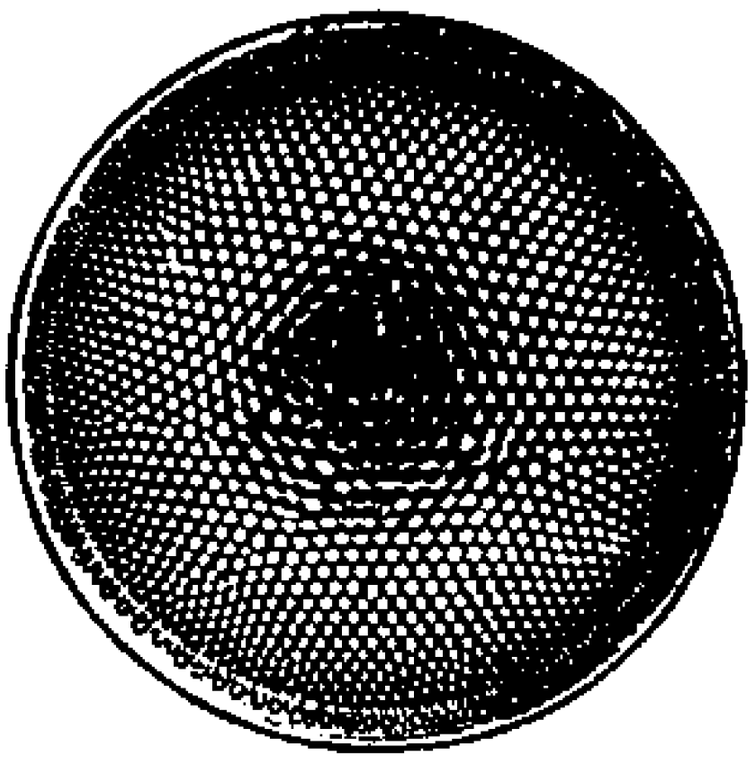

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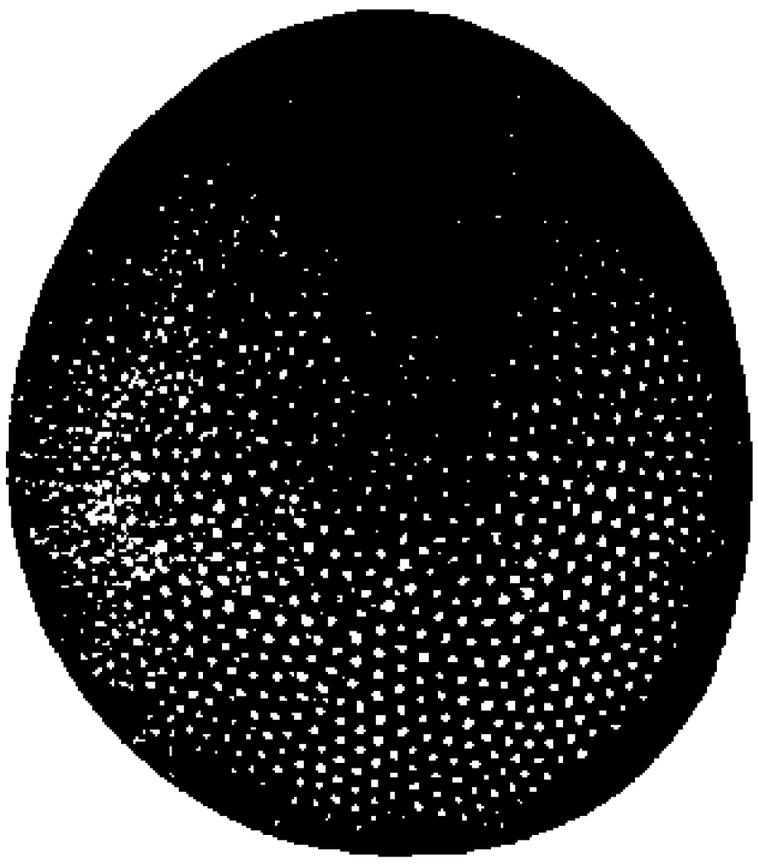

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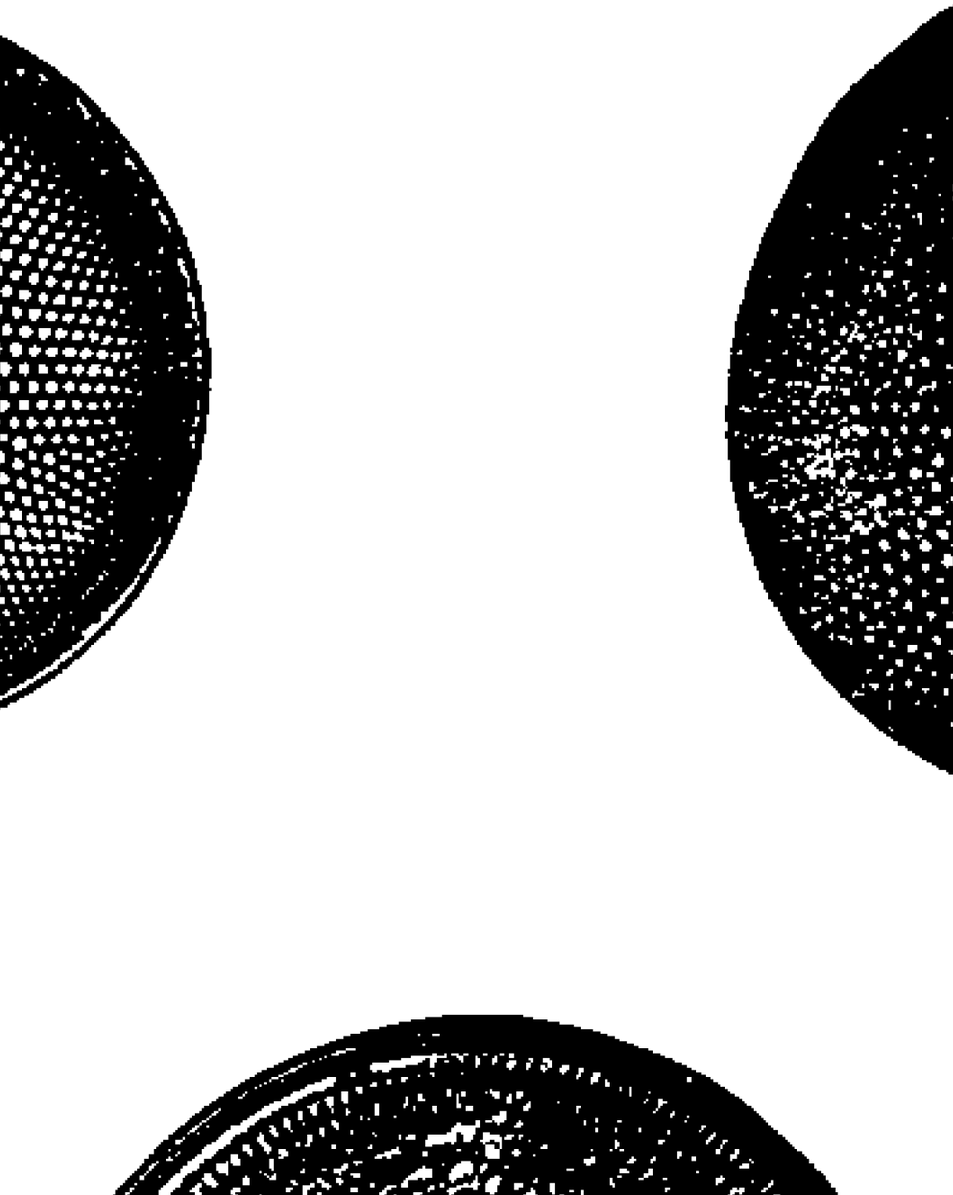


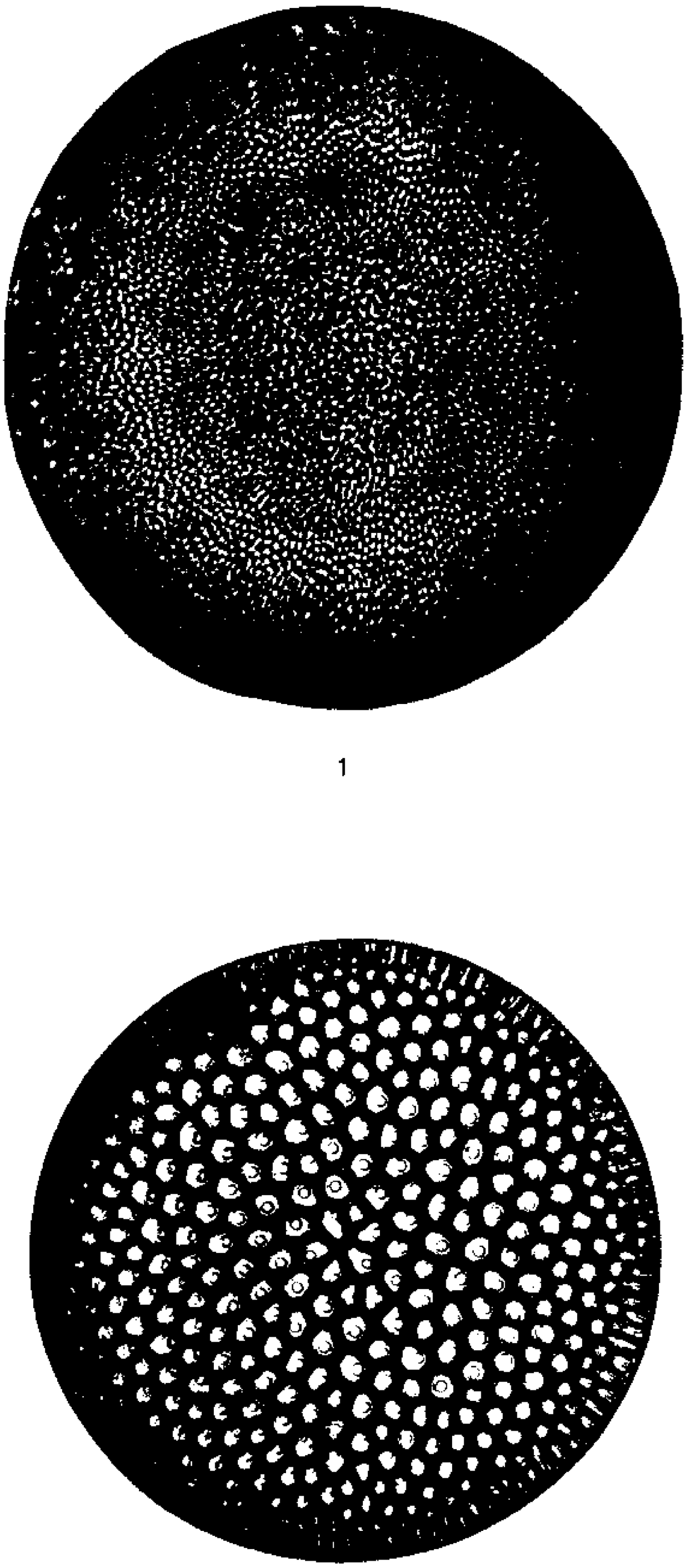
4

DIATOMS OF THE GENUS COSCINODISCUS.

PLATE XLIX.

PLATE XLIX.

FIG. 1.—*Coscinodiscus undulosus* Mann. Enlarged 550 diameters. Description, p. 259.
FIG. 2.—*Coscinodiscus marginatus* Ehrenb. variety (?) Enlarged 375 diameters. Description, p. 253.



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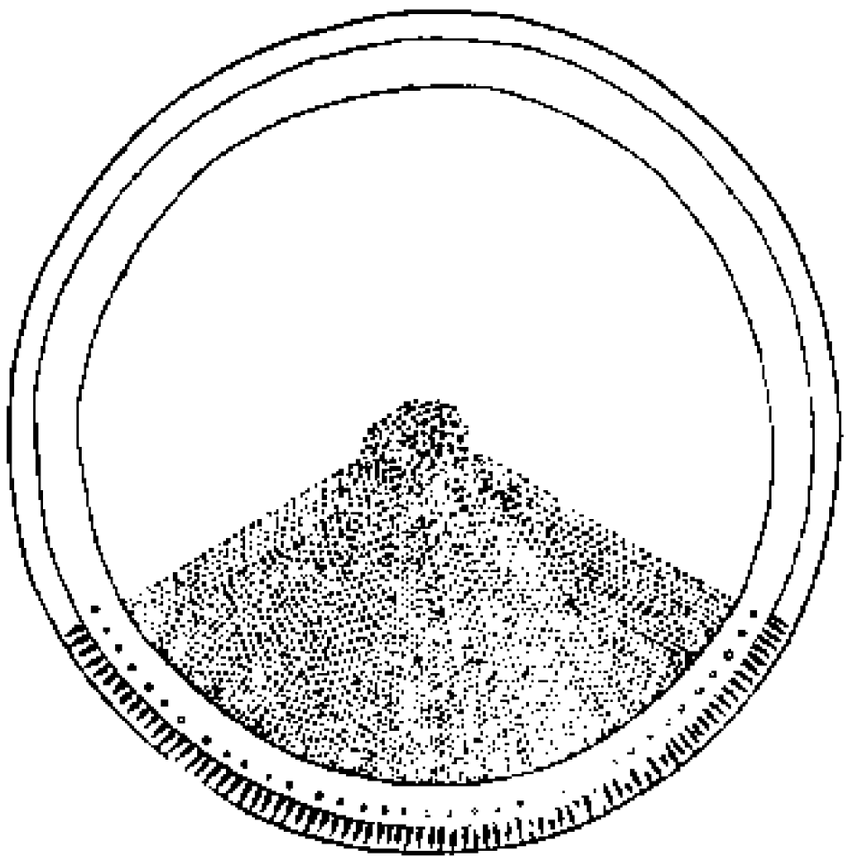
DIATOMS OF THE GENUS COSCINODISCUS.

PLATE L.

PLATE L.

FIG. 1.—*Coscinodiscus verecundus* Mann. Enlarged 500 diameters. Description, p. 259.
FIG. 2.—*Cyclotella regina* Mann. Enlarged 500 diameters. Description, p. 265.
FIG. 3.—*Melosira medusa* Mann. Enlarged 500 diameters. Description, p. 238.
FIG. 4.—*Melosira scopos* Mann. Enlarged 600 diameters. Description, p. 239.
FIG. 5.—*Stictodiscus gelidus* Mann. Enlarged 600 diameters. Description, p. 268.
FIG. 6.—*Tripodiscus beringensis* Mann. Description, p. 278.

PLATE L.



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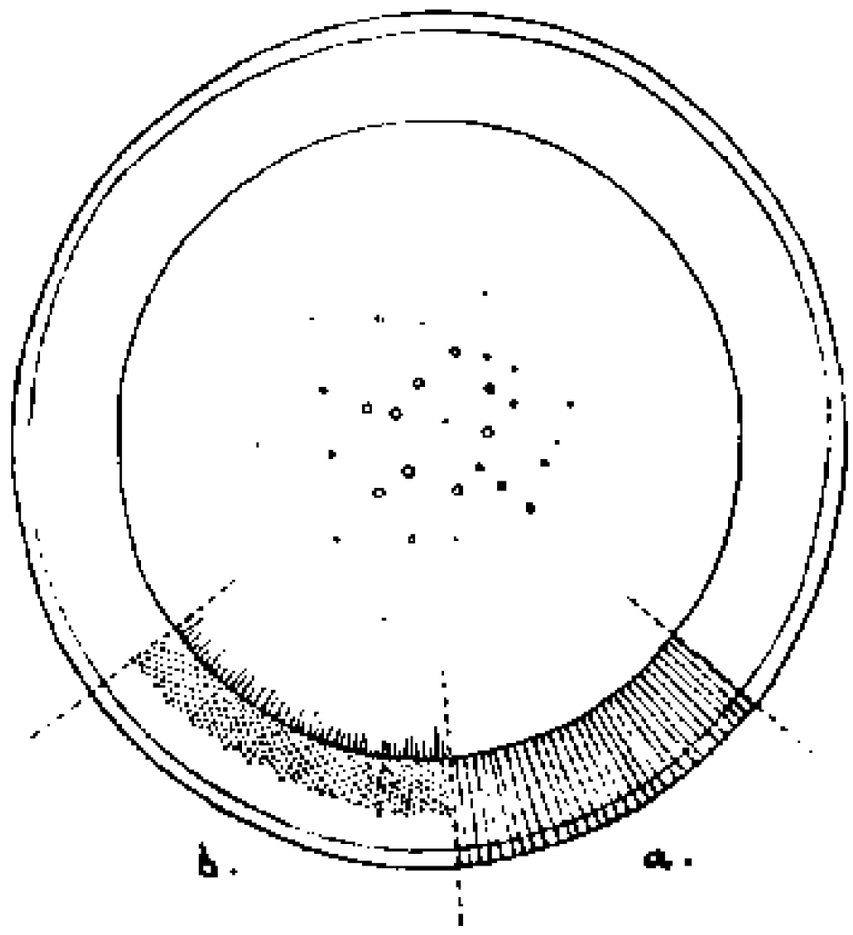

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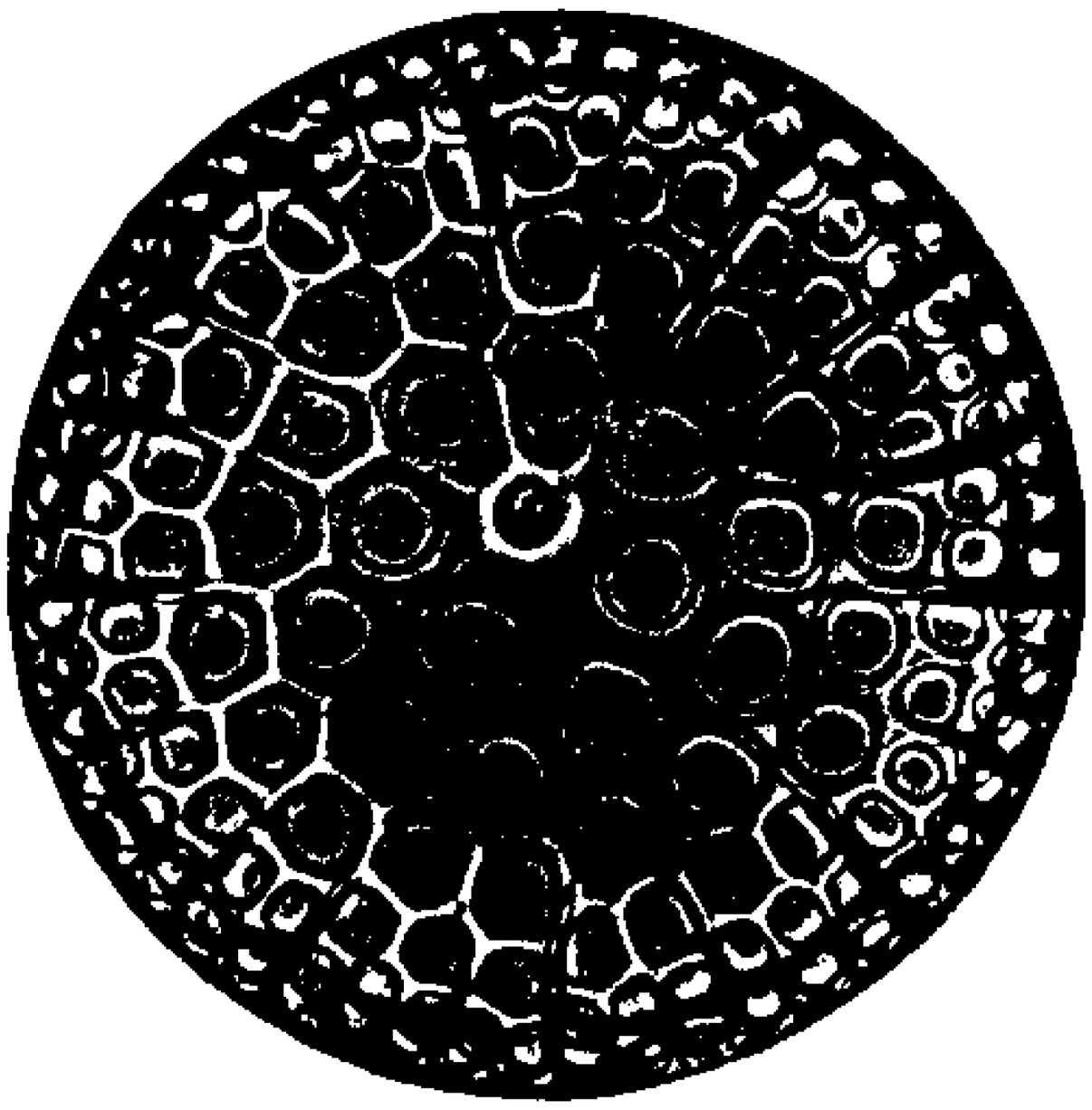

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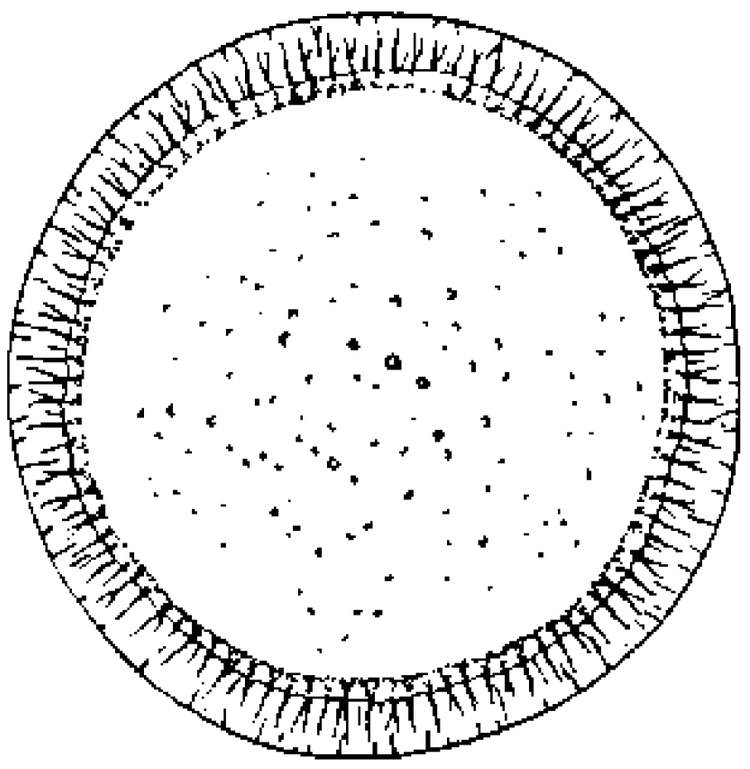

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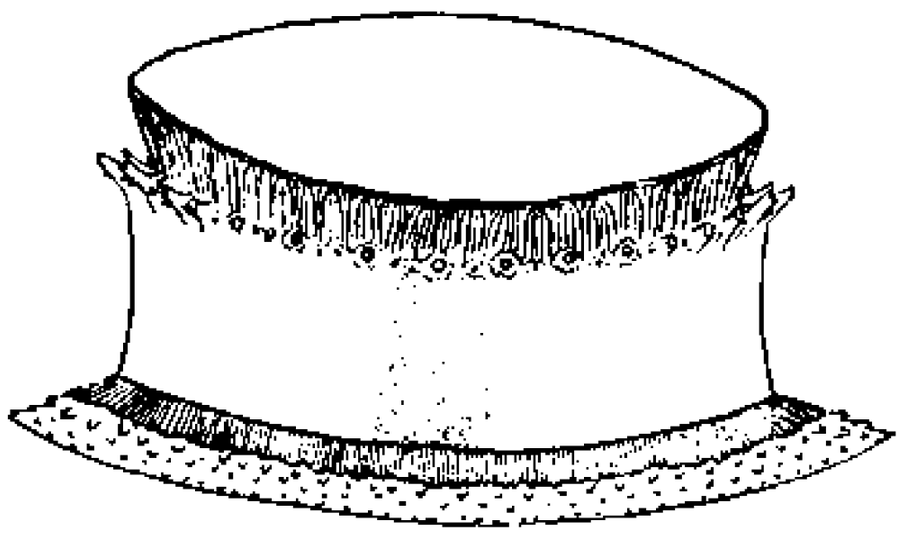
DIATOMS OF SEVERAL GENERA.

PLATE LI.

PLATE LI.

FIG. 1.—*Melosira coronaria* Mann (zonal view). Enlarged 600 diameters. Description, p. 237.
FIG. 2.—*Melosira coronaria* Mann (valval view). Enlarged 600 diameters. Description, p. 237.
FIG. 3.—*Campylodiscus galapagensis* Mann. Enlarged 300 diameters. Description, p. 387.
FIG. 4.—*Trigonium rusticum* Mann. Enlarged 600 diameters. Description, p. 294.
FIG. 5.—*Trigonium adspersum* Mann. Enlarged 600 diameters. Description, p. 292.

PLATE LI.



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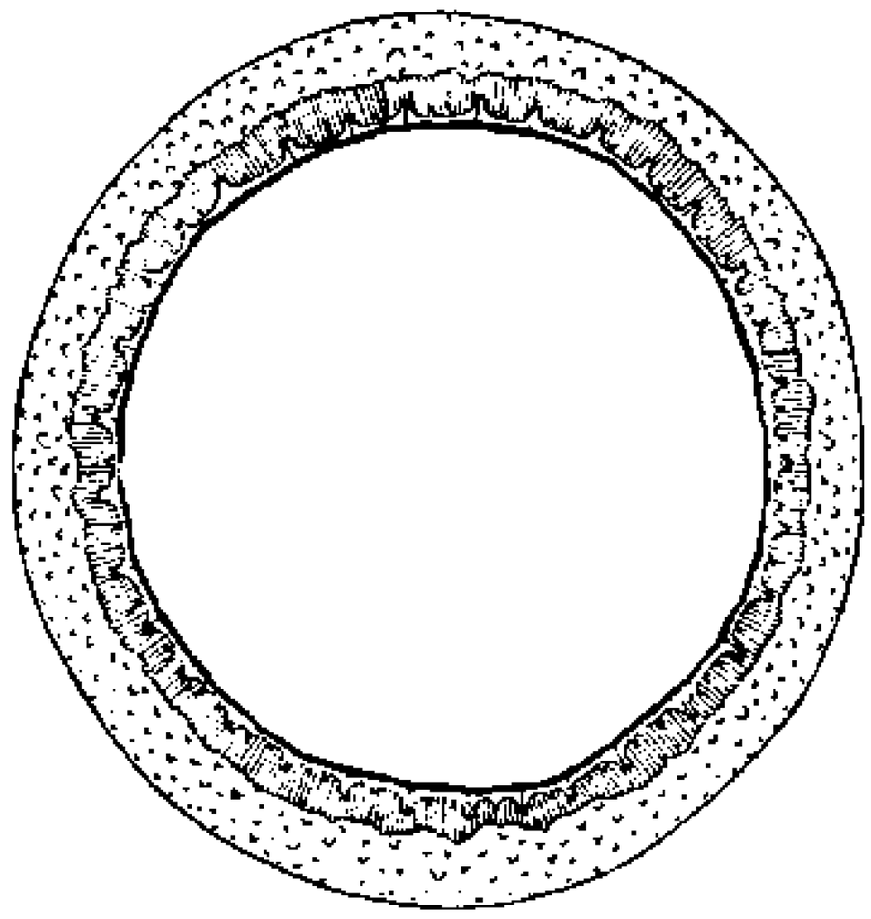

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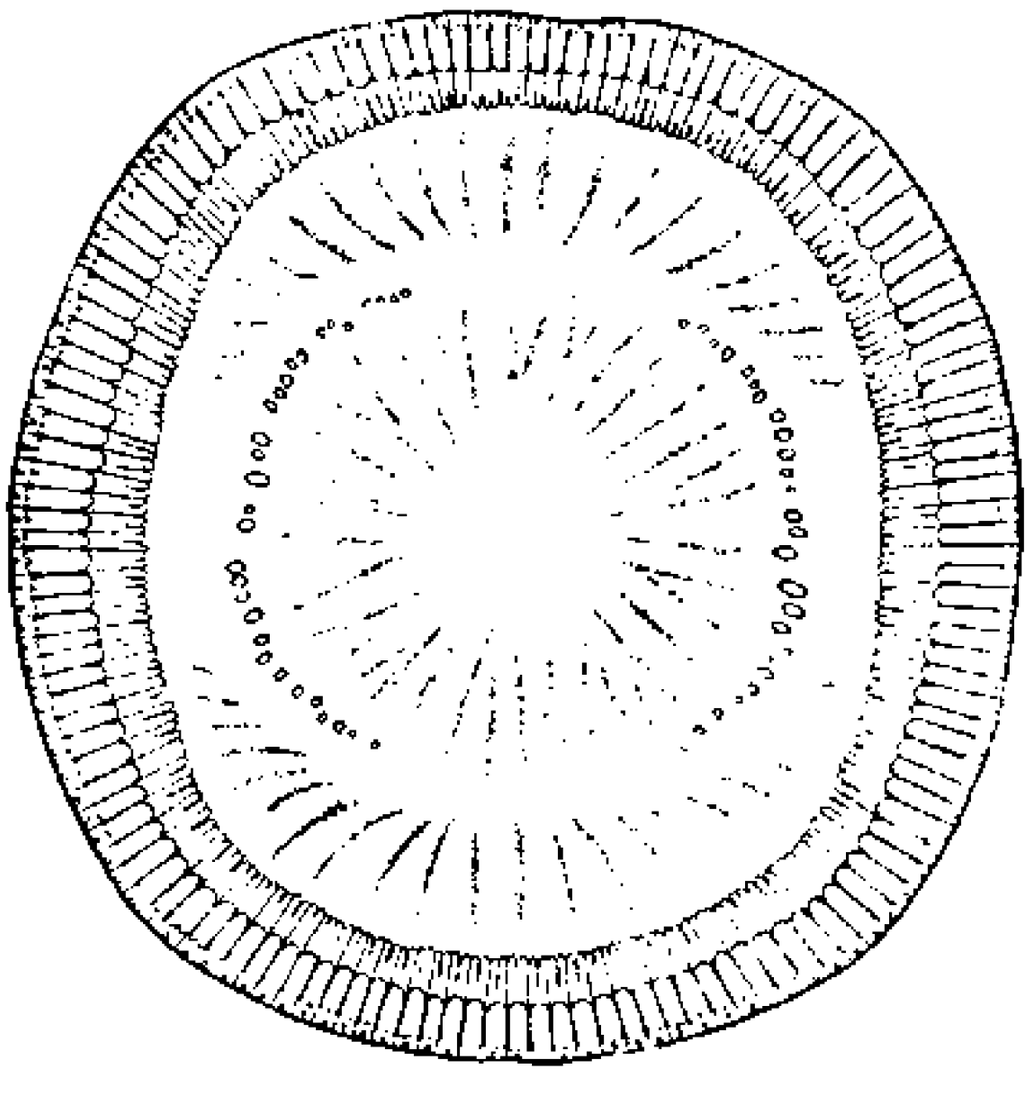

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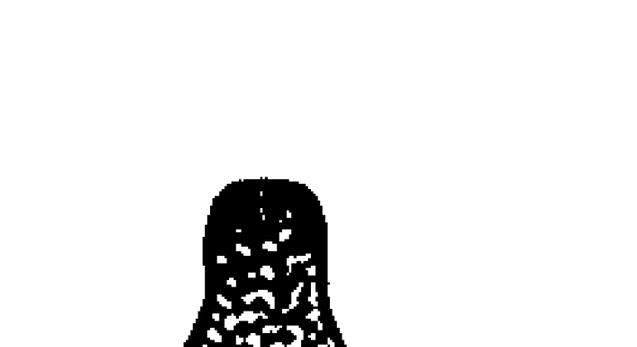

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DIATOMS OF THE GENERA MELOSIRA, CAMPYLODISCUS, AND TRIGONIUM.

PLATE LII.

PLATE LII.

FIG. 1.—*Plagiogramma sceptrum* Mann (valval view). Enlarged 375 diameters. Description, p. 326.
FIG. 2.—*Plagiogramma sceptrum* Mann (zonal view). Enlarged 375 diameters. Description, p. 326.
FIG. 3.—*Navicula vidovichii* Grun. (form). Enlarged 550 diameters. Description, p. 358.
FIG. 4.—*Navicula curvilineata* Mann. Enlarged 515 diameters. Description, p. 341.
FIG. 5.—*Navicula speciosa* Mann. Enlarged 550 diameters. Description, p. 356.
FIG. 6.—*Navicula gyrinida* Mann. Enlarged 660 diameters. Description, p. 344.
FIG. 7.—*Navicula spuma* Mann. Enlarged 600 diameters. Description, p. 357.

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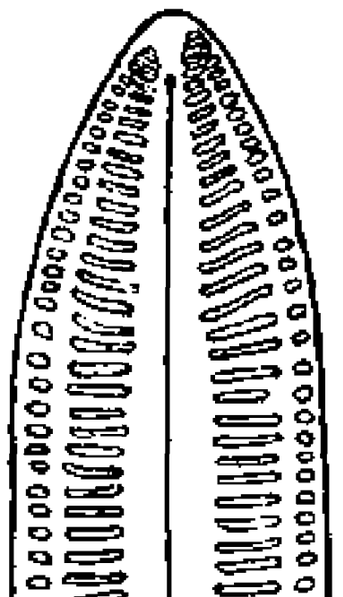

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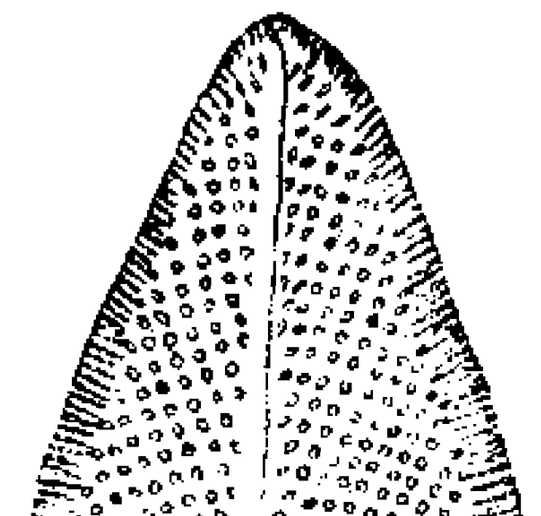

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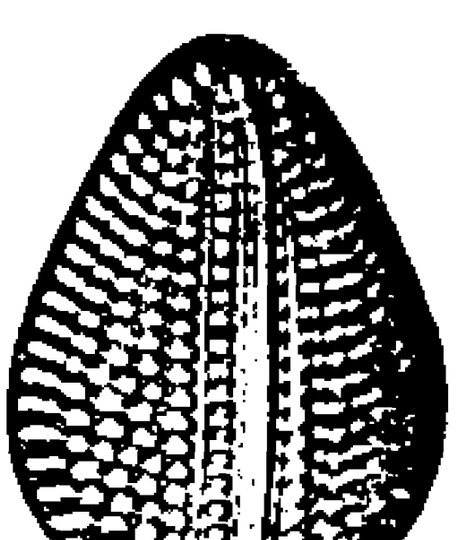

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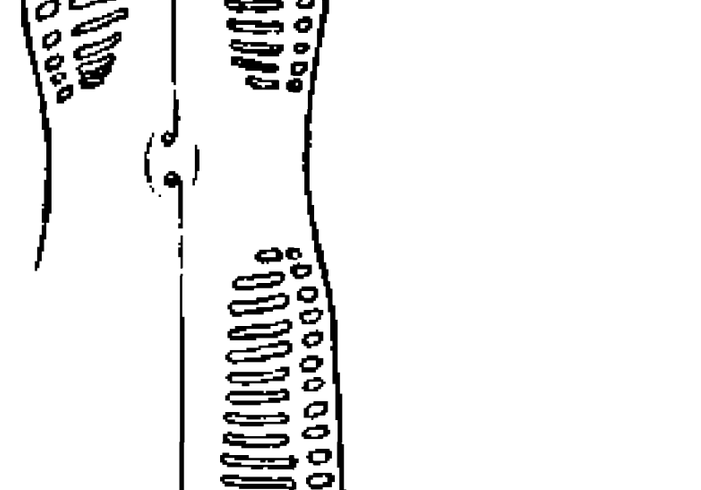

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7

DIATOMS OF THE GENERA PLAGIOGRAMMA AND NAVICULA.

PLATE LIII.

PLATE LIII.

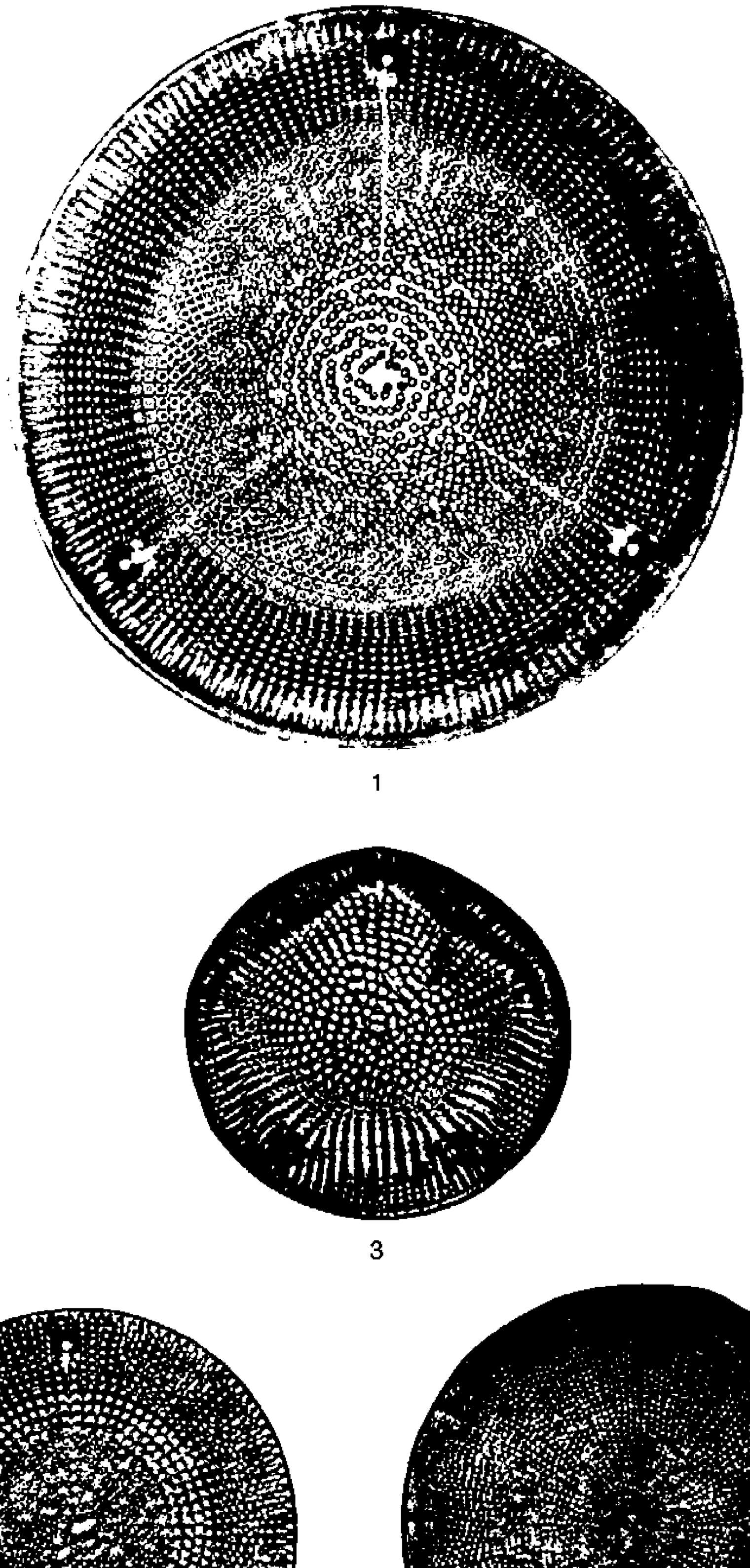
FIG. 1.—*Naricula undata* Mann. Enlarged 990 diameters. Description, p. 358.
FIG. 2.—*Naricula ardua* Mann (valval view). Enlarged 600 diameters. Description, p. 336.
FIG. 3.—*Naricula ardua* Mann (zonal view). Enlarged 600 diameters. Description, p. 336.
FIG. 4.—*Naricula prodiga* Mann. Enlarged 600 diameters. Description, p. 352.
FIG. 5.—*Naricula pinguis* Mann. Enlarged 375 diameters. Description, p. 350.
FIG. 6.—*Naricula invenusta* Mann (type). Enlarged 375 diameters. Description, p. 346.
FIG. 7.—*Naricula invenusta* Mann (form). Enlarged 375 diameters. Description, p. 346.

DIATOMS OF THE GENUS NAVICULA.

PLATE LIV.

PLATE LIV.

FIG. 1.—*Tripodiscus concentricus* Mann (type). Enlarged 600 diameters. Description, p. 278.
FIG. 2.—*Tripodiscus concentricus* Mann (form). Enlarged 600 diameters. Description, p. 278.
FIG. 3.—*Tripodiscus laxus* Mann. Enlarged 550 diameters. Description, p. 279.
FIG. 4.—*Tripodiscus cosmiodiscus* Mann. Enlarged 550 diameters. Description, p. 279.



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DIATOMS OF THE GENUS TRIPODISCUS.