

# MARINE DIATOMS OF THE PHILIPPINE ISLANDS

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## INTRODUCTION

The diatom flora of the Philippine Islands is easily recognizable as a subtropical one. Its forms as a class are large, elaborately ornamented, and therefore very beautiful, and there is no preponderance of the so-called naviculoid forms, elongated diatoms of rather plain design, which are in such large majority in colder waters. This robust and ornate development is due mainly to temperature, the effect of which on the size and ornamentation of the diatoms has been studied by Schumann (*Diat. Hoh. Tetra*, p. 38), Heribaud (*Journ. Roy. Micros. Soc.*, 1894, p. 491), and others. But abundant nourishment, including organic products in solution, and ample light are also contributory factors in the richness of the diatom flora of these islands.

The locality is also a prolific one, both in the sense of the abundant number of individuals and in that of the great diversity of genera and species inhabiting these waters. It is generally found that colder seas, like the north and south polar regions, while producing rather plain diatoms, are richest in diatom life, as measured by the number of individuals in a given cubic area of water or of bottom material. But even in this particular I have yet to find any specimens of "marine ooze" to equal some collected at Jolo Jolo. In the high percentage of diatoms it contained it reminded me, though it actually surpassed, some material collected by the Shackleton South Polar Expedition at McMurdo Sound. In a paper on Organic Fertility of the North Pacific Ocean (Scripps Institute publications), E. L. Michael says that diatom ooze is very abundant in south polar regions, with isolated patches near the Aleutian and the Galapagos Islands, and he adds: "It is also reported from the Philippine region, an anomalous fact, since diatoms are most abundant in cold latitudes."

The abundance expressed in number of genera and species above noted is, on the other hand, truly subtropical. Just as a prolific production of individuals is generally associated with cold waters, so a

prolific diversity of forms is more often met with in warm waters. In the Philippine flora there seems to be in this abundance of genera a fairly even gradation maintained that corresponds to the relative size of each genus. Thus of the large genus, *Biddulphia*, 70 species are recorded here; the enormous genus *Navicula* is represented by 149 species; *Coscinodiscus* is somewhat below its average with 36 species; *Campylodiscus* somewhat above with 47 species; the genus perhaps showing a markedly strong development is *Amphora*, which contributes the relatively large number of 56 species. Of course the many gatherings here included vary greatly in this respect; some are made up principally of round forms, others are decidedly *Amphora* gatherings, etc.

There is here only occasional mention of strictly plankton diatoms, as no plankton gatherings were available for this investigation; and the few species recorded, chiefly *Chaetoceros* and *Rhizoselenia*, were stray individuals found in dredged samples, where a few plankton specimens would necessarily be expected.

Next to the diatoms, the most abundant microorganisms were found to be the radiolaria and the spicules of sponges. As to foraminifera, no estimate of their abundance was possible, because a careful survey of the material was not undertaken until after it had been prepared for diatom study by boiling in acids to remove the organic matter. This process, which leaves unaffected the siliceous diatoms, radiolaria, and spicules, destroys the calcareous foraminifera, together with all the softer organisms, such as copepods, annelids, nematodes, etc. But the preliminary examinations made to determine which samples were diatomaceous enables me to say that foraminifera were present in most of them and in some they were abundant.

I regret to have to record that the exact location of most of the Philippine Island dredgings examined for this paper can not be given. The labels, usually attached to the neck of the bottles of *Albatross* specimens, sometimes included on a slip of paper within the bottle, were in nearly every instance lacking. Those who made the collections can find no explanation for this omission. In one or two bottles fragments of labels were found, but in most cases there was not even a trace of paper fiber discoverable under the microscope. But it is the unfortunate absence of these labels, and not the reason for their absence, that is of importance. The date of collecting, depth, and exact place on the coast where each sample was obtained are therefore wanting. It can however be said that these bottles without labels were unmistakably Philippine Island dredgings, as the letter P was in every case painted upon the cork of the bottle. The nature of the material in most cases, and especially in the samples richest in diatoms, indicated that they were bottom samples taken in shallow bays or harbors rather than along the more exposed parts of the coast.

The richest sample among the many hundreds examined was fortunately known to have come from the neighborhood of Jolo Jolo, Sulu Island. A sort of whirlpool circling of waters coming in from different directions takes place at this point, and it is doubtless in part this huge movement serving to gather together and concentrate the solid material from the converging currents that explains the unusual richness, both in species and numbers of individuals. It was also at this point that many species hitherto reported from the East India islands were found.

The Philippine Islands are very advantageously located with reference to the great ocean currents, the chief carriers of diatoms from one part of the world to another. The great northern and the southern equatorial currents converge on the eastern and southern shores of the Philippines and spread their waters about the island group. Other currents skirt the islands of the East Indies, New Guinea, Celebes, and Borneo on their southern sides, Java on its northern side, Sumatra and parts of the Malay Peninsula on their eastern sides; they then stream northward and northeastward to come to rest along the western coasts of the Philippines. The Sulu Sea is especially a focal center for many such currents, and represents one of the most complexly connected oceanographic localities known. On the other hand, the cold current from Bering Sea and the Arctic which flows southwest along the coasts of Kamchatka, Manchuria, and the eastern side of Korea is here pushed back by a warm current moving up between Korea and Japan and fails to reach the Philippines. It is quite evident that this great convergence of powerful ocean currents is largely responsible for the rich flora and fauna of the Philippine waters.

Another thing helping to bring about this richness of marine life at the Philippines is the great range of depth of its waters. The eastern shores lie adjacent to some of the most profound depths in the Pacific Ocean, one point just east of the northern end of Mindanao being the deepest sea abyss yet discovered, 5,350 fathoms, or 32,100 feet, or over 6 miles. On the other hand, the western side is shallow and many of the channels between the islands are extremely so. Thus Manila Bay has an average depth of only 3 to 4 fathoms. This wide diversity of depth, with its attendant range in temperature, salinity, and light, must be responsible to no small degree for the diversity of life, including diatom life at the Philippines.

There is in preparation a report on the diatoms of the Hawaiian Islands, studies for which, though incomplete, reveal the fact that outside of strictly cosmopolitan species, hardly any of the Hawaiian diatoms are represented in the Philippine flora. This probably is accounted for not so much by the distance between them as by the fact that the powerful northern equatorial current flowing westward

across the Pacific passes a little too far south of the Hawaiian Islands to carry away any appreciable amount of its marine flora.

There is no necessity to record in detail the technique used in preparing material for this investigation, beyond the statement that a sufficient number of strewings of each cleaned sample was made by spreading on a microscope slide and drying over a spirit lamp. These were then carefully searched for new forms, which when found were picked up and mounted separately in styrax, Canada balsam, or some other medium. By this method each species is preserved as a single herbarium specimen and, when properly labeled, represents the species recorded here, with none of the uncertainty that always goes with identification based on strewn slides. The labor involved of course is considerable, but the great convenience and accuracy secured fully justify it. No attempt was made to preserve duplicate specimens of species if they were subsequently found in material from other localities. The labor of making these and of preparing a list of species for each one of the many dredgings examined would have been great; and in this case it would have been nearly superfluous, seeing that, as above mentioned, the precise location of each dredging was unknown.

All the new species herein described are represented by their type specimens deposited in the United States National Museum, and the serial number of each one is given at the end of the description. With the exception of four or five specimens all the other species here enumerated and any specially noted varieties are also deposited in the Museum, the few lacking having been on slides made by other diatomists and duplicates of them not having been subsequently found by the author. None of these missing species, however, are rare, and authentic examples of them can be seen in the general diatom collection of the Museum.

A few strictly plankton diatoms are incidently included in this report, but they doubtless represent merely accidental additions to the true flora, the bottom-living diatoms. No plankton samples were available, nor could they have been taken as characteristic of any particular locality. Doubtless the Philippine Islands as a whole have a plankton life differing in a general way from that of far distant places. But as all marine plankton forms are wanderers, swept from one locality to another by sea currents and the surface drift of the waters they inhabit, it is quite idle to report them as belonging to any one locality. American students of plankton diatoms are well aware of how closely the European species correspond to those drifting along our own Atlantic seaboard or even those of the Pacific coast, a parallel conspicuously absent from the diatom floras of the bottom-living species of Europe and America.

It is therefore practically immaterial that a list of the plankton diatoms is not included in this report, as its purpose is to record the truly characteristic diatom flora of the Philippines; that is to say, those species that have their fixed and natural habitat in those waters.

#### SIMILARITY OF CAMPECHE BAY AND PHILIPPINE ISLANDS DIATOM FLORAS

A remarkable fact has been brought out by this study of Philippine Island diatoms, their close similarity to those of Campeche Bay in the Gulf of Mexico. How great this really is can only be conjectured at present, for a thorough study of the Campeche Bay diatoms has never been undertaken. A more extended examination of material from there is much to be desired, so as to see how far this interesting correspondence goes. But even such meager references to Campeche Bay forms as have been met with in Schmidt's Atlas and other publications during these studies have established the fact that many species, and especially many unique varieties, are common to these two localities and rarely if ever found elsewhere. The value of extending this comparison in this particular instance is because there evidently is involved here a certain law or laws of development which, if discovered, will help to explain some curious marine biological puzzles. For we have in these places a case of extreme isolation from each other, and yet a notable similarity in their diatom flora. Not only are they geographically remote, but the vast barrier of North and South America is interposed between them; so that any connection by means of ocean currents is absolutely out of the question. It should be mentioned that the materials were collected before the opening of the Panama Canal, through which, as time goes on, there will take place a slow but steady transference of small forms of animal and plant marine life.

At first it might seem equally strange were certain rare species of diatoms discovered to be common to the shores of Alaska and of the Hawaiian Islands; but such a coincidence would be no parallel to this one. For it could well be explained by assuming that the golden plover, as well as certain ducks, curlews, and other shore birds, known to migrate annually between these two remote places were the carriers responsible for such striking cases of similarity. Or, to take another example, it is now well established that there are currents which bear logs and other drift from northwestern America to the far off shores of the Hawaiian group; and it is believed that some of the old war canoes found on these islands were made from trees not native there, but indigenous to such remote localities as Oregon and the shores of Puget Sound. Here again a satisfying explanation for

any diatom identities that may exist in the two places is supplied; for such ships of passage might, and in fact did, bear as freight hosts of marine animal and plant life from one shore to the other. But so far as is known to science there is no communication, bird or otherwise, between Campeche Bay and the Philippines, or even between Campeche Bay and the Pacific coast; and it is certain no drifting log could make such a journey without rounding the Arctic end of North America or the Antarctic end of South America, and thereby subjecting these subtropical diatoms to the fatal rigors of low temperature. In the matter of diatom transportation, it should also be borne in mind that the difficulties that confront these organisms do not apply to some other marine groups. Thus they must be literally transported from one spot to another, as their limited locomotion consists merely of crawling infinitesimal distances, but not of free swimming; and also the brief life duration of the individual, only a few days at most, prevents its bridging over long-continued adverse conditions during an extensive journey of many thousands of miles. It is pretty sure the Campeche Bay diatoms have not made the trip to the western coast of America by any means whatever, seeing that its characteristic species have never been reported from those regions.

If we try to see in this Campeche Bay-Philippine diatom parallel a case of "discontinuous distribution" the lateness of the appearance of diatoms geologically, hardly as early as the bottom of the Pliocene, would still leave us confronted by the barrier of the American continent, preventing any transportation to the Pacific Ocean; while if we imagine an eastern transportation, the western shores of Africa, the Indian Ocean or the shores of Java, Sumatra, or Celebes would be much more likely to afford us Campeche Bay forms than the Philippine Islands, lying so far east of them. There are indeed many species common to the Philippines and these islands of the East Indies, but they are not Campeche Bay diatoms.

The list of coincidences here given is very incomplete, because it leaves out many species common to both but having little significance, as they are practically cosmopolitan diatoms. And yet if each flora were grouped into a picture and the two compared, these additional forms, not peculiar to the two places but present in both, would greatly increase their resemblance. I think it will be admitted there is a greater significance in the duplication of unique varieties in the two floras than in the duplication of species, because it indicates a peculiarly close and exact correspondence carried out to its minutest degree. In other words, such cases are not merely similar but literally identical. Thus the slight incurving on the dorsal side of *Amphora spectabilis* Gregory which marks the variety figured in Schmidt's Atlas, plate 40, figure 21, from Campeche Bay, is sharply duplicated in my specimen

from the Philippines; the Philippine specimens of *Navicula pelagi* A. Schmidt could be used to reproduce its figure in Schmidt's Atlas, plate 7, figure 26, from Campeche Bay, so accurately does it agree in line and curve and every minute detail. In Schmidt's Atlas, plate 2, figure 20, is an illustration of what I consider to be a very doubtful example of *Navicula approximata* Greville, and which Grunow calls var. *substauroniformis*. This Campeche Bay specimen is so exactly like one I have from the Philippines that the word "identical" is fully justified.

When, therefore, diatom floras from two widely separated places parallel each other in so many minute particulars, the fact suggests that the factors determining these forms must also be strikingly alike; and problems of environmental and perhaps genetic influence are conjured up that well deserve further attention.

### LIST OF CAMPECHE BAY-PHILIPPINE DIATOMS

#### A. FOUND NOWHERE ELSE

- Amphora crassa*, var. *campechiana* Grunow in Schmidt, Atlas, pl. 28, fig. 16.  
*Auliscus caelatus*, var. *latecostata* A. Schmidt in Schmidt, Atlas, pl. 32, figs. 16-20.  
*Biddulphia juncatensis* (Grunow) Mann in Schmidt, Atlas, pl. 76, fig. 13.  
*Campylodiscus muelleri* A. Schmidt in Schmidt, Atlas, pl. 14, fig. 13.  
*Campylodiscus phalangium* A. Schmidt in Schmidt, Atlas, pl. 14, figs. 11-12.  
*Campylodiscus punctulatus* Grunow in Schmidt, Atlas, pl. 17, fig. 4.  
*Campylodiscus triumphans* A. Schmidt, in Schmidt, Atlas, pl. 15, figs. 4-5.  
*Coscinodiscus exiguus* Rattray in Schmidt, Atlas, pl. 58, fig. 30.  
*Mastogloia grundleri* A. Schmidt in Schmidt, Atlas, pl. 188, fig. 26.  
*Navicula approximata*, var. *substauroneiformis* Grunow in Schmidt, Atlas, pl. 2, fig. 20-21.  
*Navicula californica*, var. *campechiana* Grunow in Schmidt, Atlas, pl. 3, fig. 19.  
*Navicula carinifera* Grunow in Schmidt, Atlas, pl. 2, fig. 1.  
*Navicula coarctata* Ehrenberg, var.? in Schmidt, Atlas, pl. 11, figs. 20-21.  
*Navicula formicina* Grunow in Schmidt, Atlas, pl. 160, figs. 38-41.  
*Navicula intercedens* A. Schmidt in Schmidt, Atlas, pl. 160, figs. 3-5.  
*Navicula lacrimans* A. Schmidt in Schmidt, Atlas, pl. 12, figs. 59-60.  
*Navicula margarita* A. Schmidt in Schmidt, Atlas, pl. 174, fig. 17.  
*Navicula multicostata* Grunow, var. in Schmidt, Atlas, pl. 11, fig. 20.  
*Navicula pelagi* A. Schmidt in Schmidt, Atlas, pl. 7, figs. 25-26.  
*Navicula probabilis* A. Schmidt in Schmidt, Atlas, pl. 50, fig. 46.  
*Navicula pudens*, new species, in Schmidt, Atlas, pl. 7, fig. 49 (no name).  
*Navicula serrulata* Grunow in Schmidt, Atlas, pl. 7, figs. 42-43.  
*Navicula splendida* Gregory, var. in Schmidt, Atlas, pl. 69, fig. 22.  
*Navicula splendida* Gregory, var. in Schmidt, Atlas, pl. 69, fig. 15 (misnamed).  
*Nitzschia fluminensis*, var. *majuscula* Grunow in Van Heurck, Synopsis, pl. 62, fig. 5.  
*Nitzschia weissfloggi* Grunow, var. in Peragallo, Diatom. France, pl. 76, fig. 34.  
*Surirella fastuosa* Ehrenberg, var. in Schmidt, Atlas, pl. 5, fig. 11.  
*Surirella fluminensis* Grunow, var. in Schmidt, Atlas, pl. 4, fig. 9.

## B. FOUND ALSO, MORE OR LESS RARELY, IN OTHER LOCALITIES.

- Amphora alata* Peragallo.  
*Amphora crassa* Gregory, typical form.  
*Amphora egregia* Ehrenberg.  
*Amphora exsecta* Grunow.  
*Amphora formosa* Cleve.  
*Amphora furcata* Leuduger-Fortmorel.  
*Amphora fusca* A. Schmidt.  
*Amphora gibba* A. Schmidt.  
*Amphora gigantea* Grunow.  
*Amphora grundleri* Grunow.  
*Amphora inflata* Grunow.  
*Amphora schmidtii* Grunow.  
*Biddulphia antillarum* (Cleve) Boyer.  
*Biddulphia campechiana* (Grunow) Mann.  
*Biddulphia elegans* Greville.  
*Biddulphia pentecrinus* (Ehrenberg) Boyer.  
*Biddulphia scitula* (A. Schmidt) Mann.  
*Campylodiscus adornatus* A. Schmidt.  
*Campylodiscus concinnus*, var. *lineata* Grunow.  
*Campylodiscus rabenhorstianus* Janisch.  
*Campylodiscus rattrayanus* Deby.  
*Cistula lorenziana* Cleve.  
*Climacosphenia moniligera* Ehrenberg.  
*Coscinodiscus nitidulus* Grunow.  
*Coscinodiscus variolatus* Castracane.  
*Cymatoneis sulcata* (Greville) Cleve.  
*Mastogloia rhombus* (Petit) Cleve.  
*Navicula approximata* Grunow.  
*Navicula campylodiscus* Grunow.  
*Navicula chersonensis* Grunow.  
*Navicula diffusa* A. Schmidt.  
*Navicula excavata* Greville.  
*Navicula forcipata*, var. *densistriata* A. Schmidt.  
*Navicula graeffii* Grunow.  
*Navicula hennedyi* W. Smith.  
*Navicula inexacta*, new name.  
*Navicula longa* Gregory.  
*Navicula (marginata) janischii* Castracane.  
*Navicula marginata* Lewis.  
*Navicula puella* A. Schmidt, typical form.  
*Navicula separabilis* A. Schmidt.  
*Navicula weissflogii* A. Schmidt.  
*Nitzschia campechiana* Grunow.  
*Nitzschia distans*, var. *tumescens* Grunow.  
*Nitzschia fluminensis* Grunow, typical form.  
*Nitzschia marginulata*, var. *subconstricta* Grunow.  
*Nitzschia pulcherrima* Kitton.  
*Nitzschia valida* Cleve and Grunow.  
*Nitzschia valida* (var. in Van Heurck, Synopsis, pl. 65, fig. 10).  
*Trigonium cinnamomeum* (Greville) Mann.



## NOMENCLATURE

The nomenclature used in this report is that which has received the general approval of leading diatomists throughout the world. It involves the rejection of a few names, chiefly generic names, which appear earlier in print, but with verbal description or illustration—or in some cases both—so meager and unsatisfactory as to make it a safer plan to treat them as *nomina nuda* than to accept the alternative, to so amend and amplify them that they will be distinctively marked off from other genera subsequently discovered. They comprise chiefly the following: *Hemiptychus* for the universally used *Arachnoidiscus*, *Tripodiscus* for *Aulacodiscus*, *Sphinctocystis* for *Cymatopleura*, *Cystopleura* for *Epithemia*, *Gyrosigma* for *Pleurosigma*, and *Tessella* for *Rhabdonema*. These practically defunct genera were admitted into my Diatoms of the Albatross Voyages, but with misgivings as to the necessity and wisdom of the change, a statement to that effect being made in the introduction. I am glad to here note that this upsetting of classical and long established names on my part has not had the slightest influence on subsequent diatom literature.

While holding to the rigid enforcement of the law of priority in nomenclature in present and future cases, I wish to call attention to the exceptionally disastrous result of its retroactive enforcement in diatom nomenclature. Many of the names above recorded have been in extensive use for a half century or more in scientific literature, outside of technical diatom publications, as well as in popular literature, because of the uses of diatoms as test objects to determine the excellence of optical instruments, together with other uses. Thus *Pleurosigma angulatum* is known to every microscopist or user of optical instruments, and has long been an integral part of literature bearing on applied optics. But nobody has heard of *Gyrosigma thuringicum*, a name applied to the same diatom at a slightly earlier date. And what intensifies the difficulty of justifying such drastic retroactive enforcement of a new rule here is that the great works of diatom taxonomy are rare and so expensive to produce that there is little, if any, chance of new editions ever being published. The identification of ninety-nine hundredths of the 7,000 or more species of diatoms must always be done by means of these classical illustrated publications, as, for example, the works of William Smith, Ehrenberg, Greville, Gregory, Grunow, Schmidt, De Toni, Van Heurek, in all of which these long accepted names are generally used, in preference to the obscure and more or less questionable ones above mentioned.

After many years of diatom study I have come to repose great confidence in the opinions of the late Dr. Henri Van Heurek, because of his wide knowledge and his spirit of conservatism; and in this matter of the above obscure names his position is the same as that already stated.

On another point of nomenclature this report is in accord with Van Heurck, as to P. T. Cleve's plan for dividing the unwieldy genus *Navicula* into a number of genera. He accepts these as useful sub-generic divisions of that huge genus, but considers them to be too difficult of sharp definition to justify their adoption as valid genera. But he does recognize, and I think correctly, three exceptions to the foregoing, *Cistula*, *Cymatoneis*, and *Frustulia*. For the last he favors Brébisson's synonym, *Van Heurckia*, but with this I can not agree. As will be explained under these names, these three seem to be sufficiently unlike other Naviculae to justify their separation.

The general custom among diatomists of capitalizing proper names is not followed in this report, as it conflicts with the rules governing the scientific publications issued by the United States National Museum. The author therefore contents himself with here stating that to him the necessity for such capitalization seems to be at times undeniable; as, for example, *Navicula Liber* W. Smith.

All of the material examined for this report was collected by the steamer *Albatross* of the United States Bureau of Fisheries; and the writer wishes to express here his appreciation of the great service the Bureau of Fisheries has rendered to science, and especially to oceanography, by these and the vast number of other collections it has secured and freely made available to investigators.

As the genera and their species are both arranged in the text in strict alphabetical order, a final alphabetical index is omitted as unnecessary.

## GENERA AND SPECIES, WITH SYSTEMATIC DISCUSSIONS

### Genus ACHNANTHES Bory

#### ACHNANTHES COCCONEIFORMIS, new species

##### Plate 1, fig. 1

Valves broadly elliptical with a barely perceptible angular or prismatic outline; apices pointed; under valve marked with strong, smooth costae slightly radial and straight at the center of the valve, increasingly radial and curved toward the apices; each costa enlarged at the outer marginal end; a narrow stauros reaching to the margin; central area narrow, elliptical, about one-fifth the width of the valve, reaching the apices. The valve figured in Schmidt's Atlas, plate 198, figure 41, unnamed, seems to be the same diatom.

Length 0.079; width 0.033; costae 6 in 0.01 mm.

*Type*.—Cat. No. 43560, U.S.N. M.

#### ACHNANTHES COMPACTA, new species

##### Plate 1, fig. 2

Valves elongated, with evenly rounded ends and parallel sides barely constricted at the center; under valve crossed by double rows of beading separated by costae, as in *A. longipes* Agardh, nearly trans-

verse at the center, increasingly radial toward the ends; a narrow linear transverse stauros, no hyaline median area bordering the rhaphe; upper valve with same beading as under valve.

Length 0.039; width 0.012; 6 double lines in 0.01 mm.

*Type*.—Cat. No. 43561, U.S.N.M.

The shape of this new species is closely similar to that of *A. sub-sessilis* Kützing, which, however, like *A. brevipes* Kützing, has single rows of beads without separating costae. The beading is like *A. longipes*, from which it differs both in outline and in being, despite its small size, a relatively much more massive diatom, with thick, heavy frustules. It is also more coarsely beaded; thus for *A. longipes* with a length of 0.2 mm. we have six double rows in 0.01 mm. (see De Toni, Syl. Alg., p. 470) while here six rows are found on a valve of only 0.039 mm. *A. longipes* occurs in the Philippines and the two are unmistakably distinct. The species is abundant at Jolo Jolo, Sulu Islands. It was not found elsewhere in the Philippine Islands. It, however, occurs at the Laysan Islands, and has an average length of about 0.04 mm.

**ACHNANTHES CRENULATA** Grunow

(Cleve and Grunow, Arct. Diat., p. 20; figure in Le Diatomiste, pl. 9, figs. 3-4.)

The measurements of my specimen are: Length 0.079; width 0.018; 7 lines in 0.01 mm.

**ACHNANTHES HETEROMORPHA** Grunow

(According to Cleve in Schmidt, Atlas, pl. 198, figs. 52-58.)

This might be better classified as *Cocconeis*. Its resemblance to *A. lanceolata* (Brébisson) Grunow may be responsible for placing it under *Achnanthes*. It has no trace of bend in the girdle view in any of the specimens I have examined. It has some likeness to *A. flahaulti* Heribaud (Diat. foss d'Auverg., 1903, pl. 10, figs. 17-18) except for the stauros.

**ACHNANTHES HEXAGONA** Brun and Cleve

(Brun, Espec. Nouv., p. 5, pl. 19, figs. 3a-b.)

**ACHNANTHES INFLATA** (Kützing) Grunow

(Grunow, Reise, F. Novara, p. 98.)

It is Ehrenberg's *A. ventricosa* (1854) (not Kützing, 1844), and is well figured in Ehrenberg's Mikrogeologie (pl. 3, figs. 18-19).

**ACHNANTHES LONGIPES** Agardh

(Smith, Brit. Diat., pl. 36, fig. 300.)

**ACHNANTHES TENUISTAUROS**, new species

Plate 1, figs. 3-6

Valves very broadly fusiform, sometimes very broadly oval; ends acuminate, rounded; under valve with markings of double rows of beading with separating costal lines, strongly radiating; median area

almost absent and with rhaps strongly or obscurely tortuous; transverse stauros sharply distinct but very narrow, not at all flaring toward the ends, which are usually distant from the margins one-quarter the width of the valve. Upper valve as the under one, its median line very narrow.

Length 0.053–0.091; width 0.031–0.047; 9 lines in 0.01 mm.

Species somewhat resembling this are—

*A. baldjikii* (Schmidt's Atlas, pl. 198, figs. 44–48).

*A. danica* Cleve (Schmidt's Atlas, pl. 198, figs. 60–61).

*Navicula vaszaryi* Pantocsek (Hung. Diatom., pt. 3, pl. 16, fig. 239).

*A. exigua* Grunow (Van Heurck, Synopsis, pl. 27, figs. 29–30).

*Achnantheidium danicum* Flogel (Schmidt, Atlas, pl. 198, fig. 50).

*A. javanica* Grunow (Diat. Siam, Oestrup, pl. 1, figs. 15–16).

Its nearest published resemblance is found in the unnamed figure in Schmidt's Atlas, plate 198, figure 49.

*Type*.—Cat. No. 43562, U.S.N.M.

### Genus ACTINOCYCLUS Ehrenberg

#### ACTINOCYCLUS BIPARTITUS, new species

Plate 1, fig. 7

Valve almost flat except near the margin where the convexity is sudden, its surface sharply separated into two areas, an inner sparsely beaded and an outer densely beaded area; the former with about 25 radii of widely spaced beads, with somewhat shorter rows interspaced between them; this inner area, with a diameter of a little over one-half that of the valve, is surrounded by the densely beaded outer area, composed of the extension of the radiating rows of the former plus other interpolated rows; all the rows slightly tortuous; near the margin of the valve the beading becomes compacted into even, closely set rows, the beads progressively smaller; about 25 obscure processes near the margin at the ends of the 25 or more primary radii; pseudonodule minute, evident, close to the margin, surrounded by a small circular hyaline area.

Diameter 0.079 mm.

This species somewhat resembles *A. sparsus* (Gregory) Rattray (Micro. Journ., 1857, pl. 1, fig. 47) and Rattray (Rev. Actinocyclus, p. 170); also *A. punctulatus* Castracane (Chall. Exp., pl. 16, fig. 3) and its variety *A. nebulosus* Peragallo (Diat., France, pl. 113, fig. 11.)

*Type*.—Cat. No. 43563, U.S.N.M.

#### ACTINOCYCLUS CURVATULUS Janisch

(Janisch, Gaz. Exp., pl. 5, fig. 8; Schmidt, Atlas, pl. 57, fig. 31.)

#### ACTINOCYCLUS DECUSSATUS, new species

Plate 2, figs. 1–2

Surface of valve evenly and densely covered with beading radially arranged, but so spaced as to produce the watchcase pattern seen in *Hyalodiscus subtilis* Bailey, etc., and to display forty to fifty of

the radii characteristic of *Actinocyclus*, but very obscurely, or in some specimens apparently lacking; no central hyaline area; beading adjacent to the margin a trifle more compact and slightly smaller than within; center of the valve raised into a low conical elevation one-third to one-quarter the diameter, surrounded by a shallow depressed ring one-sixth to one-eighth the diameter, with the outer area raised to the same focal plane as that of the central cone; pseudonodule large, robust, surrounded by a narrow hyaline space and placed on the extreme outer margin.

Diameter 0.08 to 0.18 mm.

*Type*.—Cat. No. 43564, U.S.N.M.

**ACTINOCYCLUS OBSCURUS** Rattray

(Rattray, Rev. Actinocyclus, p. 187, pl. 11, fig. 5.)

**ACTINOCYCLUS PRUINOSUS** Castracane

(Castracane, Chall. Exp., pl. 4, fig. 2, as defined in Rattray, Rev. Actin., p. 167.)

**ACTINOCYCLUS PUNCTULATUS** Castracane

(Castracane, Chall. Exp., p. 146, pl. 16, fig. 3.)

This is the same as Peragallo's *A. nebulosus* (Diat., France, pl. 113, figs. 10–11.)

**ACTINOCYCLUS ROTULA** Brun

(Brun, Espec. Nouv., p. 6, pl 17, fig. 5.)

Specimens typical according to Brun's figure are frequent; but this species may be only a variety of *A. sparsus* (Gregory) Rattray.

**ACTINOCYCLUS SPLENDENS** Rattray

(Rattray, Rev. Actinocyclus, p. 168, pl. 11, fig. 14.)

**ACTINOCYCLUS STICTODISCUS**

See under *Stictocyclus*, new genus.

**ACTINOCYCLUS SUBTILIS** (Gregory) Ralfs

(Pritchard, Infusoria, p. 835; Van Heurck, Synopsis, pl. 124, fig. 7; H. L. Smith, Types, No. 14.)

**Genus ACTINODISCUS** Greville

**ACTINODISCUS SCHLEINITZII** (Janisch) Mann

(Schmidt, Atlas, pl. 149, fig. 19; Janisch, Gaz. Exp., pl. 20, figs. 18–19.)

Specimens of this diatom were found in several of the Philippine Islands dredgings, but in no case was there present an *Actinoptychus* or other circular diatom to which it could be referred as "an inner valve," to confirm the suggestion of Van Heurck (Treat., p. 501). But the creation of a new genus for this form, as is done by Schmidt (Atlas, pl. 149, fig. 19), where it is named *Gyroptychus contabulatus* A. Schmidt, is quite unnecessary. It should be classed under *Actinodiscus* as defined in Van Heurck's Treatise, p. 497. Compare it

with *A. barbadensis* Greville in Schmidt, Atlas, plate 132, figure 1, and *A. grayii* Grove in Schmidt, Atlas, plate 184, figure 1. Some of my specimens have 9, others 14 divisions. Janisch (Gaz. Exp., pl. 20, figs. 18-19) accurately figures it but calls it *Polymyxus schleinitzii*. *Polymyxus* Bailey, based upon *P. coronalis*, can not be successfully separated from *Aulacodiscus*; but Janisch's specific name, *schleinitzii*, given in 1888 (1889?) antedates that of Schmidt, 1890. However, this can not go over with *Polymyxus* into *Aulacodiscus*, seeing that it has a decided ridge traversing each elevated sector of the circle and ending at the margin in a sessile ocellus, not in a pedicelled horn.

### Genus ACTINOPTYCHUS Ehrenberg

#### ACTINOPTYCHUS ANNULATUS (Wallich) Grunow

(Van Heurck, Treat., p. 495, fig. 237; Micros. Journ., 1856, pl. 12, fig. 15.)

There is reason for looking on this generic classification with dissatisfaction, and several other assignments of this diatom have been made. Wallich's original name was *Triceratium annulatum*. Grunow (Bot. Centralblatt, vol. 15, No. 10, p. 36.), suggested the new generic name, *Cymatogonia*. De Toni (Syl. Alg., p. 1395) proposed the untenable new genus *Schuetzia* and unites this form with the similar *Actinoptychus amblyceros* (Ehrenberg) A. Schmidt, the less similar *Triceratium marylandicum* Brightwell and *T. neogradense* Pantocsek, and the wholly unlike *T. trigonium* A. Schmidt and *Actinoptychus trilingulatus* (Brightwell) Ralfs. On the whole the position taken by Van Heurck, who retains this form in *Actinoptychus*, is the least unsatisfactory one. (See Van Heurck, Treatise, p. 496.)

#### ACTINOPTYCHUS AREOLATUS (Ehrenberg) A. Schmidt

(Schmidt, Atlas, pl. 1, fig. 9.)

It is doubtful if this can be held as a valid species rather than a wide variety of the variable *A. undulatus* (Bailey?) Ralfs. But it is the prevailing form in the Philippine Islands, where it contrasts rather sharply with the typical *A. undulatus*.

#### ACTINOPTYCHUS HEXAGONUS Grunow

(Schmidt, Atlas, pl. 1, figs. 15-17.)

Large and elegant specimens of the truly hexagonal form are not uncommon in the Philippine Islands, as well as a great variety of gradations into strictly circular specimens.

#### ACTINOPTYCHUS HISPIDUS Grunow

(Van Heurck, Synopsis, pl. 123, fig. 2.)

#### ACTINOPTYCHUS JANISCHII Grunow

(Schmidt, Atlas, pl. 153, figs. 8-10.)

## ACTINOPTYCHUS PARVUS, new name

Plate 1, fig. 8

Sector of valves about 12, all evenly pebbled with closely set beading, no superimposed network or anastomosing lines, no hyaline area across outer ends of sectors or between them, and no hyaline line bisecting each sector; a hyaline central rosette about one-eighth the diameter of the valve; a small but evident process at the margin in the middle of each sector; difference in focal plane of alternating sectors slight—that is to say, undulation of valve surface small.

Diameter 0.045–0.059 mm.

*Type*.—Cat. No. 43565, U.S.N.M.

This minute and delicate species, abundant in the Philippine Islands and rather widely distributed elsewhere, seems to have been generally overlooked, probably having been taken for a small variety of *A. splendens*. It is figured in Schmidt, Atlas, plate 132, figure 15, from a specimen from Yokohama, but is misnamed *A. laevigatus* Grunow, a fossil species from Monterey, Calif., which it only slightly resembles. This can be seen by comparing it with Grunow's original figure (Van Heurck, Synopsis, pl. 122, fig. 7). It also is like the intermediate *A. biseptinarius* Ehrenberg in Mikrogeologie, plate 33, section 16, figure 5, one of a long list of names given by Ehrenberg to similar or identical species, basing the distinctions on the unimportant quality of the number of sectors into which the specimens happened to be divided. This entire series of over 100 names is therefore rejected by diatomists.

I incorrectly called a specimen of the present species *A. moelleri* Grunow in my Diatoms of the Albatross Voyages (p. 271). It resembles this, but only in a general way.

## ACTINOPTYCHUS SPLENDENS (Ehrenberg) Shadbolt

(Van Heurck, Synopsis, pl. 119, figs. 1–4; pl. 120, figs. 1–4; Schmidt, Atlas, pl. 153, fig. 16.)

## ACTINOPTYCHUS SUBANGULATUS A. Schmidt

(Schmidt, Atlas, pl. 132, fig. 11.)

Schmidt's figure represents a form with 16 sectors; my specimen has 20 sectors.

## ACTINOPTYCHUS TRILINGULATUS (Brightwell) Ralfs

(Schmidt, Atlas, pl. 1, fig. 20.)

See reference under *A. annulatus* (Wallich) Grunow.

## ACTINOPTYCHUS UNDULATUS (Bailey) Ralfs

(Pritchard, Infusoria, pl. 5, fig. 88; Schmidt, Atlas, pl. 1, figs. 1–6.)

Both the typical form and many varieties of this cosmopolitan diatom were found, including the untenable *A. tenarius* Janisch (Schmidt, Atlas, pl. 1, fig. 2), which in Fricke's Verzeichniss of

Schmidt's Atlas is correctly included here, it being nothing more than an immature valve.

**ALLONITZSCHIA, new genus**

Valve elongated, bilaterally unsymmetrical, tapering to the slightly curved apices, *Nitzschia*-like; its dorsal side straight, ornamented with a closely set row or chain of polygonal divisions forming a heavy border, slightly over one-half the width of the valve and proportionally decreasing in size toward the gracefully tapered apices; ventral side slightly convex, its margin gently undulate, the undulations corresponding to barely perceptible elevations and depressions or waves of the valve surface running across the valve and corresponding in number to the polygonal divisions of the dorsal border; the whole valve, including this border, covered with fine transverse rows of beading.

Side (girdle) view narrow rectangular, the lines or costae of the polygonal dorsal border of the valve here appearing as septal thickenings, thereby having the appearance of crossbars, like those seen in girdle views of *Denticula lauta*, *Epithemia zebra*, etc.

**ALLONITZSCHIA MUNIFICA, new species**

Plate 2, fig. 3

Characters those of the genus. I found but one species and after much searching could obtain only a single specimen; but fortunately this was a complete frustule. Its general appearance is near to that of *Nitzschia*, or to that section of it now generally classed as *Hantzschia*, as the striking row of polygonal divisions forming a border along one edge is on the same side, not the opposite side, of each valve of the frustule.

Length of valve 0.118; widths 0.010; dorsal division 1.4 in 0.01; beaded lines 9 in 0.01 mm.

Found at Jolo Jolo, Sulu Islands.

*Type*.—Cat. No. 43566, U.S.N.M.

**Genus AMPHIPRORA Ehrenberg**

Exclusive of those forms which seem to me rightly to be included by Cleve in his new genus, *Tropidoneis*, which see.

**AMPHIPRORA LIMPIDA, new species**

Plate 3, fig. 1

Valve of characteristic shape, nearly bisected by the middle sinus, the two arched halves having a broad heavy rim along the dorsal side beaded on its lower edge; the inner ventral edge of the valve nearly straight but curving slightly at the ends, and bordered by a heavy



band, crossbarred, with the but slightly curved rhaphe as its upper outline; the two lunate spaces between the rim of the bicurved dorsal side and the broad straight band of the ventral side show faint traces of lines connecting the single row of beads of the former with the crossbars of the latter; the terminal beads of the rhaphe large and at the extreme tips of the valves; central nodule broad but obscure.

Length 0.117, width 0.019 mm.

This delicate species resembles in form, but not in markings, *A. paludosa* W. Smith, typical specimens of which also occur in the Philippine Islands.

*Type*.—Cat. No. 43567, U.S.N.M.

**AMPHIPRORA O'SWALDII** Janisch

Plate 3, fig. 2

(Janisch, Gaz. Exp., pl. 20, figs. 22-24.)

Although there is considerable resemblance between this and the doubtful example of *Nitzschia* which Cleve calls *N. ocellata* (New and Little-Known Diatoms, pl. 4, fig. 47), I take this at least to be a true *Amphiprora*, one of my specimens showing the complex and interlaced girdle of this genus.

**AMPHIPRORA PALUDOSA** W. Smith, var.?

(Smith, Brit. Diat., pl. 31, fig. 269; Van Heurck, Synopsis, pl. 22, fig. 10.)

This diatom in the Philippines varies considerably from its type. In fact, were we to judge from Smith's description on page 44 of the above reference, and especially by the figure there given, which is by the generally accurate artist, Tuffen West, we should be justified in calling the Philippine form a new species. But when we compare with more recent illustrations, such as the one given above by Van Heurck, it is safer to consider the specimen as a variety of Smith's diatom. My specimen measures length 0.169 mm., with 4.5 lines in 0.01 mm., measured midway on the dorsal curves.

**AMPHIPRORA PELAGICA** Brun

(Brun, Espec. Nouv., pl. 23, figs. 3-4.)

**AMPHIPRORA PLICATA** Gregory

(Gregory, Diat., Clyde, pl. 12, fig. 57.)

**AMPHIPRORA TEMPEREI** Cleve

(Le Diat., vol. 1, pl. 2, fig. 3.)

**Genus AMPHORA** Ehrenberg

**AMPHORA ALATA** Peragallo

(Peragallo, Diat., France, pl. 43, figs. 4-5; Schmdit, Atlas, pl. 26, figs. 60-61, no name.)

## AMPHORA ALTERNATA, new species

Plate 3, fig. 3

Dorsal side of valve convex in an even arc; ventral slightly biconvex, constricted in the center; ends broad and rounded, not flexed; rhaps double bow-shaped with a strong central nodule, the ends slightly reflexed; no hyaline area; beading in closely set transverse rows of oval or rectangular beads, the spacing of each row alternating with that of the rows on either side, thus producing a basket-work or brick pattern. A robust, massive diatom.

Length 0.141; width 0.034; 6 lines in 0.01 mm.

*Type*.—Cat. No. 43568, U.S.N.M.

## AMPHORA ANCEPS, new species

Plate 3, fig. 4

Valve broad, the breadth one-half the length; the dorsal side with a deep central indentation, resulting in two pronounced peaks; the apices of the valve produced into two short extensions, contiguous with the ventral side and slightly reflexed at the tips; ventral side nearly straight, barely indented at the center; rhaps close to and parallel with the ventral side; markings rows of elongated beads, the interspaces the same width as the rows, transverse at the center of the valve and increasingly curved outward toward the apices.

Length 0.068–0.090; width 0.024–0.040; 7 lines in 0.01 mm., measured along the ventral side.

There is a general resemblance between this diatom and *A. corpulenta* Cleve and Grove, both in its breadth and in the arrangement of its beading.

*Type*.—Cat. No. 43569, U.S.N.M.

## AMPHORA ANGUSTA Gregory

(Schmidt, Atlas, pl. 25, figs. 8, 14, according to Cleve, Nav. Diat., vol. 2, pp. 135–6.)

I have two specimens which correspond with the above two figures in Schmidt's Atlas. But Cleve has made a painstaking study of *A. angusta* Gregory and *A. cymbelloides* Grunow and writes that Schmidt's two figures represent, not, as there stated, *A. cymbelloides*, but *A. angusta*, which latter, he says, is much more delicately marked. He gives for *A. angusta*, 7 to 17 lines in 0.01 mm. and for *A. cymbelloides* at least 29 lines in 0.01 mm. My specimens have 8.3 and 12.5 lines in 0.01 mm.

## AMPHORA ARCUATA A. Schmidt

(Schmidt, Atlas, pl. 25, figs. 27–29.)

This is not to be confused with the form bearing the same name in Pantocsek (Hung. Diat., vol. 2, 1888, pl. 4, fig. 70). Schmidt's identification has priority, 1875.

**AMPHORA ARENARIA** Donkin

(Peragallo, Diat., France, pl. 48, figs. 11-14.)

**AMPHORA BICONVEXA** Janisch

(Schmidt, Atlas, pl. 25, fig. 68.)

Although Cleve in his *Naviculoid Diatoms* (vol. 2, p. 137) and some other diatomists admit this to specific rank, it is too close to *Amphora bigibba* Grunow.

**AMPHORA CAMELUS** Cleve and Grove

(Le Diat., vol. 1, p. 158, pl. 22, figs. 9-12.)

Curiously, I have selected the name *A. dromas* for this diatom before finding the above illustration—a more descriptive name, as this species has two humps. Measurements of my specimen were, length 0.095; width 0.028; lines 6 in 0.01 mm.

**AMPHORA CLARA** A. Schmidt

(Schmidt, Atlas, pl. 25, fig. 20.)

The type was found in material from the nearby waters of Yokohama.

**AMPHORA CLATHRATA**, new species

Plate 3, fig. 5

Dorsal side of valve slightly convex for most of its length, then rapidly curving toward the blunt rounded ends; ventral side nearly straight, but indented at the center; rhaps adjacent to and parallel with the ventral side; central nodule obscure; no hyaline area; terminal nodules on lower side of the rounded ends elongated and reflexed; markings heavy, closely set, transverse costae extending from the ventral edge to within one-quarter that of the dorsal side, this one-quarter marked with two rows of large oval beads, fewer than the costae.

Length 0.165; width (median) 0.031; costae 5 in 0.01 mm.; dorsal beads 3.2 in 0.01 mm.

This diatom is related to *A. egregia* Ehrenberg, especially as figured in *Diatoms of France*, plate 46, figure 12, and resembles somewhat *A. praevalida* Janisch (Janisch, *Gaz. Exp.*, pl. 20, fig. 21).

*Type*.—Cat. No. 43570, U.S.N.M.

**AMPHORA COMPACTA**, new species

Plate 3, fig. 6

Dorsal side of valve flat for three-quarters of its length or barely reflexed at the middle, curved to the very blunt ends; ventral side slightly biconvex, indented at the middle, the ends having small hyaline "ear lobes" below the ventral edge; rhaps slightly double-

bowed, its central and terminal nodules adjacent to the ventral edge; no hyaline area; markings transverse, very closely set, slightly wavy; costae obscurely cross-striated.

Length, 0.144; width, 0.028; lines, 7.2 in 0.01 mm.

A plump, robust form, simulating some of the insect larvae.

*Type*.—Cat. No. 43571, U.S.N.M.

**AMPHORA CORPULENTA** Cleve and Grove

(Le Diat., vol. 1, p. 68, pl. 10, fig. 14.)

This species is common in the Philippine Islands. The original was found at the not far distant Macassar Straits.

**AMPHORA COSTATA** W. Smith

(Smith, Brit. Diat., pl. 30, fig. 253.)

I do not agree with Cleve's idea of this being like *A. cymbifera* Gregory the same as *A. erebi* Ehrenberg (Mikrogeologie, 35A, pl. 23, fig. 2). This last is practically indeterminate and came from the Arctic, namely, Assistance Bay. Gregory's form is figured in Diatoms of the Clyde, plate 14, figure 97.

**AMPHORA CRASSA** Gregory

(Gregory, Diat., Clyde, p. 524, pl. 14, fig. 94; Schmidt, Atlas, pl. 28, fig. 16.)

Many varieties of this inconstant species were found, including the form peculiar to Campeche Bay and called by Grunow, var. *campechiana*.

**AMPHORA CUCUMERIS**, new species

Plate 3, fig. 7

Valve stout, almost cylindrical, with blunt ends which are only slightly bent toward the ventral (rhaphe) side; convex on the dorsal side, the ventral barely convex or straight except for a shallow sinus at the middle; markings coarse longitudinal rows of heavy beads, six to seven rows, the space between the two median ones wider than between the others, thus producing a longitudinal, median hyaline line; rhaphe in general parallel with the ventral margin. No complete frustule was found; hence the character of the connecting zone is not known.

Length, 0.092; width, 0.026; rows of beading, 3.6 in 0.01 mm.; beads in each row, 3 in 0.01 mm.

This very stout diatom with its valves curiously like the rough cucumber known as the gherkin, belongs to the group of *Amphoras* of which *A. crassa* Gregory is the type. It can not, however, be assigned to any hitherto described species. It is rare in the Philippines.

*Type*.—Cat. No. 43572 U.S.N.M.

## AMPHORA CYMBIFERA Gregory

(Gregory, Diat., Clyde, p. 526, pl. 14, fig. 97; Schmidt, Atlas, pl. 25, figs. 17-19.)

Cleve in his *Naviculoid Diatoms* (vol. 2, p. 122) places this and *A. costata* W. Smith (Smith, Brit. Diat., 1853, pl. 30, fig. 253) under *A. terroris* Ehrenberg (as named in Abh. Berl. Akad., 1853, p. 526, and figured in Ehrenberg, *Mikrogeologie*, 35A, pl. 23, fig. 2, also in Lens, p. 83, pl. 3, fig. 20) and makes a correction in the text of Ehrenberg's *Mikrogeologie*, giving figure 2 instead of figure 3 for *A. terroris* and figure 3 for *A. erebi* Ehrenberg. De Toni, taking the uncorrected figures in the foregoing, unites *A. costata* W. Smith with figure 2, *A. erebi*, but keeps Ehrenberg's *Mikrogeologie*, plate 25A, section 23, figure 3 separate, calling it *A. terroris* (Syl. Alg., pp. 287 and 418). The figure of Gregory and that of W. Smith do not agree, especially in the outline of the valve on its ventral side. It is best to keep these forms separate, as similar but not identical, particularly as H. L. Smith states that he and Professor Gregory have compared notes on the structure of the Gregory specimen and the figure of W. Smith's species and find them to be different. My specimens agree accurately with Gregory's figure and description.

## AMPHORA DEDUCTA A. Schmidt

(Schmidt, Atlas, pl. 25 fig. 13.)

My specimen agrees exactly with the above, but it is doubtful if it can be held separate from *A. angusta* Gregory (Schmidt's Atlas, pl. 25, fig. 14).

## AMPHORA DICHOTOMA, new species

Plate 4, fig 1

Dorsal side of valve strongly convex for three-quarters its length, thence to the broad and blunt ends only slightly so; ventral side strongly concave for three-quarters its length, with an arc parallel to that of the ventral side, then curving upward to the ends; rhaps having its center nodule adjacent to the ventral edge, then curving upward and ending in two strong terminal nodules at the ends and close to the upper, dorsal side; a large hyaline area about the central nodule; marking above the rhaps of coarse but misty, radiating, and curved costae, thicker on the dorsal side and tapering to fine dichotomous ends next to the rhaps; below the rhaps (ventral side) the costa are finer, indistinct, and curved away from the center.

Length, 0.095; width, 0.028; lines, 6 in 0.01 mm., measured on the median dorsal side.

This species belongs to that group of this large genus the type of which is *A. spectabilis* Gregory, especially as figured in *Diatoms of France*, plate 48, figure 8.

*Type*.—Cat. No. 43573, U.S.N.M.

## AMPHORA DURA, new species

Plate 4, fig. 2

Dorsal side with a sharp median indentation in which is a single large bead, the dorsal edge being barely convex to within one-sixth of the ends, then curved smoothly down to the ventral edge; ventral side slightly biconcave; rhaps starting from a strong central nodule, arched upward on both sides and terminating in two large spherical nodules set at the sharp apices of the ends on the central side; an indistinct hyaline stauros across the valve from the dorsal bead to the central nodule; closely set coarse vermiform markings over the entire valve.

Length, 0.124; width, 0.023 mm.; no transverse lines.

Although this form is near *A. obtusa* Gregory, the massive bead on the dorsal side and the constant vermiform markings give it more than varietal rank. It is related to *A. delphinia* Bailey, as figured in Schmidt's Atlas, plate 40, figures 24-27. It is abundant in all Philippine Islands gatherings and is uniform in appearance.

*Type*.—Cat. No. 43574, U.S.N.M.

## AMPHORA EGREGIA Ehrenberg

(Schmidt, Atlas, pl. 28, figs. 13-15.)

All my specimens are of the Campeche Bay variety, as mentioned in the above reference.

## AMPHORA EXSECTA Grunow

(Janisch, Gaz. Exp., pl. 21, fig. 2; Schmidt, Atlas, pl. 27, fig. 55, not fig. 54.)

## AMPHORA FLEXA, new species

Plate 4, fig. 4

Dorsal side of the valve smoothly bent at the middle, barely convex to the narrow ends; ventral side even less strongly concave; ends small, evenly rounded; rhaps close to the ventral edge, slightly double-bowed; a large hyaline central area extending across the valve from the central nodule on the ventral edge to near the dorsal side, where there are short rows of beads; markings of loosely set rows of beads radially arranged, parallel, with interspaces as wide as the rows, none transverse.

Length 0.118; width 0.024; lines 8 in 0.01 mm., measured on the dorsal side.

It bears a slight resemblance to *A. scabriuscula* Cleve and Grove (Le Diat., vol. 2, pl. 3, fig. 7). A variety occurs with the beads somewhat unevenly placed in the different rows, thereby giving a wavy appearance to the marking.

*Type*.—Cat. No. 43575, U.S.N.M.

**AMPHORA FORMOSA** Cleve

(Schmidt, Atlas, pl. 28, fig. 34 and pl. 39, fig. 2.)

**AMPHORA FURCATA** Leuduger-Fortmorel

(Leuduger-Fortmorel, Diat., Ceyl., p. 20, pl. 1, fig. 11; Schmidt, Atlas, pl. 40, figs. 19-23, misnamed.)

This delicate diatom with remarkably forked lines upon the dorsal side, whence its name, is referred by Schmidt to *A. spectabilis* Gregory, which is similar in outline only, as may be seen from his description in Diatoms of the Clyde, page 516, and the figure on plate 13, figure 80.

**AMPHORA FUSCA** A. Schmidt

(Schmidt, Atlas, pl. 27, fig. 68.)

The original was from the Gulf of Mexico.

**AMPHORA GIBBA** A. Schmidt

(Schmidt, Atlas, pl. 39, fig. 32.)

The specimens found were of the Campeche Bay type.

**AMPHORA GIGANTEA** Grunow

(Schmidt, Atlas, pl. 27, fig. 46.)

This is also a Campeche Bay diatom found at the Philippine Islands.

**AMPHORA GRAEFFEI** Grunow

(Schmidt, Atlas, pl. 25, figs. 40, 42.)

**AMPHORA GREVILLEANA** Gregory

(Schimid, Atlas, pl. 25, fig. 41.)

**AMPHORA GRUNDLERI** Grunow

(Schmidt, Atlas, pl. 28, figs. 24-27, and pl. 39, fig. 25.)

The original of this was also from Campeche Bay.

**AMPHORA HENSHAWII**, new species

Plate 3, fig. 8

Dorsal side with a small shallow median sinus, which is otherwise strongly convex to the slightly enlarged rounded ends; ventral side nearly straight, barely concave; rhaps parallel to the ventral edge but removed from it by a narrow hyaline space, not reflexed at the ends; markings of massive, well separated, smooth costae, transverse at the middle of the valve, increasingly radial and slightly curved toward the ends, reaching to the rhaps, but leaving the hyaline band above mentioned along the ventral edge; this edge marked with a single row of fine beads.

Length 0.072; width 0.017; lines 6 in 0.01 mm., measured on the dorsal side.

This species resembles the questionable variety *subconstricta* Grunow of *A. lineata* Gregory, a fresh-water form figured in Diatoms of the Caspian Sea, plate 3, figure 5, but has relatively much coarser markings and blunter ends. The true *A. lineata* is a widely different form, and is given in Diatoms of the Clyde, page 512, plate 12, figure 70. It also slightly resembles *A. philippinica* Castracane (Chall. Exp., pl. 27, fig. 2), which on account of its original locality being identical with that of this form, deserves consideration; but Castracane's species is much narrower, has "apices that are very prolonged, sharp and slightly bent" and "striis transversis perspicuis punctulatis." The two, therefore, can not be confused.

It is named in honor of Mr. Henry W. Henshaw, who found the first specimen.

*Type*.—Cat. No. 43576, U.S.N.M.

**AMPHORA HYALINA Kützing**

(Schmidt, Atlas, pl. 26, figs. 52-55; H. L. Smith, Types, No. 614.)

**AMPHORA INFLATA Grunow**

(Schmidt, Atlas, pl. 25, figs. 29-30.)

The original of this also was from Campeche Bay.

**AMPHORA INTERSECTA A. Schmidt, var.?**

Plate 5, fig. 6

(Schmidt, Atlas, pl. 25, figs. 37-38.)

I give a figure of what may be a coarse variety of the above species. The differences hardly warrant a separate name, but Schmidt's specimens from Baltshick are not only much finer, but also somewhat different on the ventral side. It may be found necessary to rename this more robust form, in which case it could be called *Amphora interrupta*, new species.

**AMPHORA LUNARIS, new species**

Plate 4, fig. 5

Valve lunate, the dorsal side a strongly convex arc, the ventral strongly concave except for a slight convexity at the middle; ends narrow, rounded, barely swollen; rhapshe adjacent to the ventral edge except toward the ends; its two terminal beads touching the margin of the ends; markings of closely set transverse rows of elongated beads, so spaced as to form a tessellated pattern.

Length 0.158; width 0.050; lines 5 in 0.01 mm., measured on the dorsal side.

Resembles slightly *A. virgata* Ostrup (Ostrup, Diat., N. E. Groenland, pl. 13, fig. 12).

*Type*.—Cat. No. 43577, U.S.N.M.



**AMPHORA MAGNIFICA** Greville

Plate 5, fig. 4

(Greville, So. Pac. Diat., p. 575, pl. 4, fig. 1; Lens, pl. 1, fig. 8.)

**AMPHORA MILESIANA** Gregory

(Gregory, Diat., Clyde, p. 49, pl. 5, fig. 83; Lens, pl. 1, fig. 7.)

**AMPHORA MONILIFERA** Gregory

(Gregory, Diat., Clyde, pl. 12, fig. 69.)

**AMPHORA NODOSA**, Brun, variety

Plate 5, fig. 3

(Brun, Espec. Nouv., pl. 12, fig. 2.)

**AMPHORA OBESA** Cleve and Grove

(Le Diat., pl. 22, fig. 8.)

A variety of this diatom was incorrectly named by me *A. honshuensis* Mann, in my Diatoms of the Albatross Voyages, plate 44, figure 1.

**AMPHORA OBTUSA** Gregory

(Mier. Journ., vol. 5, pl. 1, fig. 34; Schmidt, Atlas, pl. 40, figs. 4-7, 11, and 16-17.)

With several varieties, including var. *oceanica* Castracane.

**AMPHORA OCELLATA** Donkin(Mier. Journ., 1861, p. 11, pl. 1, fig. 11*b*; Van Heurek, Synopsis, pl. 1, fig. 26.)

Including the var. *cingulata* Cleve.

**AMPHORA OCLUS** A. Schmidt

(Schmidt, Atlas, pl. 27, fig. 52.)

The type was from the near by Bay of Yokohama.

**AMPHORA OSTREARIA**, var. **VITREA** Cleve

(Peragallo, Diat., France, pl. 49, figs. 14-15.)

**AMPHORA OVALIS** Kützing

(Smith, Brit. Diat., pl. 11, fig. 26; Schmidt, Atlas, pl. 26, figs. 106-111; H. L. Smith, Types, No. 40.)

This generally common diatom is rare in the Philippine Islands.

**AMPHORA PAUCA**, new species

Plate 4, fig. 6

Valve long, narrow, straight, with rounded ends, having obscure "ear lobes" on the ventral side; raphe adjacent to and parallel with the ventral side, its ends only slightly enlarged and barely reflexed; markings of strong, smooth costae, transverse except at the middle

of the valve, where one or two pairs form a V-shaped figure; a hyaline line bisects all the costae; traversing the entire length of the valve.

Length, 0.195; width, 0.023; lines, 4.1 in 0.01 mm.

The nearest known forms are in Schmidt's Atlas, plate 28, figure 17, and plate 39, figure 27, both unnamed.

*Type*.—Cat. No. 43578, U.S.N.M.

**AMPHORA PECTEN** Brébisson

(Brun, *Espec. Nouv.*, pl. 12, fig. 4.)

**AMPHORA PERMAGNA** Pantocsek

(Pantocsek, *Hung. Diat.*, vol. 2, pl. 6, fig. 113.)

**AMPHORA POLYGONATA** Castracane

(Castracane, *Chall. Exp.*, pl. 27, fig. 8.)

This form can not be admitted to be a variety of Castracane's *A. polygonata* (figured in *Chall. Exp.*, pl. 27, fig. 8) if that author's descriptions and figures are to be trusted; in which case, this form agreeing with his figure 8 should have a new name.

**AMPHORA PRAEVALIDA** Janisch

(Janisch, *Gaz. Exp.*, pl. 20, fig. 21.)

Cleve (*Nav. Diat.*, vol. 2, p. 110) places this under *A. pecten* Brun, a very much coarser and altogether different diatom (figured and described in Brun, *Espec. Nouv.*, p. 9, pl. 12, fig. 4). I have both from the Philippine Islands and their union is impossible. This species is much closer to *A. scalaris* Castracane (*Chall. Exp.*, p. 18, pl. 27, fig. 19) from which it differs only by the heavy border on the ventral side of the latter.

**AMPHORA PRISMATICA** Cleve

(Cleve, *Nav. Diat.*, vol. 2, pl. 4, fig. 26.)

**AMPHORA PROTEUS** Gregory

(Gregory, *Diat.*, Clyde, p. 518, pl. 13, fig. 81; Schmidt, *Atlas*, pl. 27, figs. 2-3, 5-6.)

**AMPHORA PULCHRA** Greville

Plate 5, fig. 1

(Greville, *So. Pac. Diat.*, p. 575, pl. 4, fig. 2; Cleve, *Nav. Diat.*, vol. 1, p. 20, pl. 2, fig. 23.)

This diatom is placed erroneously in the genus *Auricula* by Cleve in the above reference. This error is doubtless due to not studying the face view, of which there seems to be no illustration, and for which one is here supplied. It will be seen at once that this belongs where Greville placed it, in the genus *Amphora*. Indeed, the girdle view looks more like *Amphiprora* than like *Auricula*.

**AMPHORA RECESSA**, new species

Plate 5, fig. 2

Dorsal side of valve slightly and evenly convex, ventral slightly biconcave; ends narrow, rounded; rhabhe double-bowed, generally parallel to the ventral edge, its outer ends thickened but without beads and not reflected; markings of fine closely set moniliform costae along the dorsal side, but leaving a hyaline space of equal width along the ventral side, except at the middle, where a wedge-shaped extension reaches nearly to the central nodule; girdle (back) marked with two to three very delicate longitudinal, widely separated lines of beading.

Length, 0.155; width, 0.020; width of frustrule, 0.056; lines, 9 in 0.01 mm.

This delicate species belongs in the *A. proteus* group. It has some resemblance to one shown in Schmidt's Atlas, plate 27, figure 37, and plate 27, figure 65, two varieties of *A. pellucida* Gregory.

*Type*.—Cat. No. 43579, U.S.N.M.

**AMPHORA RECTANGULARIS** Greville

(Greville, So. Pac. Diat., pl. 2, fig. 10.)

**AMPHORA RHOMBICA** Kitton

(Schmidt, Atlas, pl. 40, fig. 39.)

**AMPHORA SCHMIDTII** Grunow

(Schmidt, Atlas, pl. 28, fig. 3.)

The original of this species was from Campeche Bay.

**AMPHORA SIMA**, new species

Plate 5, fig. 5

Valve plump, massive, smoothly convex on dorsal side and biconvex on the ventral side; ends blunt, reflexed, flattened; rhabhe closely adjacent to the ventral edge; markings of heavy transverse costae without cross-striation, but having a single bead in the middle of each costa, the beads thereby forming a median line bisecting the valve longitudinally.

Length, 0.195; width, 0.043; lines, 3.5–4 in 0.01 mm.

*Type*.—Cat. No. 43580, U.S.N.M.

*A. labuensis* Cleve (Vega Diat., p. 493, pl. 35, fig. 1*b*) is a close relative of this, but its costae are striated, and lack the median row of beads, the ends also are not flattened and reflexed like the present species. There is some relation between it and *A. areolata* Grunow (Le<sup>3</sup>Diat., pl. 22, figs. 1–4).

## AMPHORA TUMULIFER, new name

Plate 4, fig. 3

Valve elongated, massive, dorsal side consisting of six strong sinuations; ends blunt and rounded, not incurved; ventral side double-bowed, with a shallow depression at the center; markings of coarse, transverse, somewhat wavy, moniliform lines, extending from the dorsal side across the rhapshe to the ventral side; the rhapshe approaching the ventral side at the center and ends, each half slightly bowed upward toward the dorsal side.

Length, 0.065; width, 0.016; lines, 10.3 in 0.01 mm.

This diatom is well illustrated in Schmidt's Atlas, plate 25, figure 80, but is misnamed *A. sarniensis* Greville, with however a question mark. It can not be united with that species (see the original in Micro. Journ., 1862, pl. 9, fig. 12, a figure well reproduced in Schmidt's Atlas, pl. 25, fig. 73). Fricke's Index repeats this name, but also questions it. Cleve (Nav. Diat., vol. 1, p. 120) unites this with figures 78-79 of Schmidt's Atlas, same plate, making it a new species, *A. tetragibba* Cleve, an impossible combination. De Toni (Syl. Alg., p. 394) prefers to join figures 78-79 with *A. sinuata* Greville, which is at least admissible. (See also Greville, So. Pac. Diat., pl. 2, fig. 5, and H. L. Smith, Lens, p. 81, pl. 3, fig. 8.) *A. sinuata* has a straight rhapshe about equidistant from the ventral and dorsal side, different ends and no such coarse lines as this species. H. L. Smith writes that they are "obscure." *A. dorsalis* Cleve and Grove (Le Diat., vol. 1, pl. 32, fig. 15) resembles this species slightly, but the description (p. 158) shows that the resemblance is only superficial. Its nearest relative seems to be *A. camelus* Cleve and Grove, when seen in the position shown in Le Diatomiste, volume 1, plate 22, figure 12.

## AMPHORA TURGIDA Gregory

(Gregory, Diat. Clyde, pl. 12, fig. 63; Schmidt, Atlas, pl. 25, figs. 22-23, 27-28, 31.)

## AMPHORA WEISSFLOGII A. Schmidt

(Schmidt, Atlas, pl. 25, figs. 58-59.)

## Genus ANISODISCUS Grunow

## ANISODISCUS ADEEI, new species

Plate 6, fig. 1

Valve circular, nearly flat; a central circular hyaline area, about one-third the radius, surrounded by an area of slightly greater width, ornamented by beads widely set apart with equal spacing, but presenting only an indistinct radial arrangement; this in turn surrounded by an outer area, about one-half the radius, ornamented with 18 to 24 radiating rows of double beads; interpolated between these near

the margin an equal number of shorter rows of double beads, 6 to 7 pairs of beads in length, alternating with the long double rows; adjacent to the margin 18 to 24 small but evident semicircular processes, in some specimens at the ends of the long radiating rows; in others at the ends of the shorter interpolated rows.

Diameter 0.056 to 0.086 mm.

This beautiful diatom owes its delicate appearance to the fineness of its beading and the artistic lace open-work pattern of its arrangement. I have named it in honor of the late Hon. Alvey A. Adee, Assistant Secretary of State, whose skill as a photographer of the diatoms was of exceptional quality.

The species clearly belongs with *Stictodiscus kossuthii* Pantocsek (Hung. Diat., vol. 3, pl. 26, fig. 395) and *Actinodiscus horologium* Brun (Le Diat., pl. 23, fig. 13). But no *Stictodiscus* has the terminal semicircular elevations of the Pantocsek form, and *Actinodiscus* is especially distinguished by sharp radiating ridges, terminating at the margin in ocelli or pseudonodes; so that both of these assignments are untenable. My specimens are especially unlike *Stictodiscus* in not being evenly convex. As no complete frustule was found, the dissimilarity of the two valves, referred to in the generic name, could not be noted. But as several specimens were found showing variation in the radiating lines of beads, this characteristic may be assumed to belong to the present species.

*Type*.—Cat. No. 43581, U.S.N.M.

#### Genus ARACHNOIDISCUS Ehrenberg

##### ARACHNOIDISCUS EHRENBERRGH Bailey

(Smith's Brit. Diat., pl. 31, fig. 256; Schmidt, Atlas, pl. 68, fig. 1.)

#### Genus ASTEROLAMPRA Ehrenberg

##### ASTEROLAMPRA MARYLANDICA Greville

(Micro. Journ., 1860, pl. 2, figs. 14–15; pl. 3, figs. 1–4.)

##### ASTEROLAMPRA PRINCEPS Rattray

(Rattray, Rev. Cosc., p. 644; Castracane, Chall. Exp., pl. 5, fig. 5.)

My specimen has a diameter of 0.141 mm., and 26 rays.

##### ASTEROLAMPRA VAN HUERCKII Brun

(Brun, Espec. Nouv., p. 10, pl. 14, fig. 1.)

A typical specimen of this large and delicate diatom.

#### Genus ASTEROMPHALUS Ehrenberg

##### ASTEROMPHALUS ARACHNE (Brébisson) Ralfs

(Pritchard, Inf., pl. 5, fig. 66; Schmidt, Atlas, pl. 38, figs. 3–4.)

## ASTEROMPHALUS AREOLATUS, new species

Plate 6, fig. 5

Valve slightly oval, the long axis coincident with the single dissimilar radial arm. Seven arms in all, six of them broad, tapering to the margin, with a very minute process at the marginal end, separated by zig zag partitions where they join to form the central area, which is one-third the diameter of the valve; the dissimilar arm very narrow with a large process at its marginal end, its club-shaped inner end passing beyond the center of the valve; beading very coarse, not reticulated, the beads well separated, those bordering the arms larger than the others, two to three beads wide at the inner end and six to seven at the marginal end of each sector.

Long diameter, 0.045 mm.

This minute species has a general likeness to *A. reticulatus* Cleve (Diat. Java, p. 5, pl. 1, fig. 2). It is, however, not reticulated, its arms are dissimilar in shape and do not stop short of the margin but touch it, where there are small but evident processes at the tips, apparently lacking in Cleve's form. It is closer to the unnamed figure in Schmidt's Atlas, plate 38, figure 9, one specimen found being identical with that figure. It is not rare in the Philippine Islands dredgings, but its minuteness and delicacy make it difficult to find. Less similar is *A. robustus* Castracane (Accad. Pont. Nuovi Lincei, 1875, pl. 6, fig. 5).

*Type*.—Cat. No. 43582, U.S.N.M.

## ASTEROMPHALUS BEAUMONTHI Ehrenberg

(Schmidt, Atlas, pl. 38, figs. 6-7, misnamed. Fricke's index, p. 15.)

The correct name is indicated by the opinion, cited in the above, by Janisch. (See Mann, Diat. Alb. Voyages, p. 274.)

## ASTEROMPHALUS BROOKEI Bailey

(Amer. Journ. Sci., 1856, p. 2, pl. 1, fig. 1; Schmidt, Atlas, pl. 38, figs. 21-23.)

## ASTEROMPHALUS ELEGANS Greville

(Quart. Journ. Micro. Sci., 1859, pl. 7, fig. 6; Schmidt, Atlas, pl. 38, figs. 1-2.)

## ASTEROMPHALUS HILTONIANUS (Greville) Ralfs

(Rattray, Rev. Cosc., p. 213; H. L. Smith, Types, No. 49.)

## ASTEROMPHALUS RETICULATUS Cleve

(Cleve, Java Diat., p. 5, pl. 1, fig. 2.)

## ASTEROMPHALUS ROPERIANUS (Greville) Ralfs

(Schmidt, Atlas, pl. 38, fig. 15; Micro. Journ., 1860, pl. 4, fig. 14.)

## Genus AULACODISCUS Ehrenberg

## AULACODISCUS KINKERI A. Schmidt

(Schmidt, Atlas, pl. 106, figs. 4-5.)

It is very questionable if Rattray's uniting this as a variety with *A. margaritaceus* Ralfs is an advantage (see Rattray, Rev. Aulaco., p. 352).

## AULACODISCUS MACRAEANUS Greville

(Micro. Journ., 1862, pl. 2, fig. 4; Schmidt, Atlas, pl. 104, fig. 2.)

## AULACODISCUS MARGARITACEUS Ralfs

(Schmidt, Atlas, pl. 37, figs. 4-5; pl. 104, figs. 7-8; pl. 105, figs. 1, 2, 4.)

## AULACODISCUS ORIENTALIS Greville

(Micro. Journ., 1864, pl. 2, fig. 6; Schmidt, Atlas, pl. 34, figs. 1, 3.)

Although the type of this species is clearly different from *A. oregonus* Harvey and Bailey, a perfect series of intermediate forms bridges the gap between the two.

## AULACODISCUS PRETIOSUS, new species

Plate 6, fig. 2

Valve circular, having a round hyaline central area from which proceed about 11 radial lines bordered by single rows of fine, closely set beads; each hyaline line broadening at the margin into a small circular space, in the center of which is placed a minute sessile hemispheriod process; the rows of beading between the radii generally parallel to within one-third of the margin, then converging toward the central row; the short secondary rows are suddenly multiplied around the outer one-quarter of the radius of the valve, the beading being smaller as it becomes more crowded, so that the outer one-quarter appears as an external band; the center of every bead is marked by a minute dot or prickle; the surface of the valve is nearly flat, the central part barely depressed, and the areas between the eleven marginal processes only slightly concave.

Diameter, 0.129 mm.

The nearest species are those shown in Schmidt's Atlas (pl. 107, fig. 6) *A. oregonus*, var. *sparsus-punctata* Grunow and (pl. 107, figs. 5-6) *A. voluta coeli* Brun.

*Type*.—Cat. No. 43583, U.S.N.M.

## AULACODISCUS RECEDENS, new species

Plate 6, fig. 3

Valve circular, flat to within one-fifth of the margin, thence curving rapidly downward; a hyaline central area one-sixth the radius in diameter, from which proceed eight broad, hyaline radii to within

one-fifth of the margin, where they slightly expand around eight strong, round, slightly protuberant processes; the rows of large, widely spaced beads bordering the eight radii are perfectly straight, the other rows in each of the eight sectors being parallel to the median row; no crowding of beads toward the margin.

Diameter, 0.070 mm.

The large, widely spaced beading of this species, its flat surface surrounded by a rapidly depressed outer band, and the strongly recessed circle of processes give to it a unique appearance.

It resembles somewhat *A. amoenus* Greville (Schmidt, Atlas, pl. 34, fig. 6) and more closely the unnamed figure in Schmidt's Atlas, plate 133, figure 7.

*Type*.—Cat. No. 43584, U.S.N.M.

### Genus *AULISCUS* Ehrenberg

#### *AULISCUS CAELATUS* Bailey

(Smith. Contrib., 1854, p. 6, figs. 3-4; Schmidt, Atlas, pl. 32, figs. 14-15)

The type form and a large number of varieties were found including var. *delicatula* Rattray (Rev. *Auliscus*, p. 886, pl. 15, fig. 5) and var. *latecostata* A. Schmidt, (Atlas, pl. 32, figs. 16-20) the latter being a Campeche Bay form.

#### *AULISCUS COMPOSITUS* A. Schmidt

(Schmidt, Atlas, pl. 30, fig. 9.)

#### *AULISCUS PHILIPPINARUM*, new species

Plate 6, fig. 4

Valve slightly oval, long axis passing slightly to the left and right of the two processes; central hyaline area large, somewhat rectangular; two processes (ocelli) of moderate size, strongly ringed, tilted obliquely outward, set close to the margin on two wedge-shaped elevations, which are coarsely rugose with irregular-shaped beads; the rest of the valve ornamented loosely with curved strings of heavy beading radiating from two club-shaped areas which extend from the central area right and left to within a short distance of the margin; valve and all markings massive and glistening.

Long diameter, 0.082-0.159.

This spectacular diatom is abundant in the Philippines. It is very nearly the same as one figured in *Le Diatomiste* (p. 2, pl. 2, figs. 4-5) but misnamed *A. oamaruensis*, var. *madagascarensis* Tempère and Brun. It has some resemblance to *A. hardmanianus* Greville, including the fossil form from Monterey, Calif., and especially as it is figured in Schmidt's Atlas, plate 89, figure 4, from a Santa Monica, Calif., specimen, also fossil. But to unite this clearly distinct and constant form with either of the above fossil species would be unwise.

*Type*.—Cat. No. 43585, U.S.N.M.



**AULISCUS QUADRATUS**, new species

Plate 7, figs. 1-2

Valve slightly oval, its long axis about  $45^\circ$  right and left from the two ocelli; these large, sessile, with elevated and rugose centers; the entire valve, except a small hyaline circular central area, covered with a network of anastomosing lines, but in a large square occupying the middle of the valve these lines are either obscure or sometimes absent, so that this square is sharply defined from the rest of the valve.

Diameter, 0.101-0.107 mm.

*Type*.—Cat. No. 43586, U.S.N.M.**AULISCUS RETICULATUS** Greville

(Micro. Journ., 1863, pl. 2, fig. 4; Schmidt, Atlas, pl. 30, figs. 1-3.)

**AULISCUS SCHMIDTII** Grundler

(Schmidt, Atlas, pl. 30, fig. 7.)

**AULISCUS STOCKHARDTII** Janisch

(Janisch, Guanos., pl. 1, fig. 4; Schmidt, Atlas, pl. 30, figs. 11-13; pl. 67, fig. 6.)

This species occurs in a large number of fossil deposits that are widely separated, New Zealand, California, Hungary, Bolivia, etc., but is rare as a living form. It may be looked upon as a hold over.

**Genus AURICULA** Castracane**AURICULA INSECTA** Grunow

(Schmidt, Atlas, pl. 40, figs. 2-3.)

**AURICULA JAPONICA** Brun

(Brun, Diat. Jap., pl. 4, fig. 8.)

**AURICULA OSTREA** Brun

(Brun, Diat. Jap., pl. 4, fig. 7.)

**Genus BIDDULPHIA** Gray**BIDDULPHIA ABJECTA**, new species

Plate 7, figs. 3-4.

Valve triangular, with slightly concave sides; apices ending in blunt subsessile rings; a few scattered beads, closely but irregularly set, form a curved line crossing each of the angles; the middle part of the valve quite hyaline, except for a few coarse blotches along the sides; these curve downward to form the deep triangular half box which, united with the corresponding other half by the girdle, makes the

frustule. In side (girdle) view the three apices are seen to be very blunt, with a hemispherical end, back of which is the curved line of irregular beads above mentioned. The outer part of the apices running vertically down from the three processes to the girdle are buttressed by a slight fold or extension of the valve; the vertical sides of the valve (between the three apices) are scantily marked with small irregular beads or blotches.

Diameter 0.0612 mm., depth of valve (face to girdle line) 0.030 mm.

*Type*.—Cat. No. 43587, U.S.N.M.

**BIDDULPHIA ANTILLARUM (Cleve) Boyer**

(Cleve, *Diat.*, W.I., pl. 5, fig. 29; Schmidt, *Atlas*, pl. 99, fig. 14.)

De Toni resurrects for this and a few other unmistakable *Biddulphiae* Ehrenberg's impossible genus, *Amphipentas*, stressing the accidental five-angled form of some individuals that differ in no other respect from those in the same gathering having three or four angles, a process that reduces the concept, species, to an absurdity. Some examples, besides the above, are his *A. quinquelobata*, *A. godeffroyi*, *A. campechiana*, and the unimportant variety of *Trigonium arcticum* (Brightwell) Cleve, which is called *Triceratium cyclamen* Brun in Schmidt's *Atlas* (pl. 165, fig. 5). (See De Toni, *Syl. Alg.*, p. 910.)

**BIDDULPHIA AURITA (Lyngbye) Brébisson**

(Smith, *Brit. Diat.*, pl. 45, fig. 319; Van Heurck, *Synopsis*, pl. 98, figs. 4-9.)

A number of varieties of this inconstant and prolific species was found.

**BIDDULPHIA BALAENA (Ehrenberg) Brightwell**

See *Trigonium balaena* (Ehrenberg) Cleve.

**BIDDULPHIA BALEARICA (Cleve and Grunow) Mann**

(Cleve, *New and Little Known Diatoms*, pl. 6, fig. 73; Schmidt, *Atlas*, pl. 97, figs. 20, 21.)

The *reductio ad absurdum* of De Toni's assignments of certain forms to "*Amphipentas*," mentioned under *B. antillarum* above, is his placing two figures of this species (Schmidt, *Atlas*, pl. 98, fig. 20) in *Amphitetras* and (pl. 98, fig. 21) in *Amphipentas*.

**BIDDULPHIA BICORNIS Cleve**

See under *B. dubia* (Brightwell) Cleve

**BIDDULPHIA BIROSTRUM Brun**

(Brun, *Espec. Nouv.*, p. 11, pl. 12, fig. 10.)

This has rather close resemblance to *B. aurita*

**BIDDULPHIA BROECKII** (Leuduger-Fortmorel) Mann

(Schmidt, Atlas, pl. 82, figs. 10, 12, 13.)

The spelling of the specific name *broeckii* by Schmidt is incorrect.

**BIDDULPHIA CAMPECHIANA** (Grunow) Boyer

(Cleve, Diat., W. I., p. 16, pl. 5, fig. 28.)

As the name indicates, this is another Campeche Bay species.

**BIDDULPHIA CASTELLIFERA** (Grunow) Mann

(Schmidt, Atlas, pl. 128, figs. 8, 17-18.)

**BIDDULPHIA CINGULATA**, new species

Plate 7, figs. 5-6

Valve broadly elliptical with pointed ends; the rim (the margin which joins the girdle of the frustule) is undulating, and marked with delicate, widely separated cross lines; the central part of the valve, raised above the rim, is ornamented with orderly rows of beads running longitudinally but converging toward the bases of the two horns that arise at the ends of this elevated central part of the valve; a broad band bounded by a delicate hyaline line crosses the valve transversely, with a strong erect spine set near each end of it, a fine hyaline line connects the two spines and thus bisects the band; in side (or girdle) view each valve shows two very long outwardly curving hyaline horns, their globular ends bent outward; the undulating rim extends beyond the rest of the valve, which is separated from it by a narrow hyaline space and is rounded out on each side into two "cheeks." In some specimens the beading is sparsely sprinkled with fine prickles, best seen in side view. The girdle is narrow and covered with closely set rows of transverse beading.

Length of valve (including rim), 0.082 to 0.169 mm.; width, 0.056 to 0.135 mm.; height of frustule, with horns, 0.110 mm.

*Type*.—Cat. No. 43588, U.S.N.M.

**BIDDULPHIA CONCAVA**, new name

(Schmidt, Atlas, pl. 84, fig. 17, misnamed.)

This evident *Biddulphia* is well illustrated in the above reference, where it bears the name *Triceratium japonicum* A. Schmidt. Its transfer to *Biddulphia* with that specific name is impossible because of *B. japonica* Castracane (Challenger Exp., pl. 23, fig. 14) *Triceratium concavum* Bailey (Wilkes Exp., pl. 9, figs. 24-26) not being a true *Biddulphia*, but belonging to the genus *Trigonium*, would not affect the validity of the above name. This species has a merely general resemblance to *Biddulphia* (*Triceratium*) *scitula* (Brightwell). Schmidt's specimen came from the not far distant Yokohama, Japan.

## BIDDULPHIA CONSIMILIS (Grunow) Boyer

(Van Huereck, Synopsis, pl. 108, fig. 2; Schmidt, Atlas, pl. 84, figs. 13-14, and pl. 84, fig. 17, misnamed.)

The only locality hitherto reported for this species is the fossil deposit at Santa Monica, Calif. The finding therefore of several unmistakable specimens in Philippine Islands dredgings is interesting.

## BIDDULPHIA CORNIGERA, new species

Plate 8, fig. 2

Valve seen in face view broadly elliptical with pointed ends forming an obtuse angle, in which, close to the apices, arise two long horns; a circular or slighty oval central area represents about four-fifths to five-sixths of the surface of the valve and is slightly elevated above the part surrounding it, the line of separation being armed with an indefinite number of stout spines irregularly placed, sometimes grouped on one side, generally scattered along opposite sides; the rest of the valve thickly covered with short prickles; in side (or girdle) view the two long horns are seen to be divergent and to have enlarged bulbous ends, slightly pointed on the inner side; the rim (joining the girdle) is broad, hyaline, and extends beyond the sides of the valve; the girdle is covered with a fine rugose marking.

Length of valve, 0.046-0.124; width; 0.028-0.106 height of frustule; 0.073-0.096 mm.

The question of the identity of this species and *B. expedita* Janisch is an interesting but unsolvable one. Certain small specimens with wide girdles appear, if viewed obliquely, exactly like the sketchy figure of *B. expedita* given in his Diatoms of the Gazelle Expedition, plate 21, figure 7, and reproduced in Schmidt's Atlas plate 121 figure 3. But with no description, no direct side (girdle) view, and no knowledge of the shape and markings of the valves it is idle to attempt any conclusion. All diatomists know that two species of *Biddulphia* may closely resemble each other in one view and yet show marked distinctions in the other view. In fact certain frustules of the widely different diatom, *B. cingulata*, when slightly turned and seen in the girdle view, are equally like the crude figure of *B. expedita*.

It is most desirable, whenever possible, to have both the face and side views of the *Biddulphiae*. I am compelled to ignore the *B. expedita* of Jansich as indeterminate. This species is abundant in many of the Philippine dredgings. In valve view it somewhat resembles the fossil *B. oamaruensis* Grove and Sturt (Oamaru, Diat., p. 5, pl. 1, fig. 10).

Type—Cat. No. 43589, U.S.N. M.

**BIDDULPHIA CORNUTA** (Greville) Mann

(Micro. Journ., 1861, pl. 8, fig. 8; Van Heurck, Synopsis, pl. 108, figs. 12-13.)

**BIDDUPLHIA CULCITELLA** Mann

(Mann, Diat., Alb. Voyages, p. 300, pl. 46, fig. 3.

**BIDDULPHIA CUSPIDATA** (Janisch) Mann

(Schmidt, Atlas, pl. 84, figs. 2-3.)

The side (girdle) view of this species shows that the valve is flat, not convex, and that the areolation extends through the border. It can not be united with *B. favus* (Ehrenberg) Van Heurck, as is done by Boyer (Bidd. Forms, p. 706).

**BIDDULPHIA CYCLOIDES**, new species

Plate 8, fig. 1

Valve subcylindrical, with eight protruding processes, giving it an octagonal outline; surface slightly and evenly convex to the vertical sides, covered with radiating rows of beading, the beads scattered in the central part, becoming closer and more truly set in rows toward the margin; the eight processes blunt, nearly sessile, protruding beyond the margin; in side view the convex valve is seen to drop vertically down to the rim, the depth of the valve being somewhat less than one-third its diameter.

Diameter, 0.057 to 0.099 mm.; Depth of latter, 0.031 mm.

Although this diatom is not infrequent in Philippine dredgings no complete frustule was found and therefore the girdle can not be described.

The only published species at all similar to this is *Triceratium forresterii* Pantocsek (Le Diat., vol. 1, pl. 1, fig. 2). But this lacks the *Cerataulus* like horns at the angles and is not evenly convex. There is a slight similarity to be seen in *Cerataulus rotundus* Tempère and Brun (Le Diat., vol. 1, pl. 5, fig. 3).

*Type*.—Cat. No. 43590, U.S.N.M.

**BIDDULPHIA DISCURSA**, new species

Plate 8, fig. 3

Valve triangular, each side slightly distended until near the acute apices; central portion of valve convexly elevated; horns narrow, their basal portion dotted, not enlarged at the end; areolation a hexagonal network, somewhat crowded and irregular in the middle of the valve, becoming slightly larger toward the sides and regularly arranged in rows not radial but parallel to the sides, the outside row elongated toward the margin but not angled where its areolations touch the margin; this margin or rim is cross-marked with bars that are enlarged into beads at their outer ends; the secondary markings

beneath the network consist of closely set beading in strictly radial arrangement; a single small but evident spine in the center of each hexagon. The name refers to the laterally parallel rows of the network contrasted with the radially arranged rows of the beading.

Diameter (from apex to middle of opposite side) 0.25 mm.; diameter of hexagons (average), 0.007 mm.; rows of beading (average), 13 in 0.01 mm.

This *B. favus*-like diatom has some resemblance to two other forms, *B. (Triceratium) broeckii* Leuduger-Fortmorel (Schmidt, Atlas, pl. 82, figs. 10, 12) and *B. (Triceratium) scitulum* Brightwell (Micro. Journ., 1854, pl. 4, fig. 9).

*Type*.—Cat. No. 43591, U.S.N.M.

**BIDDULPHIA DISTINCTA (Janisch) Mann**

(Schmidt, Atlas, pl. 83, fig. 1.)

**BIDDULPHIA DUBIA (Brightwell) Cleve**

(Micro. Journ., 1859, pl. 9, fig. 12; Schmidt, Atlas, pl. 78, figs. 32-35.)

I include with this Cleve's *Triceratium bicornis* (Schmidt, Atlas, pl. 78, figs. 24-25). The species has also close affinities with *Biddulphia reticulata* Roper, which almost justify their union.

**BIDDULPHIA EXACTA, new species**

Plate 9, fig. 1

Valve triangular, side slightly convex, apices not produced; processes nearly sessile, tilted outward; the entire surface covered with a large, strong-walled, hexagonal network arranged in exactly straight lines perpendicular to the three sides, the areolation only slightly smaller toward the margin; beneath the areolation are secondary markings of extremely minute beads, obscurely, if at all, radial in arrangement; a sharp slightly curved spine in the center of each hexagon; in side (or girdle) view the top of the valve is seen to be flat and closely set with the above-mentioned spines, the three horns protruding at an angle of 45° and the sides below these being recessed; the rim (adjacent to the girdle) extends beyond the tips of the horns: the girdle is broad and entirely covered with close beading, arranged in quincunx order.

This side view of the entire frustule is accurately figured in Schmidt, Atlas, plate 87, figure 6, and it is a proof of the keen observation of that author that he suspects this evidently solitary specimen brought to his attention to be a new species, but refrains from naming it. His specimen is marked as coming from the near-by North Celibes. In the Philippine Islands it seems also to be rare.

Diameter (apex to middle of opposite side) 0.144 mm.; height of frustule 0.107 mm.

*Type*.—Cat. No. 43592, U.S.N.M.

**BIDDULPHIA EXPEDITA** Janisch(?)

(Schmidt, Atlas, pl. 121, fig. 3.)

As to whether or not this is present in my Philippine Islands material is discussed under *Biddulphia cornigera*, new species.

**BIDDULPHIA FAVUS** (Ehrenberg) Van Heurck

(Mikrogeologie, pl. 19, fig. 17; Schmidt, Atlas, pl. 82, figs. 1, 3, 4.)

This very cosmopolitan diatom, both in recent material and fossil deposits, is represented in the Philippine Islands by the type form and many varieties. A variety that bears the name of *Triceratium scitulum* Brightwell, is well illustrated in the original figure (Micro. Journ., 1853, pl. 4, fig. 9, and Schmidt, Atlas (pl. 83, figs. 11-13 but not pl. 84, figs. 5-6), the latter being here given the new specific name *B. scitula* (A. Schmidt) Mann. Schmidt suggests the union of plate 83, figures 11-13, with *B. favus* as a variety, this being the true Brightwell form, but he does not include plate 84, figures 5-6.

**BIDDULPHIA FIMBRIATA** (Wallich) Mann

(Micro. Journ., 1856, pl. 2, figs. 4-9; Schmidt, Atlas, pl. 82, figs. 6-7.)

There is a general tendency to unite this with the former species. It is a much more delicate diatom with a different arrangement of the areolation next to the margin. In fact, the margin, seen in side (girdle) view, is wholly unlike that of *B. favus*. It may be remarked here that the side view in *Biddulphia* is too frequently neglected in descriptions and illustrations, although its significance is most valuable. This species is not to be confused with *Biddulphia fimbriata* Greville, which Grunow has rightly transferred to *Denticella* (Diat. F. Jos. Land, p. 6).

**BIDDULPHIA FRACTOSA**, new species

Plate 8, fig. 5; plate 10, fig. 1

Valve triangular, elevated at the center, its sides slightly or strongly convex; horns at the three angles, stout, tapering, rugose to the tip, their ends even with the margin of the valve; markings of course beading, imperfectly radial in arrangement, loosely scattered over the central part, more compact near the margin; from the sides there run irregularly inward short cracklike depressed lines, two to five on each side, and occasionally a few short isolated ones near the center.

Diameter (apex to opposite side), 0.056-0.090 mm.

The general resemblance of this species to *Biddulphia* (*Triceratium*) *tabellarium* Brightwell, especially to its variety called *T. venulosum* Greville, is apparent. The powerful horns, however, make their union impossible. No girdle view of this species was obtainable.

Comparison may be made with *T. lineolatum* Greville (Micro. Journ., 1863, pl. 10, fig. 16) fossil at Barbados; also with the questionable variety of *T. areolatum* Greville figured in Walker and Chase, New Diatoms, plate 3, figure 13, practically identical with what Grunow calls *T. jensenianum* (Schmidt, Atlas, pl. 77, figs. 15-16). The typical *T. areolatum* Greville can be found in the Microscopical Journal for 1861, plate 8, figure 13.

*Type*.—Cat. No. 43593, U.S.N.M.

**BIDDULPHIA GEMINA (A. Schmidt) Mann**

(Schmidt, Atlas, pl. 80, fig. 16.)

The original specimen was from the Samoan Islands.

**BIDDULPHIA GIBBOSA (Bailey) Van Heurck**

(Wilkes Exp., p. 181, pl. 9, fig. 32; Schmidt, Atlas, pl. 80, figs. 13-21.)

This diatom's place among the *Biddulphiae* is most questionable. Bailey himself indicated doubt of the correctness of the assignment. The peculiar finishing of its angles, which have, instead of horns or processes, flat disciform areas, bounded on the outer side by semicircular ridges, like the eyebrows over an eye, and each accompanied by a single, sharp, curved spine, gives it a strikingly individual aspect. Its delicate texture and beading are also unique. The side view is even more unlike *Biddulphia* than that of the face. Van Heurck, De Toni, and others suggest its classification under Bailey's genus *Lampriscus*, in company with such forms as *Triceratium circulare* Shadbolt, *T. shadboltianum* Greville, *T. globosum* Bailey, etc. To this group should probably be added that doubtful example of *Aulacodiscus*, *A. kittonii* Arnott. De Toni does not assign to *Lampriscus* the single figure of that diatom given in Schmidt's Atlas (pl. 80, fig. 11), but for some undivulged reason puts all the others under *Aulacodiscus kittonii*. Although favorable to a change of genus I here follow the *Biddulphia* classification, pending further discussion of the subject.

**BIDDULPHIA GRUNDLERI A. Schmidt**

(Schmidt, Atlas, pl. 118, figs. 22-24.)

**BIDDULPHIA GRUNOWIANA (Castracane) Mann**

(Castracane, Chall. Exp., p. 110, pl. 16, fig. 5.)

**BIDDULPHIA HETERO CEROS Grunow**

(Van Heurck, Synopsis, pl. 102, fig. 5.)

**BIDDULPHIA IMPRESSA (Grunow) Mann**

(Van Heurck, Synopsis, pl. 115, figs. 3-6.)

De Toni (Syl. Alg., p. 986) places this in *Lithodesmium*, but expresses doubt of its correctness.



**BIDDULPHIA INDICA** (Ehrenberg) Roper

(Micro. Journ., 1859, pl. 1, figs. 20-22.)

**BIDDULPHIA INFORMIS**, new species

Plate 9, figs. 2, 3

Valve convex, elongated, naviculoid, broadened at the middle and with wedge-shaped ends, covered with scattered beads irregularly distributed, the two horns at the extreme apices; in side (girdle) view the horns are seen to rise perpendicularly from the apices, the outer and straight side being the extremity of the valve, the inner side sloping backward to the valve surface; girdle relatively broad and hyaline, except for a single row of minute beads along each edge.

Length of valve, 0.066-0.087; width of valve, 0.016-0.018 mm.; depth of frustule, 0.033 mm.

This singularly crude diatom was found in two dredgings but was infrequent in both. Its girdle view reminds one of the doubtful *Plagiogramma van huerckii* Grunow (Van Heurck, Synopsis, pl. 36, fig. 4).

*Type*.—Cat. No. 43594, U.S.N.M.

**BIDDULPHIA INSIGNIS** (Greville) Mann

(Micro. Journ., 1861, p. 75, pl. 9, fig. 5; Schmidt, Atlas, pl. 78, fig. 3.)

**BIDDULPHIA INVERTA**, new species

Plate 9, fig. 4; plate 10, figs. 2, 3

Valve triangular, its sides straight or barely concave; center a domelike convexity separated from the broad bases of the three horns by three deep sinuses that appear in face view as three narrow hyaline bands uniting to form an inner triangle in reversed position to that of the valve; the whole surface of the valve, except the tips of the horns and the three hyaline sinuses, loosely covered with large, crudely formed beads showing an imperfectly radial arrangement; in side view the apparently simple topography of the valve surface is seen to be a highly complicated series of elevations and depressions; the bases of the massive horns are separated from the domelike center by deep sinuses, their tips rounded, incurved, and covered with fine, closely, and regularly set beads; a deep groove runs around the base of the valve (next to the girdle); on each half of the girdle, which is very wide, a single row of large beads along the line of its attachment to the valve, below this a few large scattered beads and toward the bottom of each half similar beads closely set in vertical rows, that is, transverse to the girdle, six to eight beads long.

Diameter of valve (apex to middle of opposite side), 0.169-0.287 mm.; height of frustule, 0.265-0.282 mm.

The form or architectural plan is carried in this and similar species of *Biddulphia* to so high a degree of complexity that an accurate image of the specimen by means of description without the aid of illustration is quite impossible. The highly elaborate ornamentation of this diatom showed slight variations in the large number of specimens obtained.

It is related more or less closely to *Triceratium partitum* Greville (Moebius, Diat. Taf., pl. 55, fig. 8; Micro. Journ., 1864, pl. 2, fig. 8) to *T. celluloseum* Greville as figured by Walker and Chase (New Diat., pl. 4, fig. 8), but less so with the original in the Microscopical Journal for 1861, plate 4, figure 14, with *T. expressum* Janisch (Schmidt, Atlas, pl. 94, fig. 16) and, except for the very unlike horns, with *T. madagascarensis* Grunow (Schmidt, Atlas, pl. 94, fig. 15).

*Type*.—Cat. No. 43595, U.S.N.M.

**BIDDULPHIA JUNCATENSIS (Grunow) Mann**

(Schmidt, Atlas, pl. 76, fig. 13.)

This species is incorrectly united with *B. (T.) inelegans* (Greville) by Boyer (Bidd. Forms, p. 725). It is found both in Campeche Bay and the Philippine Islands, but not elsewhere.

**BIDDULPHIA JUNCTA (A. Schmidt) Mann**

(Schmidt, Atlas, pl. 98, figs. 1-3.)

This large and handsome diatom is quite common in the Philippine Islands. Its being a *Biddulphia* is so evident that one wonders why Schmidt did not in this instance break away from the untenable arrangement of putting such forms in *Triceratium*.

**BIDDULPHIA MADAGASCARENSIS (Grunow) Mann**

(Schmidt, Atlas, pl. 81, fig 18; pl. 94, fig. 15; Van Heurck, Synopsis, pl. 108, fig. 8.)

This species has rather too close resemblance to *T. radio-punctatum* A. Schmidt (Schmidt, Atlas, pl. 94, fig. 14).

**BIDDULPHIA MEMBRANACEA Cleve**

See *Trigonium membranaceum* (Cleve) Mann.

**BIDDULPHIA MOBILIENSIS Bailey**

(Amer. Journ. Sci., 1845, p. 336, pl. 4, fig. 24; Van Heurck, Synopsis, pl. 101, figs. 4-6.)

The best figures for distinguishing between this and the similar *B. chinensis* Greville are to be found in Schmidt's Atlas on plate 122. Although common in Japanese waters it is rather uncommon in the Philippine Islands.

**BIDDULPHIA PAPILLATA** (Grove and Sturt) Mann

(Grove and Sturt, Oamaru Diat., p. 14, pl. 6, fig. 14.)

**BIDDULPHIA PENTACRINUS** (Ehrenberg) Boyer

(Schmidt, Atlas, pl. 98, figs. 7-13.)

**BIDDULPHIA PETITIANA** (Leuduger-Fortmorel)? Mann

Plate 10, figs. 4, 5

I figure this unique and rare diatom because, although I can not separate it from *Triceratium petitianum* as figured and described by Leuduger-Fortmorel (Diat. Cot. Occ. Africa, p. 28, pl. 5, fig. 12) and probably including the unnamed figure in Schmidt's Atlas on plate 94, figure 10, it differs very greatly from it in its markings. The original is covered with coarse, irregularly placed beads or blotches, with no reticulations. There can be no question of error in this, because the diatom is carefully described and twice illustrated and several specimens were found, as is indicated by the measurements given. In contrast to this, the valves of all my specimens are covered with a coarse strong reticulation, except on the ends of the two processes, and within the reticulum are accurately arranged rows of fine perfect beading, radiating from the center of the valve and also covering the unreticulated ends of the two processes. In the center is a single blunt curved spine. The girdle is covered with closely set regular rows of beads running vertically, that is, across the girdle, the beads being of the same size as those on the valve.

Length of valve, 0.056-0.059; width, 0.037-0.039; height of frustule, 0.035-0.079 mm. Length of valve of Leuduger-Fortmorel specimens, "4-7 c.d.m."

*Type*.—Cat. No. 43596, U.S.N.M.

**BIDDULPHIA PETITII** (Leuduger-Fortmorel) Mann

Plate 8, fig. 4

(Leuduger-Fortmorel, Diat. Malaisie, p. 39, pl. 6, fig. 3.)

*Cerataulus turgidus* Ehrenberg has been made the repository for several allied forms having in common massive, oval and convex valves, with two heavy blunt horns capped with round or oval hyaline ends, analogous to the ocelli of certain species of *Auliscus*, and generally set one near to each end of the long axis of the valve but a little to one side of it. To a few forms distinctive names have been given, but several species still appear under the old Ehrenberg name. The best collections of figures of diatoms of this group are to be found in Schmidt's Atlas, plates 115 and 116, and in A. Forti's Contributions to Diatoms, 1910, plates 1 and 2.

The old genus *Cerataulus* can not be marked off from *Biddulphia* by satisfactory characters. Both are normally of elongated or oval valve outline, very convex and deep, and united by a wide girdle, so that the frustule is usually deeper than wide; at the apices of the bilateral valves are two massive processes or horns; the markings are frequently coarse and more or less radial, and spines, sometimes in large number, are often superposed on the sculpture; these in some species like *Biddulphia heteroceros* Grunow and *Cerataulus turgidus* Ehrenberg, are massive, long and bifurcated at the tip; the method of growth of the two is the same; so that on the whole it is no wonder the same diatom is assigned by one able diatomist to *Biddulphia* and another equally able to *Cerataulus*, as in the case of *Biddulphia radiata* Roper and *Cerataulus smithii* Ralfs.

The Philippine specimens of the present species, *B. petittii*, vary somewhat from the type form of Leuduger-Fortmorel, judged by his sketchy figure and rather meager description; the horns being not to one side of the long axis but bisected by it, the spines near the middle being not fewer and smaller but closer and larger, and the beading being not rectangular but radial. But comparison of the two figures will show that these differences are not specifically important. The type came from the near-by island of Java.

#### BIDDULPHIA PULCHELLA Gray

(Smith, Brit. Diat., pl. 44, fig. 321; Schmidt, Atlas, pl. 118, figs. 26-33.)

This cosmopolitan species is known to be very variable both in size and form. Small specimens, with deep valves and girdles, so wide as to give a tubular form, are the prevailing ones in the Philippine Islands.

#### BIDDULPHIA PUNCTATA Greville

(Micro. Journ., 1864, pl. 11, fig. 10.)

The type came from the fossil bed at Cambridge, Barbados. Boyer's *B. interrupta* (Proc. Acad. Nat. Sci. Phila., 1898, pl. 24, fig. 2.) is similar, but has radiating beads, spines at the center, and the interrupting arcuate bands do not fully cross the valve.

#### BIDDULPHIA PYGMAEA, new name

(Schmidt, Atlas, pl. 98, fig. 16.)

This species is accurately illustrated in the above figure, and there named *Triceratium pulchellum* Grunow. It is an evident *Biddulphia*, but can not be transferred with its specific name because of *B. pulchella* Gray. It is therefore renamed. It is also what is called *T. cornutum*, var. *pulchella* Grunow, in Van Heurck's Synopsis, plate 108, figures 12-13, but this can hardly be united with Greville's *T. cornutum* in the Microscopic Journal for 1861, page 45, plate 8, figure 8.

**BIDDULPHIA RETICULATA** Roper

(Micro. Journ., vol. 7, pl. 2, figs 14-17; Schmidt, Atlas, pl. 78, figs 21-23; pl. 84, figs, 9, 15, 16; pl. 85, fig. 8.)

The variety, *subspinosa*, figured in Schmidt's Atlas, plate 84, figure 15, also found, is questionable as belonging here.

**BIDDULPHIA RETIFORMIS**, new species

Plate 10, fig. 6

Valve fusiform, the broad spindle made up of a very convex circular central part, from opposite sides of which protrude two triangular extensions, their surfaces at a lower level than the central part and ending in sharp angles from which arise two horns pointing obliquely outward; the circular central part is covered with a reticulate network of lines, set with numerous fine prickles and underlaid with radiating rows of beading; the network is replaced on the two extensions by three to four longitudinal ridges; the horns are long, narrow, tapering, and enlarged at the ends.

Length 0.056; width 0.031 mm.

Although only a single specimen was found, I can not reconcile its symmetrical form and its reticulate markings with the idea that it is an abnormal two-angled specimen of *B. pentacrinus* (Wallich) Van Heurck.

*Type*.—Cat. No. 43597, U.S.N.M.

**BIDDULPHIA ROBERTSIANA** (Greville) Boyer

(Micro. Journ., 1863, p. 231, pl. 9, fig 9; Schmidt, Atlas, pl. 83, figs. 3, 5-7.)

Both the type form and the spineless variety called *inermis* were found.

**BIDDULPHIA ROPERIANA** Greville

(Micro. Journ., vol. 7, pl. 8, figs. 11-13; H. L. Smith, Types, No. 625; Van Heurck, Synopsis, pl. 99, figs. 4-6.)

**BIDDULPHIA RUDIS**, new species

Plate 10, fig. 7

Valve triangular, massive and practically hyaline, a few scattered imperfect blotches being dimly seen on some specimens; apices very blunt, with three short stout horns of the *Cerataulus* pattern, ending in circular disks that are inclined outward.

As no complete frustule was found, the girdle aspect is unknown.

Diameter (measured from one apex to opposite side)

0.059 mm.

There is a slight resemblance between this and the unnamed figure in Ostrup, Diatoms of Siam, plate 1, figure 4.

*Type*—Cat. No. 43598, U.S.N.M.

**BIDDULPHIA SCHMIDTII (Janisch) Mann**

(Schmidt, Atlas, pl. 86, figs. 1-2; pl. 85, figs. 3-4, variety.)

**BIDDULPHIA SCITULA (A. Schmidt) Mann, new name**

(Schmidt, Atlas, pl. 84, figs. 5-6, misnamed.)

It is evident that Brightwell's species bearing the name of *Triceratium scitulum* is a somewhat delicate variety of *B. favus* (Ehrenberg) Van Heurck; but Schmidt groups with this two figures which are not like Brightwell's variety of *favus* nor like its type form; and in uniting the true figures of Brightwell's with *B. favus* he leaves out these two figures. They correspond to the present species. They, therefore, require a separate specific name and I here propose *B. scitula* (A. Schmidt) Mann, new name.

This is another species common to both Campeche Bay and the Philippine Islands.

**BIDDULPHIA SECEDENS (A. Schmidt) Mann**

(Schmidt, Atlas, pl. 126, figs. 3-4.)

**BIDDULPHIA SETIGERA (Bailey) Mann**

(Smiths. Contrib., 1854, p. 11, pl. 1, fig. 26.)

For a discussion of the adoption of this name given in 1854, rather than either of its synonyms, *Triceratium spinosum* Bailey (1843) or *T. armatum* Roper (1854) see my Diatoms of the Albatross Voyages, p. 309.

**BIDDULPHIA SPINULOSA (Grunow) Mann**

(Schmidt, Atlas, pl. 87, fig. 1.)

**BIDDULPHIA STOKESIANA (Greville) Mann**

(Micro. Journ., 1866, p. 8, pl. 2, fig. 23; Schmidt, Atlas, pl. 112, fig. 19.)

**BIDDULPHIA TABELLARIA (Brightwell) Boyer**

(Micro. Journ., vol. 4, p. 275, pl. 17, fig. 15; Schmidt, Atlas, pl. 77, figs. 1-5.)

Here are included *Triceratium venulosum* Greville and, with considerable doubt, var. *diplosticta* Grunow and *T. grave* A. Schmidt (See Schmidt, Atlas, pl. 77, fig. 17, and Truan and Witt, Diat. Hayti, pl. 7, figs. 1, 13.)

**BIDDULPHIA TEMPEREI (Brun) Mann**

(Le Diat., vol. 1, p. 33, pl. 3, fig. 7.)

**BIDDULPHIA TRIPOS (Cleve) Mann**

(Cleve, New and Little Known Diat., p. 24, pl. 6, fig. 68; Schmidt, Atlas, pl. 84, fig. 8.)

A remarkable specimen, circu'ar in form and with two processes was found, as well as the typical triangular form.

**BIDDULPHIA TRISINUA, new species**

Plate 10, figs. 8-9

Valve triangular, trifoliate, the sides deeply concave, the angles broad and blunt; the three processes or horns rounded, closely beaded; across each angle back of the processes is a transverse row of irregularly placed beads; the central part of the valve sparingly dotted with minute beads arranged in imperfect circles; in side (girdle) view the valve is seen to be flat in the center, the horns vertical and enlarged at the ends; the sides of the valve sparingly and irregularly dotted, like the upper surface; a small groove extends around the valve next to the rim, which is not produced beyond the rest of the valve.

Diameter of valve (measured from apex to opposite side), 0.101 mm.; height of valve, 0.090 mm.

This can hardly be made a variety of *Triceratium trisulcum* Bailey, its nearest relative (Schmidt, Atlas, pl. 78, figs. 5-8; pl. 94, fig. 5; pl. 112, figs. 11-18). Also compare with *T. turiferum* Truan and Witt (Diat. Hayti, pl. 7, figs. 22-23.)

*Type*.—Cat. No. 43599, U.S.N.M.

**BIDDULPHIA TUMESCENS (Castracane) Mann**

(Castracane, Chall. Exp., p. 109, pl. 6, fig. 9.)

Among the specimens found one resembles *T. robertsonianum*, forma *inermis* (Schmidt, Atlas, pl. 83, fig. 4), but Castracane's species is valid because the processes are blunt disks, not horns, and the areolation reaches to their bases. De Toni somehow manages to discover a likeness between this and *T. fimbriatum* Wallich.

**BIDDULPHIA TUOMEYI (Bailey) Roper**

(Micro. Journ., 1859, p. 8, pl. 1, figs. 1-2; Schmidt, Atlas, pl. 119, figs. 1-8.)

Numerous specimens of this widely distributed and essentially fossil diatom were found and, so far as could be made out, were members of the now living flora.

**BIDDULPHIA TURGIDA W. Smith**

(Smith, Brit. Diat., p. 50, pl. 62, fig. 384; Van Heurck, Synopsis, pl. 104, figs. 1-2.)

Together with the typical form a somewhat spiny-covered variety was found.

**BIDDULPHIA TURRIGERA, new species**

Plate 11, figs. 1, 2

Valve triangular, with barely convex sides; horns in the angles tall, erect, with truncated apices, their flat triangular ends having each a central rosette of watery beads; surface of the valve hyaline, flat to

near the margin, then sloping diagonally downward; in side (girdle) view the three flat-topped horns are seen to be notched near the top on the outside; sides of the valve hyaline like its upper surface; girdle densely covered with rows of beading running vertically, that is, across it.

Diameter of valve (measured from apex to opposite side), 0.045–0.082 mm.; height of frustule, 0.056–0.073 mm.

This species, which is of the *Triceratium castelliferum* group resembles most nearly one of the figures of *T. turriferum* Truan and Witt, as given in their Diatomaceen von Hayti, plate 7, figure 6.

*Type*.—Cat. No. 43600, U.S.N.M.

**BIDDULPHIA UNDULOSA, new species**

Plate 11, fig. 3

Valve broadly oval, convex, its margin strongly undulating, or more correctly, scalloped, the indentations being broadly curved, but the external points of union between the scallops being acute angles; a short pedicelled horn set close to the margin at either end of the valve; surface of valve dusted over with an exceedingly fine rugosity and evenly covered with thickly set sharp but very short prickles; the girdle, joining the two strongly convex valves, is ribbed to correspond with the undulations of the rim of the valves, and is more coarsely rugose than it, but destitute of prickles.

Length, 0.089; width, 0.076 mm.

Comparison may be made with *B. punctata* Greville from Oamaru, New Zealand (Schmidt, Atlas, pl. 141, figs. 2–3).

*Type*.—Cat. No. 43601, U.S.N.M.

**Genus CAMPYLODISCUS Ehrenberg**

**CAMPYLODISCUS ADORNATUS A. Schmidt**

(Schmidt, Atlas, pl. 51, fig. 5; pl. 52, fig. 3; Deby, Campy., pl. 3, fig. 21.)

This is rather too close to *C. ornatus* Greville to justify a separate name. It is another of the forms found in both Campeche Bay and the Philippine Islands.

**CAMPYLODISCUS ADRIATICUS Grunow**

(Schmidt, Atlas, pl. 16, figs. 13–16, 18; Deby, Campy., pl. 5, fig. 34.)

**CAMPYLODISCUS AMBIGUUS Greville**

(Micro. Journ. vol. 8, p. 31, pl. 1, fig. 5; Schmidt, Atlas, pl. 18, figs. 21–26; pl. 51, fig. 14.)

It is an open question if it is best to follow De Toni's plan of uniting this with *C. latus* Shadbolt. Compare the original figures and descriptions of the two in the Microscopic Journal for 1854, page 16, plate 1, figure 13, and that Journal for 1860, page 31, plate 1, figure 5.



**CAMPYLODISCUS ANCEPS** Castracane

(Castracane, Chall. Exp., pl. 16, fig. 20; Deby, Campy., pl. 5, fig. 1; see also Janisch, Gaz. Exp., pl. 19, fig. 8.)

See discussion of this form under *Surirella schleinitzii* Janisch.

**CAMPYLODISCUS BELLUS** A. Schmidt

(Schmidt, Atlas, pl. 207, fig. 4.)

**CAMPYLODISCUS BIANGULATUS** Greville

(Micro. Journ., vol. 10, pl. 4, fig. 1; Schmidt, Atlas, pl. 14, figs. 18-22; Deby, Campy., pl. 2, fig. 12.)

Here are included *C. lorenzianus* Grunow and *C. zebruanus* Castracane. Greville's type specimen came from Manila, Philippine Islands.

**CAMPYLODISCUS BILATERALIS**, new species

Plate 11, fig. 4

Valve slightly longer than wide, having along either side a strong band about one-tenth the cross diameter of the valve in width, until near the ends or poles of the valve it rapidly narrows to a mere line running around the ends; this band is transversely marked with wide evenly spaced lines, each of which terminates in a bead at the margin; the rest of the valve surface is covered with closely spaced lines that extend inward to the narrow hyaline median line connecting the two valve ends, these inner and finer lines being progressively radial and curved as they approach the ends, and showing a tendency to bifurcate where they join the bands on each side.

Diameter (between ends), 0.107 mm.

*Type*.—Cat. No. 43602, U.S.N.M.

**CAMPYLODISCUS BRIGHTWELLII** Grunow

(Wien. Verh. Zoo-Bot. Gesell., 1862, pl. 9, fig. 5; Schmidt, Atlas, pl. 15 figs. 6-7.)

This can not be distinguished from *C. grevillei* Leuduger-Fortmorel (Diat. Ceyl., pl. 5, figs. 54-56, 1879) or from *C. kinkerii* A. Schmidt (Atlas, pl. 207, fig. 16.)

**CAMPYLODISCUS BROWNEANUS** Greville

(Micro. Journ., 1862, p. 89, pl. 9, fig. 2; Deby, Campy., pl. 5, fig. 24A.)

**CAMPYLODISCUS CASTRACANEI** Janisch

(Janisch, Gaz. Exp., pl. 19, fig. 15.)

Deby claims the true figure of this species to be the one in the Report of the Gazelle Expedition, plate 20, figure 1, while the above he unites with *C. incertus* A. Schmidt (Schmidt, Atlas, pl. 15, figs. 13-15). I consider this to be a weak distinction, a specific demarcation between the two figures of Janisch being impossible. Furthermore he

makes *C. incertus* A. Schmidt a synonym under *C. samoensis* Grunow (Schmidt, Atlas, pl. 15, figs. 18—20) although Schmidt's name precedes the latter. De Toni (Syl. Alg., p. 609) follows these opinions.

**CAMPYLODISCUS COCCONEIFORMIS Grunow**

(Cleve, Vega, p. 502, pl. 38, fig. 78; Deby, Campy., pl. 9, fig. 51.)

Although this diatom is here placed under *Campylodiscus* for convenience, there is much doubt of its belonging here. De Toni also follows the generic name with a question mark. I have found this puzzling form also at Georgetown, British Guiana.

**CAMPYLODISCUS COMPTUS Janisch**

(Janisch, Gaz. Exp., pl. 19, fig. 16.)

*C. macassarensis* (Grove) Deby (Deby, Campy., pl. 14, fig. 71) is rather close to this, as is also *C. crebrecostatus* Greville; see below.

**CAMPYLODISCUS CONCINNUS Greville**

(Schmidt, Atlas, pl. 53, fig. 9; also Schmidt, Atlas, pl. 18, fig. 18.)

My specimen corresponds exactly with the var. *lineata* Grunow of the above reference. I do not agree with Deby in making this and the type form (Micro. Journ., 1860, p. 30, pl. 1, fig. 2) synonymous with *C. imperialis* Grunow (compare H. L. Smith, Types, No. 626.)

**CAMPYLODISCUS CONTIGUUS A. Schmidt**

(Schmidt, Atlas, pl. 18, figs. 19—20.)

Judging by the figures Schmidt's form is sufficiently unlike *C. latus* Shadbolt to warrant its apologetic name. If the actual diatoms have been seen to be alike by Deby he is justified in uniting them.

**CAMPYLODISCUS CREBRECOSTATUS Greville**

(Micro. Journ., 1864, pl. 1, fig. 6; Schmidt, Atlas, pl. 14, fig. 28.)

Janisch's *C. comptus* (see above) runs close to this, as does also *C. intermedius* Grunow.

**CAMPYLODISCUS DECORUS Brébisson**

(Brébisson, Diat., Cherb., p. 14, pl. 1, fig. 2; Van Heurck, Synopsis, pl. 72, fig. 3; Deby, Campy., pl. 2, fig. 15.)

De Toni (Syl. Alg., p. 612) groups this with *C. ralfsii* W. Smith and says, "*C. decorus* vix a *C. ralfsii* differt nisi pseudorhaphé distincta." This is not quite true; but even so, it is a more satisfactory mark of distinction than many species can boast.

**CAMPYLODISCUS DAEMELIANUS Grunow**

(Schmidt, Atlas, pl. 17, fig. 11; pl. 54, figs. 1—2; Deby, Campy., pl. 12, fig. 53.)

Among the large number of specimens found considerable difference exists, not in the plan of ornamentation but in the degree to which it is carried out.

**CAMPYLODISCUS DENTATUS Deby**

(Deby, Campy., pl. 14, fig. 74.)

The only specimens recorded come from the Philippine Islands.

**CAMPYLODISCUS DIPLOSTICTUS Norman**

(Micro. Journ., 1860, pl. 1, fig. 6; Schmidt, Atlas, pl. 207, fig. 2.)

The type came from Australia. It is practically the same as *C. robertsonianus* Greville, which see.

**CAMPYLODISCUS EMARGINATUS Deby**

(Deby, Campy., p. 65, pl. 14, fig. 73.)

This is reported living in the Sea of Japan (Rae) and fossil in Japan (Macrae).

**CAMPYLODISCUS EXIMIUS Gregory**

See under *C. hodgsonii* W. Smith.

**CAMPYLODISCUS GREVILLEI Leuduger-Fortmorel**

(Leuduger-Fortmorel, Diat., Ceyl., p. 47, pl. 5, figs. 54-56.)

As mentioned under *C. brightwellii* Grunow, it and this form can not be clearly distinguished from each other. De Toni admits their practical unity, but puts Grunow's name as a synonym under the above, the date of which is 1879. Grunow published his figure and description in 1862. Schmidt's *C. kinkerii* (Schmidt, Atlas, pl. 207, fig. 16) is scarcely admissible to the dignity of a variety of this.

**CAMPYLODISCUS HIBERNICUS Ehrenberg**

(Ehrenberg, Mikrogeologie, pl. 15A, fig. 9; Schmidt, Atlas, pl. 55, figs. 9-16; Deby, Campy., pl. 11, fig. 58.)

Although I here record this among the marine diatoms of the Philippine Islands, it is a strictly fresh-water species. It was doubtless brought down as river detritus. Between this and *C. noricus* Ehrenberg, also a fresh-water species, so many intermediate forms occur that a satisfactory boundary line between them is impossible.

**CAMPYLODISCUS HODGSONII W. Smith**

(Smith, Brit. Diat., pl. 6, fig. 53; Schmidt, Atlas, pl. 53, fig. 5; Deby, Campy., pl. 1, fig. 7.)

Cleve in Schmidt's Atlas (pl. 207, fig. 19) claims that the original specimens of this and *C. eximius* Gregory, figured by Gregory (Diat. Clyde, pl. 11, fig. 54) are the same species. To this I agree. Note their identical geographic distribution recorded in De Toni (Syl. Alg., pp. 610 and 628). Both De Toni and Deby (Deby, Campy., p. 43) accord to them separate rank.

## CAMPYLODISCUS HOROLOGIUM Williamson

(Ann. Mag. Nat. Hist., 1848, ser. 2, vol. 1, p. 321; Smith, Brit. Diat., pl. 6, fig. 51; Schmidt, Atlas, pl. 51, fig. 7; Deby, Campy., pl. 6, fig. 29a.)

Here is included a hardly separable variety called *C. pfitzeri* A. Schmidt in his Atlas, plate 17, figures 5-6. This same form was found by the *Challenger* expedition at the Philippine Islands and named by Castracane *C. lepidus* (Chall. Exp., pl. 16, fig. 7), although his type specimen was from the Sea of Japan and to this he gave the name of *C. orbicularis* (Chall. Exp., pl. 16, fig. 10).

## CAMPYLODISCUS INCERTUS A. Schmidt

(Schmidt, Atlas, pl. 15, figs. 13-15.)

As mentioned under *C. castracanei*, this name in Schmidt's Atlas precedes *C. samoensis* Grunow on the same plate (figs. 18-20), despite which Deby and De Toni adopt the latter. The doubt implied in the specific name may refer to this likeness between the two, although Schmidt may have had in mind *C. concinnus* Greville, between which and these forms a marked resemblance exists. As already mentioned, I see no gain for purposes of identification in placing *C. concinnus* under *C. imperialis*.

## CAMPYLODISCUS INOPINUS A. Schmidt

(Schmidt, Atlas, pl. 207, fig. 18.)

## CAMPYLODISCUS INTERMEDIUS Grunow

(Schmidt, Atlas, pl. 14, fig. 30; pl. 18, fig. 9.)

The resemblance to *C. crebrecostratus* Greville is close enough to deserve mention, but not close enough to unite them, as is done by De Toni (Syl. Alg., p. 613).

## CAMPYLODISCUS KINKERII A. Schmidt

See under *C. brightwellii* Grunow.

## CAMPYLODISCUS KITTONIANUS Greville

(Micro. Journ., 1850, p. 32, pl. 1, fig. 7; Schmidt, Atlas, pl. 16, figs. 19-20; Deby, Campy., pl. 10, fig. 52.)

## CAMPYLODISCUS LATUS Shadbolt

(Micro. Journ., 1854, p. 16, pl. 1, fig. 13; Schmidt, Atlas, pl. 207, figs. 6-9; Deby, Campy., pl. 3, fig. 30b.)

It has a wide geographical distribution, and is also quite variable. *C. ambiguus* Greville (Micro. Journ., 1860, pl. 1, fig. 5) may be the same.

See remarks under *C. ambiguus* and *C. contiguus*.

**CAMPYLODISCUS LIGULOSUS, new species**

Plate 11, fig. 5

Valve circular, strongly bent, its border consisting of an outer narrow band of a single row of small polygonal divisions rounded on their inner side and forming an angle on their outer side, the apex of each angle ending in a minute bead or bar reaching to the rim of the valve; within this band is a single row of broad tonguelike and glassy scallops of slightly unequal length and very irregular width, being from two to five times as wide as the polygonal partitions of the outer band, the largest scallops being at the two ends of the valve; the central portion of the valve, two-thirds its diameter, is without markings, except for a short central, rugose line, running toward but not reaching the ends.

Both diameters, 0.047 mm.

Although there is considerable similarity between this and the figure of *C. dubius* Leuduger-Fortmorel (Diat., Ceylan, pl. 4, fig. 47) his description on page 46 clearly shows that the two are separate species.

*Type*.—Cat. No. 43603, U.S.N.M.

**CAMPYLODISCUS LIMBATUS Brébisson**

(Brébisson, Diat., Cherb., pl. 12, fig. 1; Schmidt, Atlas, pl. 17, figs. 2-3; Deby Campy., pl. 10, fig. 62.)

**CAMPYLODISCUS MUELLERI A. Schmidt**

(Schmidt, Atlas, pl. 14, fig. 13; Deby, Campy., pl. 6, fig. 27.)

This is another of the forms peculiar to both Campeche Bay and the Philippine Islands. De Toni (Syl. Alg., p. 621) rightly notes its suspicious resemblance to *C. browneanus* Greville.

**CAMPYLODISCUS ORNATUS Greville**

(Micro. Journ., 1863, pl. 1, fig. 3; Schmidt, Atlas, pl. 17, fig. 17; pl. 51, figs. 2, 3, 6; Deby, Campy., pl. 10, fig. 60.)

According to Deby, Castracane's *C. philippinarum* (Chall. Exp., pl. 11, fig. 9) is identical with this.

**CAMPYLODISCUS PERSPICUUS, new species**

Plate 11, fig. 6

Valve circular, strongly bent; border consisting of an outer narrow row of rectangular beading, within which is a second row of longer, smooth, tonguelike divisions, and within these a final row of narrow but strong coastal ridges running radially halfway to the center, about 36 in number, which is approximately one-third the number of divisions of the second row; in this latter row the divisions are equal in length, except those that are continuous with the coastal ridges of

the inside row, which are about twice as long as the others; the sub-circular central portion, about one-half the diameter of the valve, is obscurely covered with wrinkles, a median longitudinal one being the strongest; a prominent bead is set in the outside rectangular row at each end of the valve, marking the two polar areas.

Width, 0.099; length, 0.096 mm.

*Type*.—Cat. No. 43604, U.S.N.M.

**CAMPYLODISCUS PFITZERI A. Schmidt**

See *C. horologium* Williamson.

Although De Toni thinks this worthy of mention as a variety of *C. horologium*, I do not see any appreciable difference between the two. It is figured in Schmidt's Atlas, plate 17, figures 5-6.

**CAMPYLODISCUS PHALANGIUM A. Schmidt**

(Schmidt, Atlas, pl. 14, figs. 11-12; pl. 93, figs. 16-17; Deby, Campy., pl. 5, fig. 24c.)

I agree with Deby in recognizing this as separate from *C. brown-eanus* Greville, of which De Toni (Syl. Alg., p. 620) makes it a variety. It is another form peculiar to Campeche Bay and the Philippine Islands.

**CAMPYLODISCUS PUNCTULATUS Grunow**

(Schmidt, Atlas, pl. 17, fig. 4.)

This well-marked species is another example of the diatoms peculiar to both Campeche Bay and the Philippine Islands.

**CAMPYLODISCUS RABENHORSTIANUS Janisch**

(Janisch and Rabenhorst, Diat., Hondur., p. 6, pl. 1, figs. 6-7; Schmidt, Atlas, pl. 53, figs. 12-14; Deby, Campy., pl. 9, fig. 46.)

Although not a strictly Campeche Bay form, it is approximately so, being abundant on the coast of Honduras.

**CAMPYLODISCUS RALFSII W. Smith**

(Smith, Brit. Diat., pl. 30, fig. 257; Schmidt, Atlas, pl. 14, figs. 1-3; Deby, Campy., pl. 2, fig. 18.)

As mentioned under *C. decorus* Brébisson, I do not favor uniting these two. But *C. scalaris* Tempère and Brun (Diat. Jap., pl. 4, fig. 12) seems to be only a variety of this form.

**CAMPYLODISCUS RATRAYANUS Deby**

(Deby, Campy., p. 36; Schmidt, Atlas, pl. 18, fig. 10.)

The type, according to Deby and represented by the above figure of Schmidt, is from Brazil; but *C. schmidtii* Grunow, figured in Schmidt's Atlas (pl. 53, fig. 10), is possibly the same diatom and comes from Campeche Bay.

**CAMPYLODISCUS RIVALIS** A. Schmidt

(Schmidt, Atlas, pl. 8, figs. 1-2; Deby, Campy., pl. 2, fig. 17.)

**CAMPYLODISCUS ROBERTSIANUS** Greville

(Micro. Journ., 1863, pl. 1, fig. 5; Schmidt, Atlas, pl. 17, figs. 8-10; Deby, Campy., pl. 3, fig. 32.)

I give this name, the type specimen of which came from Queensland and specimens of which are recorded from the Philippine Islands by Deby; but there is doubt if it can be held distinct from *C. diplostictus* Norman. I found it to be quite frequent in several dredgings.

**CAMPYLODISCUS SAMOENSIS** Grunow

See under *C. incertus* A. Schmidt.

**CAMPYLODISCUS TAENIATUS** A. Schmidt

(Schmidt, Atlas, pl. 16, fig 2; pl. 51, fig. 1; Deby, Campy., pl. 7, fig. 41.)

I have found this also at Hilo Hilo, Hawaii.

**CAMPYLODISCUS TRIUMPHANS** A. Schmidt

(Schmidt, Atlas, pl. 15, figs. 4-5.)

This is another strictly Campeche Bay, Philippine Islands, species.

**CAMPYLODISCUS WALLICHIANUS** Greville

(Micro. Journ., 1863, pl. 1, fig. 14; Schmidt, Atlas, pl. 14, figs. 15-16; pl. 17, figs. 13-14.)

**Genus CAMPYLONEIS** Grunow**CAMPYLONEIS GREVILLEI** (W. Smith) Grunow

(Van Heurck, Treat., p. 285, fig. 64; Van Heurck, Synopsis, pl. 28, figs. 8-16.)

Including the two varietal forms, *C. argus* and *C. regalis*.

**Genus CESTODISCUS** Greville**CESTODISCUS CINNAMOMEUS** Grunow

See *Trigonium cinnamomeum* (Greville) Mann.

**Genus CHAETOCEROS** Ehrenberg (characters emended)

Although there can be no doubt that Shadbolt's *Bacteriastrum* must be recognized as a circular and otherwise slightly modified variation of this unique genus, so that a distinction of generic value can not be discovered for their separation, it is also doubtless true that *Bacteriastrum* is a very convenient subgeneric term. As in my Diatoms of the Albatross Voyages, I here follow the opinion of Van Heurck, De Toni, etc., but add "*Bacteriastrum*" in brackets to the circular forms here recorded, as an aid to identification.

**CHAETOCEROS AFFINE** Lauder

(Micro. Journ., 1864, pl. 8, fig. 5.)

**CHAETOCEROS BOREALE** Bailey

(Smith. Contrib., 1854, p. 8, figs. 22-23; Micro. Journ., 1860, pl. 2, fig. 18.)

**CHAETOCEROS CELLULOSUM** LauderSee *C. lorenzianus* Grunow.**CHAETOCEROS COARCTATUS** Lauder

(Micro. Journ., 1864, pl. 8, fig. 6; Cleve, Java Diat., pl. 2, fig. 10.)

**CHAETOCEROS CURVISETUM** Cleve

(Gran, Norsk. Exp., pl. 3, fig. 43.)

**CHAETOCEROS DIADEMA** (Ehrenberg) Gran.

(Gran. Protophyta, p. 20, pl. 2, figs. 16-18; Micro. Journ., 1856, pl. 7, figs. 49-52.)

Only the endocysts of this pelagic diatom were found, what Ehrenberg called *Syringidium diadema* (Mikrogeologie, 35A, pl. 18, fig. 13), and in the second reference above.

**CHAETOCEROS FURCA** Cleve

(Cleve, Phytoplank., pl. 1, fig. 10.)

**CHAETOCEROS (BACTERIASTRUM) HEBES**, new species

Plate 11, fig. 7

Valve circular, hyaline; central part slightly convex, below which is set the ring of radiating arms; the bases of these have strong insets in the valve, producing a fictitious inner ring; they are stout, tapered, straight, with blunt ends and are wound spirally with two thread-like ridges set with spines and so spaced that the upper and under ridges produce a criss-cross effect.

Diameter of valve, 0.017 to 0.025 mm.; with arms, 0.084 to 0.096 mm.

Lauder's name, *B. varians*, has doubtless prevented observers from detecting some actually distinct species of these circular forms of *Chaetoceros*; for, although his species does vary, several types, like the one here described, can not be looked upon as mere variations.

*Type*.—Cat. No. 43605, U.S.N.M.

**CHAETOCEROS LORENZIANUM** Grunow

(Grunow, Neu. Ungen. Diat., p. 157, pl. 14, fig. 13; Van Heurck, Synopsis, pl. 82, fig. 2; H. L. Smith, Types, No. 629.)

Grunow's name, given in 1863, was followed the next year by Lauder's *C. cellulosus* (Trans. Micro. Soc., 1864, p. 78, pl. 8, fig. 12). A figure in Van Heurck's Synopsis, plate 82bis, figure 9, is incorrectly spelled *C. lorenzii* Grunow.



**CHAETOCEROS (BACTERIASTRUM) MEDUSA, new name**

Plate 12, figs. 1, 2

(Castracane, Chall. Exp., pl. 28, fig. 6, misnamed.)

This above-misnamed diatom is not a variety of *B. wallichii* Ralfs. (See Pritchard, Inf., p. 863, pl. 6, fig. 27.) Nor can it possibly be the same as what Castracane also calls *C. wallichii* in the Report of the Challenger Expedition, plate 23, figure 3. Ralfs' form is the *Chaetoceros bacteriastrum* Wallich (Micro. Journ., 1860, pl. 2, figs. 16-17). The specimen in the Report of the Challenger Expedition (pl. 29, fig. 6) came from Hongkong. See same from Gulf of Siam (Schmidt, Atlas, pl. 328, fig. 12, misnamed.)

Diameter of disk, 0.031; diameter including arms to their right-angle bend, 0.107; length of rest of arms from bend to tip, 0.072; length of entire arm therefore, 0.21 mm.

**CHAETOCEROS (BACTERIASTRUM) PRINCEPS, new name**

Plate 12, fig. 3

This is the form figured in the Report of the Challenger Expedition, plate 29, figure 3, and incorrectly named *B. varians* Lauder, var. *princeps* Castracane. It is wholly different from Lauder's form which, contrary to what Castracane says, has its arms spirally wound with a prickly line, sometimes two. The large circular valve of this species; the deep socketing of the arms or rays; the large number of these, 25; and the very convex valve, hyaline except for a central bead or umbo, combine to make it sufficiently dissimilar from *B. varians* to warrant a new name. I question its being the terminal form described in the Report of the Challenger Expedition (pl. 14, fig. 2), which is probably *B. hyalinum* Lauder. (See Micro. Journ., 1864, pl. 3, fig. 7a.) But it should be added that, as no good figure or description of the terminal valve of *B. hyalinum* Lauder is known, I can not affirm that my own form will not prove to belong to that species. As pointed out elsewhere, the specific name "*variens*" has doubtless been responsible for referring almost every *Bacteriastrum*-shaped *Chaetoceros* to this convenient depository.

Diameter of disk, 0.047; diameter with arms, 0.189 mm.

**CHAETOCEROS SCOLOPENDRA Cleve**

(Gran, Norweg. N. Atl. Exp., pl. 4, fig. 53; Cleve, Plankt. Sweden, pl. 1, fig. 5.)

This sharply marked species is quite common at the Philippine Islands.

**CHAETOCEROS SOCIALE Lauder**

(Micro. Journ., 1864, p. 77, pl. 8, fig. 1; Gran, Nord. Plank., fig. 123.)

Doubtless this diatom is more abundant than is recorded. It is easily overlooked in water or Canada balsam mounts, but shows up well in high refractive media, like barium-mercuric iodide.

## CHAETOCEROS (BACTERIASTRUM) VARIANS (Lauder) Van Heurck

(Van Heurck, Synopsis, pl. 80, figs. 3-5; H. L. Smith, Types, No. 57.)

The specific name is well chosen, *B. furcatum* Shadbolt, *B. curvatum* Shadbolt, and other so-called species belonging here. Nevertheless the aptness of the name has unquestionably led diatomists to refer forms here which a closer inspection would prove to be distinct. The temptation to put any delicate, circular form with radiating setae in this species is like that which has made *Biddulphia polymorpha* the acceptable for a good many unrelated species.

See under *C. medusa* above.

## CHRYSANTHEMODISCUS, new genus

Front (valve) view circular; inverted saucer-shaped, that is, barely convex to within about one-tenth of the radial distance to the margin, then rapidly curving to the margin; a circular and sharply marked central area or umbilicus, about one-eighth of the diameter of the valve in width, covered with round or oval beads, the outer row closely set and forming a perfect circle, those within evenly but not radially arranged; the rest of the valve marked with crowded radial lines or costae, slightly wider at their inner (umbilical) end and barely tapering to the margin, obscurely cross-marked but not divided into beads, somewhat tortuous, with shorter secondary lines so interspaced between them that the whole valve is evenly covered with a fine radial marking, as in certain members of the genera *Coscinodiscus*, *Actinocyclus*, etc.; the two valves similar; rim narrow, hyaline.

This genus somewhat resembles *Coscinodiscus* and still more nearly *Hyalodiscus*, from which, however, the strong radial lines and the robust central area covered with large well-formed beads unmistakably separate it. The width and ornamentation of the girdle is unknown, as no complete frustules were found. It is also questionable whether or not the frustules grow attached in pairs or chains, as in *Hyalodiscus* and *Melosira*; but the finished character of the central area implies that such is not the case.

## CHRYSANTHEMODISCUS FLORIATUS, new species

Plate 13, fig. 1

General characters as in the genus. Mounted specimens frequently split inward from the margin into numerous petallike divisions, because of the convexity of the valve close to the edge and the delicate thinness of the valve between the closely set radial lines or costae.

Diameter of valve, 0.152 to 0.203; diameter of umbilicus, 0.025 to 0.028 mm. Not uncommon in two of the Philippine Islands dredgings, one being from the Sulu Island group.

*Type*.—Cat. No. 43606, U.S.N.M.

Genus *CISTULA* Cleve

(Cleve, Nav. Diat., vol. 1, p. 124.)

*CISTULA LORENZIANA* (Grunow) Cleve

(Wien. Verh., 1860, p. 547, pl. 1, fig. 3; Cleve, Nav. Diat., vol. 1, p. 124, pl. 1, fig. 31.)

Although Cleve's suggestion to create a new genus for this unique diatom does not seem to meet with general favor, I think it is justified. Its bisymmetrical valve with a rhaps give it indeed a *Navicula*-like appearance; but its rectangular form, its peculiar undulating sculpture and the ends of the rhaps set back from the extremities of the valve mark it out from *Navicula* more sharply than do those of such generally recognized genera as *Tropidoneis*, *Scolioptleura*, etc. While standing with Van Heurck in seeing the subgeneric but not the generic worth of most of the proposed new genera into which Cleve has divided the huge genus, *Navicula*, I think this and *Cymatoneis* at least are capable of such sharply cut distinction as deserve acceptance. This is another species found at both Campeche Bay and the Philippine Islands.

Genus *CLAVICULA* Pantocsek*CLAVICULA POLYMORPHA* Grunow

(Pantocsek, Hung. Diat., p. 37, pl. 2, fig. 12; pl. 9, fig. 75; pl. 26, fig. 234, etc.)

Genus *CLIMACOSPHENIA* Ehrenberg*CLIMACOSPHENIA ELONGATA* Bailey

(Schmidt, Atlas, pl. 308, figs. 5-10.)

Whether or not this is a variety of *C. moniligera* Ehrenberg is an open question.

*CLIMACOSPHENIA MONILIGERA* Ehrenberg

(Ehrenberg, Amer., vol. 2, pl. 6, fig. 1; Schmidt, Atlas, pl. 307, figs. 1-9; H. L. Smith. Types No. 631.)

The scarcity of early diatom literature explains Shadbolt's giving this the name *C. catena* (Micro. Journ., 1854, pl. 1, fig. 15). It occurs also in Campeche Bay; but having a rather wide distribution, the fact, taken by itself, has not much significance.

*CLIMACOSPHENIA SCIMITER*, new species

Plate 12, fig. 4

Valve typically club-shaped, but increasing in width evenly from base to apex; strongly curved sideways; its surface faintly marked by transverse moniliform lines, evident at the margin but indistinct toward the middle of the valve; the internal transverse septa delicate, very narrow, and showing at the middle either obscurely or not at all the break or sutural division common to specimens of this genus; about

20 of these septa, thus dividing the valve into 20 or more rectilinear compartments.

Length, 0.414; width, 0.028 mm.

A minute and fragile species that possibly is a sickle-shaped variety of *C. elongata* Bailey (New Species and Localities, p. 8, pl. 1 figs. 10–11), especially as Bailey notes the dimness of the crosslines at the center of the valve, mentioned above. But Bailey's form is more like *C. moniligera* Ehrenberg than like this Philippine form, not only in being straight, but in the cross septa ("vittae") and the more sudden increase in the width of the valve above the long narrow basal part. The fact is, it may be found eventually that both these are merely varietal modifications of *C. moniligera*. Indeed the unique characters of the genus hint at its being monotypic.

*Type*.—Cat. No. 43607, U.S.N.M.

### Genus COCCONEIS (Ehrenberg) Grunow

#### COCCONEIS APICULATA A. Schmidt

(Schmidt, Atlas, pl. 198, fig. 31, and pl. 198, fig. 38, no name.)

I find the figure above with no name to be the same as Schmidt's Atlas, plate 198, figure 31. It may also be synonymous with "*Rhaphoneis mammalis* Cast.," Report of the Challenger Expedition, plate 26, figure 3, but this is uncertain. Were the two the same Castracane's name would stand, being given in 1886 and Schmidt's in 1895.

See a discussion of these forms under *C. citronella*, new species.

#### COCCONEIS CIRCULIFERA, new species

Plate 13, fig. 2

Valve oval, with sharp but not produced apices; markings of closely set lines indistinctly beaded, slightly undulating in unison, so that false longitudinal shadow lines parallel with the margin appear by change of optical focus; a narrow spindle-shaped hyaline area hardly reaching to the apices; on one side, adjacent to this hyaline area, not to the margin of the valve, is a small ring joined to a lunate half ring on its inner side, easily mistaken for two rings, one showing through from under the valve and slightly out of center with the upper first ring, whereas this ring and adjacent semiring are reproduced on each valve. Margin of valve heavy and hyaline.

Length, 0.056; width, 0.036; lines at margin, 11 in 0.01 mm.

Although there is a similarity between this and *Achnanthes heteromorpha* Grunow, as figured in Schmidt's Atlas, plate 198, figures 52–58, the difference in the markings, especially the position of the ocellus and its peculiar double form in this species, would preclude their being united, even if the side (girdle) view did not reveal the absence of any bend across the middle of the frustule, such as belongs to members of the genus *Achnanthes*.

*Type*.—Cat. No. 43608, U.S.N.M.

**COCCONEIS CIRCUMCINCTA** A. Schmidt

See under *C. pellucida* Grunow.

**COCCONEIS CITRINA** A. Schmidt

(Schmidt, Atlas, pl. 198, figs. 28-30.)

See remarks under next species.

**COCCONEIS CITRONELLA**, new species?

Plate 13, figs. 3-6

Valves broadly oval with apiculate apices; lower valve with delicate radiating beaded lines closely set, slightly more evident in a band near each margin, otherwise very obscure and misty; almost reaching the rhapshe but lacking on either side of the central nodule, so that a hyaline stauros is produced which is about one-fifth the width of the valve; upper valve with widely set rows of coarse rectangular beads radially arranged and slightly curved toward the two apices, the outer beads of these rows next to the margins of the valve being plainly larger than the others; a hyaline median line corresponding to the rhapshe line of the lower valve.

Length of valve 0.062-0.070; width of valve 0.034-0.039; lines on upper valve 6.5 in 0.01 mm.; lines on lower valve 21-25 in 0.01 mm.

Great confusion exists about this and some similar species, as the result of Cleve's arbitrary grouping of several dissimilar forms under *Achnanthes mammalis* (Castracane) Cleve in his Naviculoid Diatoms, volume 2, page 187, plate 3, figures 13-16. His name is based on *Rhaphoneis mammalis* Castracane (Chall. Exp., p. 48, pl. 26, fig. 3) which, although not a *Rhaphoneis*, is equally not an *Achnanthes*. But more important is it that both from the figure and the ample description of Castracane, it is evident that we have there a valve with coarse *unbeaded costae*, in no respect like Cleve's diatom except in the similarity of outline. Cleve's form seems to be the same as the diatoms figured in Schmidt's Atlas, plate 198, figures 35, 36, 40, all from Yokohama and all left unnamed by Schmidt. It might be possible to consider these as varieties of *Cocconeis citrina* A. Schmidt, as figured in his Atlas, plate 198, figures 28-30, except that the lower valve of the species as shown in figure 30 is very different. The beading also is less rectangular and more widely spaced, and there is not a trace of the minute double lines of beading shown in Cleve's figure 14. It is also significant that Schmidt himself does not include them in his *C. citrina*. It may be added that *C. citrina* also occurs in the Philippine Islands and is included in this report. There also is no good reason for Cleve including with these *Stauroneis apiculata* Greville (figured in Greville's Diat. Cal. Guano, pl. 4, fig. 8), a species which Schmidt more reasonably makes *Cocconeis apiculata* (Greville)

A. Schmidt and illustrates in the latter's Atlas, plate 198, figures 31-32. A further addition to the Cleve muddle, but for which he was less responsible, is his adding to the above *Stauroneis obesa* Greville, as given in Greville's Diatoms from the South Pacific, page 237, plate 3, figure 12. In fact the under valve of *C. citronella* Mann and *S. obesa* Greville are so remarkably alike at first sight that Cleve would have needed to compare actual specimens of the two to realize their difference. I have accordingly here illustrated the true *S. obesa*, renamed *Navicula obesa* (Greville) Mann, and also a variety of it, for the purpose of comparison. It will be seen that the lines of beading of *N. obesa* are much coarser than in *C. citronella* and differently arranged at the center of the valve. The measurements of the lines are, *C. citronella* 21-25 in 0.01 mm., and *N. obesa* 9.2-9.4 in 0.01 mm., the two diatoms being almost the same size. But what settles the matter is that in *N. obesa* both valves are exactly alike and both have raphes. The specimen here figured is a complete frustule and shows this fact plainly. Doubtless Greville saw this and was certain of the *Navicula* (*Stauroneis*) character of his specimen, a concession to that able diatomist that Cleve failed to make. It may be here added that Castracane's "*Rhaphoneis mammalis*" is probably a synonym of *Cocconeis robustus* Leuduger-Fortmorel in Diatoms of Ceylan, plate 1, figure 1, and that the unnamed figure in Schmidt's Atlas, plate 198, figure 41, is a phase of the same diatom.

*Type*.—Cat. No. 43609, U.S.N.M.

#### COCCONEIS COMPOSITA A. Schmidt

(Schmidt, Atlas, pl. 196, figs. 4-5.)

This is rather close to *C. heteroidea* Hantzsch and could be so classified as a well-marked variety.

#### COCCONEIS CURVIROTUNDA Tempère and Brun

(Brun, Diat. Jap., p. 32, pl. 8, fig. 6; Schmidt, Atlas, pl. 195, figs. 12-16.)

This also is close to *C. heteroidea* Hantzsch; De Toni (Syl. Alg., p. 456) considers it to be intermediate between *C. heteroidea* and *C. pellucida* Grunow.

#### COCCONEIS CYCLOPHORA Grunow

(Van Heurck, Synopsis, pl. 30, figs. 24-25; Schmidt, Atlas, pl. 197, figs. 20, 26, 30.)

#### COCCONEIS DISTANS Gregory

(Gregory, Glenshira, Diat., pl. 4, fig. 9; Diat., Clyde, pl. 1, fig. 23; H. L. Smith, Types, No. 70.)

An enormous number of species has been grouped by De Toni and others under the very variable *C. scutellum* Ehrenberg, of which this is one. Without passing judgment on the others, I am sure this species can not be so disposed of without rendering more difficult its

identification, a use which I hold to be at present the principal one in diatom taxonomy.

**COCCONEIS DIVISA** A. Schmidt

(Schmidt, Atlas, pl. 198, fig. 12.)

**COCCONEIS FULGUR** Brun

(Brun, Espec. Nouv., pl. 18, fig. 3; Schmidt, Atlas, pl. 198, figs. 20-21, doubtful.)

**COCCONEIS HETEROIDEA** Hantzsch

(Schmidt, Atlas, pl. 196, figs. 31-41; H. L. Smith, Types, No. 73.)

**COCCONEIS INSIGNIS** Janisch

(Schmidt, Atlas, pl. 197, figs. 2-3.)

**COCCONEIS OCELLATA**, new species

Plate 14, fig. 1

Valve broadly oval, covered with somewhat wavy rows of closely set beading, the spaces between the rows about equal to them in width; progressively curved away from the center as they approach the ends of the valve, reaching from the margin to the rhapshe line and therefore leaving no hyaline space on either side of the rhapshe; near the margin the rows regularly but not invariably fork into two smaller rows, thereby producing a border effect along the margin; markings of upper and under valves the same; a large, evident, but indistinctly outlined ocellus set to one side of the middle of the valve, smaller and less distinct on the under valve.

Length, 0.062-0.082; width, 0.048-0.062 mm.; lines, 5.5 in 0.01, at the rhapshe.

*Type*.—Cat. No. 43610, U.S.N.M.

**COCCONEIS OCULUS-CATI** Brun

(Brun, Espec. Nouv., p. 17, pl. 18, fig. 5.)

Schmidt's *C. hospes* (Atlas, pl. 198, figs. 4-6) resembles this species, but is probably distinct.

**COCCONEIS OS-PRISTIS**, new species

Plate 14, fig. 2

Valve oval in general shape, but somewhat angular in outline, the sides being slightly convex until within one-third of the apex, then bent at an obtuse angle and continuing straight to the sharp but not produced apex; strong, smooth radiating costae tapering inward, swollen at the marginal ends to semibeads, the pointed inner ends not approaching the rhapshe line but leaving a spindle-shaped central hyaline area reaching to the two apices and about equal in width to the costal area on either side; costal marking alike on both valves.

Length, 0.065-0.070; width, 0.035-0.037 mm.; lines, 3.6-4 in 0.01 mm.

*Type*.—Cat. No. 43611, U.S.N.M.

**COCCONEIS PELLUCIDA** Grunow

(Hantzsch, Diat., Ostind., pl. 6, fig. 11; Schmidt, Atlas, pl. 194, fig. 27; pl. 195, fig. 3.)

Although De Toni notes the similarity between this and *C. pseudomarginata* Gregory, his not uniting them is probably right. But he removes from this Grunow's figure in Neue and Ungenügend Diatomaceen, plate 13, figure 6, and puts it in *C. pseudomarginata* Gregory (Syl. Alg., pp. 455, 457).

**COCCONEIS PINNATA** Gregory

(Micro. Journ., 1859, p. 79, pl. 6, fig. 1; Schmidt, Atlas, pl. 189, figs. 1-5; pl. 190, fig. 3.)

De Toni can not be sustained in placing this under *C. brundusiaca* Rabenhorst (Rabenhorst, Suss. Diat., pl. 3, fig. 16.)

**COCCONEIS PSEUDOMARGINATA** Gregory

(Gregory, Diat., Clyde, pl. 9, fig. 27; Schmidt, Atlas, pl. 194, figs. 5-7; H. L. Smith, Types, No. 74.)

**COCCONEIS TRANSVERSA** A. Schmidt

(Schmidt, Atlas, pl. 196, fig. 39.)

**Genus COSCINODISCUS** Ehrenberg**COSCINODISCUS AFRICANUS** Janisch

(Janisch, Gaz. Exp., pl. 3, fig. 2; Schmidt, Atlas, pl. 59, figs. 24-25.)

**COSCINODISCUS APOLLINIS** Ehrenberg

(Ehrenberg, Mikrogeologie, pl. 35A, sec. 22, fig. 4.)

There is not much doubt that this and *C. scintillans* Greville (Quart. Journ. Micro. Soc., 1863, p. 230, pl. 10, fig. 6) are the same (see Rattray, Rev. Cosc., p. 578). My specimen agrees fully with that in Schmidt's Nordseefahrt Diatomaceen, plate 3, figure 33, to which Rattray attaches the varietal name, *compacta*. Greville's type came from the fossil bed at Cambridge, Barbados, and Ehrenberg's from a dredging in the Antarctic, while Grove reports it from the fossil deposit of Oamaru, New Zealand, a rather strikingly wide distribution in time and space. The very similar *C. galapagensis* Rattray, figured as *C. griseus* Greville, in Van Heurck's Synopsis, plate 128, figure 7, and plate 132, figure 1, led me in my Diatoms of the Albatross Voyages (p. 252) to place this variety of *apollinis* with it. Although difficult to separate these two, their union was hardly justified. Rattray is correct in throwing out of this combination "*C. scintillans* Greville" in H. L. Smith's Types, No. 99.



**COSCINODISCUS ASTEROMPHALUS Ehrenberg**

(Ehrenberg, Mikrogeologie, pl. 18, fig. 45; Schmidt, Atlas, pl. 63, figs. 5, 12, and pl. 113, fig. 23.)

A species of cosmopolitan distribution, and although showing correspondingly wide variation, too frequently mixed with other names which ought to be kept separate, as *C. biangulatus* A. Schmidt, *C. omphalanthus* Ehrenberg, *C. centralis* Ehrenberg, etc. Of course species are hard to outline sharply in this huge genus because of the comparative simplicity of pattern on which all are built; and it is therefore largely a matter of conjecture where the specific boundaries will run. Thus, although the type form of *C. oculus-iridis* of Ehrenberg is quite different from the type form of this species, one meets with intermediate forms that might as well go into one species as the other.

**COSCINODISCUS CENTRALIS Ehrenberg**

(Ehrenberg, Mikrogeologie, pl. 18, fig. 39; pl. 22, fig. 1; Gregory, Diat. Clyde, pl. 11, fig. 49.)

**COSCINODISCUS CERVINUS (Brightwell) Ralfs**

See *Hyalodiscus cervinus* Brightwell.

**COSCINODISCUS CILIATUS, new species**

Plate 14, fig. 3

Valve circular, barely convex until near the margin, then strongly so; covered with radiating rows of closely set beading uniform in size; the three or four beads in each row nearest to the margin are perhaps slightly smaller than the others; no hyaline central space, or definite rosette; two rows of fine but evident spines close to the margin, pointed outward, those in one row generally alternating with those in the other; rim strong and hyaline.

Diameter, 0.082–0.087 mm.

Karsten's *C. horridus* (Valdivia Exp., pl. 5, fig. 9) is nearest to this handsome form.

*Type*.—Cat. No. 43612, U.S.N.M.

**COSCINODISCUS CONCINNUS W. Smith**

(Quart. Journ. Micro. Sci., 1858, pl. 3, fig. 12; Pritchard, Inf., pl. 5, fig. 89; Schmidt, Atlas, pl. 113, fig. 8.)

This species is of very wide distribution and of bewildering complexity of synonyms. There is also a wide range of difference in size and in the fineness of the areolation. The prevailing Philippine Islands form is small but robust and coarsely netted. Whether or not the original type has the two blunt marginal processes, set apart

at about two-fifths of the circumference, which is the most characteristic mark of this species, I do not know, not having access to Smith's specimen; but his figure fails to show it; as do some other of the earlier illustrations. Without these it is easily confused with delicate specimens of *C. centralis*. Its color when dry has no distinctive valve, yellow, buff, brown, and even blue-green valves being present in the same slide.

**COSCINODISCUS DENTICULATUS** Castracane

(Castracane, Chall. Exp., pl. 3, fig. 8; Rattray, Rev. Cosc., p. 83.)

**COSCINODISCUS EXCENTRICUS** Ehrenberg

(Ehrenberg, Mikrogeologie, pl. 18, fig. 32, pl. 21, fig. 6; Schmidt, Atlas, pl. 58; figs. 46-49; Van Heurck, Synopsis, pl. 130, figs. 4, 7, 8.)

**COSCINODISCUS EXIGUUS** Rattray

(Schmidt, Atlas, pl. 58, fig. 30 (no name); Rattray, Rev. Cosc., p. 130.)

This is another species peculiar to both Campeche Bay and the Philippine Islands.

**COSCINODISCUS GAZELLAE** Janisch

(Grunow, Diat., Casp. Meere (Kitton's translation) in Journ. Roy. Micro. Soc., 1879, pl. 21, fig. 8; Castracane, Chall. Exp., pl. 14, fig. 4 (no name); Rattray, Rev. Cosc., p. 98.)

There is no adequate description and no good illustration of this remarkable diatom. The figure in the Report of the *Challenger* Expedition is a mere fragment of the valve and that in Kitton's translation is indistinct. Nor is there much help to be obtained from the "*Ethmodiscus*" figures in the Report of the *Challenger* Expedition (pl. 14, fig. 3, 4a-4c (not 4), 5, 6; pl. 22, fig. 10) which Rattray huddles together as synonyms of this species (see Rattray, Rev. Cosc., p. 98). The diatom is almost impossible to find unbroken, though it is abundant in the Philippine Islands, because of its enormous size and its extremely fragile character. Its most striking mark of distinction is the many short wavy lines running transversely across the delicate radiating beading of the valve, this cross-hatching becoming more abundant toward the the margin. This is well shown in the unnamed fragment in the above-mentioned Report of the *Challenger* Expedition (pl. 14, fig. 4; not 4a-4c). By this it may be easily distinguished from the somewhat smaller *C. rex* Wallich, as well as by the absence of the cluster of papillae in the central area of the latter.

**COSCINODISCUS HETEROMORPHUS** Rattray

(Schmidt, Atlas, pl. 65, fig. 17 (no name); Rattray, Rev. Cosc., p. 468 (p. 20).)

It bears considerable resemblance to *C. splendidus* Greville as shown in the Microscopical Journal for 1865, plate 5, figure 3, but not to the

figure in Schmidt's Atlas, plate 65, figure 11. Only one, but an unmistakable specimen, of this diatom was found, the type of which is marked as coming from "Piscataway."

**COSCINODISCUS JANISCHII** A. Schmidt

(Schmidt, Atlas, pl. 64, figs. 3-4.)

**COSCINODISCUS KUETZINGII** A. Schmidt

(Schmidt, Atlas, pl. 57, figs. 17-18; Gran, Nord. Plank., p. 36, fig. 38.)

**COSCINODISCUS LENTIGINOSUS** Janisch

(Janisch, Gaz. Exp., pl. 5, fig. 7.; Schmidt, Atlas, pl. 58, fig. 11.)

**COSCINODISCUS LEPTOPUS** Grunow

(Van Heurek, Synopsis, pl. 131, figs. 5-6.)

This is easily confused with *C. lineatus* Ehrenberg, which see.

**COSCINODISCUS LINEATUS** Ehrenberg

(Ehrenberg, Mikrogeologie, pl. 18, fig. 33; pl. 22, fig. 6a, b; Van Heurek, Synopsis, pl. 131, fig. 3; Schmidt, Atlas, pl. 59, figs. 27, 32.)

If there were need to select the the six most important diatoms this would be one. Its present geographical distribution is almost universal; and its general presence in fossil deposits from all parts of the world indicates it is one of a few species that have held their type characteristics unchanged from the beginning. Whether or not certain forms similar to it have branched off from it as the parent stock, it is at present impossible to say. But the resemblance of *C. excentricus* and *C. leptopus* to it is worthy of comment, when taken in connection with the fact that one does find occasionally individuals in which the linear network is disturbed so as to duplicate that of *C. excentricus*, and also there occur cases in which the single rod-like process on the margin of *C. leptopus* can be discovered on the margin of this species. The above figures in Van Heurek and in Schmidt's Atlas will enable one to distinguish between these similar forms.

**COSCINODISCUS MARGINATUS** Ehrenberg

(Ehrenberg, Mikrogeologie, pl. 18, fig. 44; pl. 33, sec. 12, fig. 13; Schmidt, Atlas, pl. 62, figs. 1-5.)

For a discussion of the haphazard use of this name and *Coscino discus robustus* Greville, see Mann's Diatoms of the Albatross Voyages, page 254. There are also some figures bearing this name which clearly belong to other species; for example, the one in Schmidt's Nord-seefahrt Diatomaceen, plate 3, figure 35, which is *C. kutzingii* A. Schmidt.

As bearing on this subject it may be here stated, that a recent examination of many specimens of *Coscinodiscus robustus* Greville, collected

in Monterey Bay, Calif., the original locality of Greville's type specimen, unmistakably shows that it is not a *Coscinodiscus* but an *Endictya*. This fact will be set forth in an illustrated article now under preparation. Meanwhile a study of Greville's figure in *Microscopical Journal* for 1865, plate 1, figure 8, as well as the one in Schmidt's Atlas, plate 65, figure 9, called *C. subvelatus* Grunow, also from Monterey, and the unnamed figure in Schmidt's Atlas, plate 62, figure 16, from Monterey, will make evident how *Endictya*-like these illustrations really are. That the true generic character of that diatom was not long ago suspected is due to the fact that Greville's type specimen is lost, as stated by Rattray, and further, the lack of any illustration of the girdle view of the diatom, which is typically that of *Endictya*.

COSCINODISCUS MICANS A. Schmidt

(Schmidt, Atlas, pl. 139, figs. 2-3.)

*C. radiosus* Grunow, especially as figured by Janisch (Gaz., Exp., pl. 5, fig. 9) is rather close to this.

COSCINODISCUS NANO-LINEATUS, new species

Plate 14, fig. 4

Valve circular, moderately convex to the margin; areolation linear, not radiating, the beads largest at the center and closely set, slightly decreasing toward the margin and proportionally more widely spaced; a single row of short, stout, sharply pointed spines next to the margin and pointing outward.

Diameter, 0.027 mm.

This appears to be essentially the species represented by the unnamed figure in Janisch's *Diatoms of the Gazelle Expedition*, plate 20, figure 16. It is also like the doubtful example of *C. lineatus* Ehrenberg in Schmidt's Atlas, plate 59, figure 30, except that *lineatus* is not at all convex, its areolation is not progressively smaller from center to margin and the apiculi are minute or absent. To unite the above uniformly unlike and minute species with *C. lineatus* is therefore to negate most of the specific characters of the latter. In fact, Schmidt in his Atlas, plate 114, figure 13 declines to unite the form there figured with *C. lineatus* solely on the ground of its convexity, a procedure which is perhaps too arbitrary and is rejected by Rattray in his Revision of the *Coscinodiscus* (p. 473).

*Type*.—Cat. No. 43613, U.S.N.M.

COSCINODISCUS NITIDULUS Grunow

(Schmidt, Atlas, pl. 58, figs. 20-21; Van Heurck, Synopsis, pl. 132, fig. 2.)

This is another species common to Campeche Bay and the Philippine Islands.

**COSCINODISCUS NITIDUS** Gregory

(Gregory, Diat., Clyde, p. 27, pl. 10, fig. 45; Schmidt, Atlas, pl. 58, fig. 18.)

**COSCINODISCUS NOBILIS** Grunow

(Grunow, Diat., Casp. See (Kitton's Translation) in Journ. Roy. Mic. Soc., 1879, pl. 1, fig. 1; Janisch, Gaz. Exp., pl. 2, fig. 6; pl. 6, fig. 13.)

**COSCINODISCUS NODULIFER** Janisch

(Schmidt, Atlas, pl. 59, figs. 20-23.)

**COSCINODISCUS NORMANII** Gregory

(Micro. Journ., 1859, p. 80, pl. 6, fig. 3; Schmidt, Atlas, pl. 57, figs 9-10, misnamed.)

**COSCINODISCUS OCLUS-IRIDIS** Ehrenberg

(Ehrenberg, Mikrogeologie, pl. 18, fig. 42; pl. 19, fig. 2; Schmidt, Atlas, pl. 63, figs. 6, 7, 9; pl. 113, figs. 1, 3-5, 20.)

Ehrenberg's *C. centralis*, figured in Mikrogeologie, plate 18, figure 30, and plate 22, figure 1, is quite distinct from this; but what he calls by that name in plate 21, figure 3 is probably this species. The same is true of what Castracane misnames *C. centralis* in the Reports of the Challenger Expedition, plate 2, figure 3.

**COSCINODISCUS PRAETEXTUS** Janisch

(Janisch, Gaz. Exp., pl. 3, fig. 4.)

Ratray is wrong in naming this the same as *C. gigas* Ehrenberg. See Ehrenberg's Mikrogeologie, plate 18, figure 34.

**COSCINODISCUS PUSTULATUS** Mann

(Mann, Diat., Albatross Voyages, p. 257, pl. 48, fig. 3.)

**COSCINODISCUS RADIATUS** Ehrenburg

(Ehrenberg, Mikrogeologie, pl. 19, fig. 1; pl. 22, fig. 3; Schmidt, Atlas, pl. 60, figs. 5, 6, 9; pl. 62, fig. 18.)

I do not agree with De Toni (Syl. Alg., p. 1246) that *C. devius* A. Schmidt in his atlas, plate 60, figures 1-4, is a small variety of this species

**COSCINODISCUS RADIOSUS** Grunow

(Van Heurck, Synopsis, pl. 132, fig. 7.)

As noted under *C. micans* A. Schmidt, it and this species are similar.

**COSCINODISCUS RENIFORMIS** Castracane

(Castracane, Chall. Exp., p. 160, pl. 12, fig. 12. See Janisch, Gaz. Exp., pl. 1, figs. 1-5, and Schmidt, Atlas, pl. 140, fig. 17, misnamed.)

This strangely shaped diatom is rather widely distributed and, though varying somewhat in contour and fineness of network, keeps closely to its type. It is a radically distinct species in the genus

*Coscinodiscus*; but it can no more be separated from that genus because of its contour, whether studied in its valve or in its girdle aspect, than can *Surirella reniformis* Grunow be separated from *Surirella*. Rattray is therefore right (Rev. Cosc., p. 548) in preferring the above name, rather than *Stoschia admirabilis* Janisch issued in his manuscript of the Diatoms of the Gazelle Expedition (1888) and accepted by Schmidt in his Atlas, plate 140, figure 17 (1889). Castracane's name was published in 1887.

**COSCINODISCUS REX** Wallich

(Schmidt, Atlas, pl. 114, fig. 7.)

This diatom is so fragile that its presence in some gatherings probably remains undetected despite its huge size.

**COSCINODISCUS SCITULUS**, new species

Plate 14, fig. 5

Valve circular, flat to within one-third of the radial length from the margin, then strongly convex for a half of that distance, whence it slopes gently down to the margin; the entire valve covered with radiating rows of beads equal in size; no central hayline area or rosette, but the beading of the secondary rows so falling short in approaching the center as to leave narrow vacant lines and thereby to produce the "sunburst" effect characteristic of the genus *Actinocyclus*; near the margin one or two rows of fine spines irregularly placed, and next to the rim a strong row of short, heavy, blunt processes extending across the rim, thereby giving to it the aspect of being divided into scallops.

Diameter, 0.052 mm.

There is a slight resemblance between this and *C. bullatus* Janisch (Gaz. Exp., pl. 6, fig. 12).

*Type*.—Cat. No. 43614, U.S.N.M.

**COSCINODISCUS SUBTILIS** Ehrenberg

(Ehrenberg, Mikrogeologie, pl. 18, figs. 35a-b; Schmidt, Atlas, pl. 57, figs. 11-13, 28, 29; Van Heurck, Synopsis, pl. 131, fig. 1.)

A species of very wide distribution and great variability.

**COSCINODISCUS SYMMETRICUS** Greville

(Micro, Journ., 1861, pl. 8, fig. 2.)

De Toni (Syl. Alg., p. 1229) excludes the figures bearing this name in Schmidt's Atlas, plate 57, figures 25-27, and probably rightly so.

**COSCINODISCUS TUBIFORMIS** Tempère and Brun

(Brun, Diat., Jap., p. 34, pl. 7, fig. 6; Schmidt, Atlas, pl. 164, fig. 1.)

The finding of a specimen of this diatom in a Philippine Islands dredging increases a doubt I have had for some time of its being anything but a small and robust form of some other species, for example

*C. marginatus* Ehrenberg. It occurs also in the marine fossil deposit at Lompoc, Calif., and abundantly in a living state in Bering Sea.

**COSCINODISCUS VARIOLATUS** Castracane

(Castracane, Chall. Exp., p. 155, pl. 2, fig. 5.)

I hardly feel ready to accept Rattray's contention that this is only a variety of *C. denarius* A. Schmidt. (See Rattray, Rev. Cosc., p. 57, and compare with Schmidt, Atlas, pl. 57, figs. 19-21.) But if this is so, it is another case where the same diatom is common to Campeche Bay and the Philippine Islands. Castracane's type came from the Philippine Islands and *C. denarius* is reported by Schmidt from Campeche Bay.

**Genus CRASPEDODISCUS** Ehrenberg

**CRASPEDODISCUS INSIGNIS** A. Schmidt

(Schmidt, Atlas, pl. 66, fig. 2.)

A study of this diatom suggests the question if this is not better regarded as a species of *Endictya*.

**Genus CYCLOTELLA** Kutzing

**CYCLOTELLA CRASSILINEATA**, new species

Plate 14, fig. 6

Valve circular, somewhat transversely undulate; an outer area, forming a band one-third the radius in width, strongly marked with closely set radiating moniliform costae, their beading being rather widely separated; within this band a circular central area, sparsely punctate with irregular dots.

Diameter 0.039 to 0.051 mm.

*Type*.—Cat. No. 43615, U.S.N.M.

**CYCLOTELLA STRIATA** (Kutzing) Grunow

(Van Heurek, Synopsis, pl. 92, figs. 6-10, 12-15; Schmidt, Atlas, pl. 223, figs. 9-20.)

**Genus CYMATONEIS** Cleve

**CYMATONEIS CIRCUMVALLATA** Cleve

(Schmidt, Atlas, pl. 212, fig. 48.)

It seems to me Cleve's removal of this diatom and *C. sulcata* from *Navicula* into his new genus, *Cymatoneis*, is an aid to classification, although he subsequently abandoned the idea. It is one of the few proposed new genera into which he tried to break up the unwieldy genus *Navicula* that seems to be sufficiently unlike the typical *Navicula* structure to be safely usable. It certainly is no more like the *Navicula* image, as it has gradually shaped itself in the minds of diatomists, than *Scoliopleura* or *Brebissonia* or *Tropidoneis*. Its sharply defined central area, its sigmoid shape, its unique rhaps terminating at each end in a spine, and its sui generis style of beading give to it

an unlikeness to what we picture as a "*Navicula*" and make its new classification a convenience to the taxonomist. Nor does it seem to me to signify that each of these marks of distinction may be found separately in some aberrant species of *Navicula*; for the same contention would destroy a good many accepted genera.

**CYMATONEIS DEFINITA, new species**

Plate 15, fig. 1

Valve prismatic-elliptical, its side nearly straight from the wide middle to the blunt apices, these being not at all produced; the narrow elliptical median area only slightly elevated above the rest of the valve at its two extremities and none at its middle; the entire valve, including the median area, covered with coarse rows of beading, the beads closely set in each row, the rows well separated, the beading so evenly arranged as to show false longitudinal striation as well as the cross striation; this striation transverse at the middle, increasingly radial toward the apices, and there arranged fanwise; rhaps straight, terminating outwardly in two long straight spines, its inner ends actually overlapping, the tips bent to opposite sides.

Length, 0.110; width, 0.046; lines, 4.2 in 0.01 mm.

*Type*.—Cat. No. 43616, U.S.N.M.

**CYMATONEIS LACUNATA, new species**

Plate 15, fig. 2

Valve oval, strongly convex, modified by a shoulder close to each apex, the apices bluntly rounded; markings of transverse, closely set rows of beading, leaving a narrow, somewhat sigmoid, perfectly hyaline central area, which is bisected by the sigmoid rhaps, at the two extremities of which are two strong pointed spines, obliquely turned outward; beading so regularly spaced in the rows that they fall into longitudinal as well as transverse lines.

Length, 0.053–0.096; width, 0.029–0.045; lines, 6.5–7.5 in 0.01 mm.

*Type*.—Cat. No. 43617, U.S.N.M.

**CYMATONEIS SUFFLATA, new species**

Plate 15, fig. 3

Valve elliptical or subrectangular, with barely convex sides, quickly rounded up to the produced papillate apices; central area elevated, extending to the apices, marked like the rest of the valve, except for a narrow hyaline area on either side of the rhaps and a slightly enlarged hyaline area about the central nodule; these valve markings strong, of closely set rectangular beads in transverse rows, becoming slightly curved and radial toward the apices, showing longitudinal lines, which become slightly incurved toward the apices and thereby



preserve the right-angle crossing of the two sets of lines; rhaps practically straight and having a distinct oblique spine at each outer end.

Length, 0.039; width, 0.023; lines, 9.5 transverse and 10 vertical in 0.01 mm.

*Type*.—Cat. No. 43618, U.S.N.M.

**CYMATONEIS SULCATA** (Greville) Cleve

(Cleve, Nav. Diat., vol. 1, p. 75, pl. 1, figs. 12–13; Schmidt, Atlas, pl. 212, figs. 41–45.)

This is another species found at both Campeche Bay and the Philippine Islands.

**Genus CYMBELLA** Agardh

**CYMBELLA EHRENBERGHII** Kützing

(Schmidt, Atlas, pl. 9, figs. 6–9, 16–18; Van Heurck, Synopsis, pl. 2, figs. 1–2.)

**CYMBELLA GASTROIDES** Kützing

(Schmidt, Atlas, pl. 9, figs. 1–2; Van Heurck, Synopsis, pl. 2, fig. 8; H. L. Smith, Types, No. 118.)

**Genus DIMEREGRAMMA** Ralfs

**DIMEREGRAMMA BILINEATUM** (Cleve and Grunow) Mann

Plate 15, fig. 4

(Cleve, Vega Diat., p. 499, pl. 37, fig. 55.)

The doubt of this being a *Rhaphoneis* expressed by the authors, is well founded. A careful study convinces me it is better classified in the present genus. A form found in the Philippine Islands is either a very dissimilar variety from those figured by Cleve, or preferably should be made into a separate species. In this case it may be called—

**DIMEREGRAMMA FLUENS**, new species

Plate 15, fig. 5

Valve nearly rod shaped, but gracefully undulate by being broadly constricted at the middle and tapering gently to the rounded ends; a double row of course rectangular beads on either side next to the margin until near the ends they become single rows, each bead marked with one or two dots; central area narrow, tapering, not constricted; apices slightly elevated, massive, hyaline.

Length 0.105; width 0.012; 7 lines in 0.01 mm.

*Type*.—Cat. No. 43619, U.S.N.M.

**DIMEREGRAMMA INFLATUM** Mann

(Mann, Diat., Alb. Voyages, p. 327, pl. 44, fig. 6.)

For a discussion of the relationship of this to Gregory's *Denticula marina*, see the above reference.

**DIMEREGRAMMA MINOR** (Gregory) Ralfs

(Van Heurck, Synopsis, pl. 36, figs. 10–11a; Gregory, Diat., Clyde, pl. 2, fig. 35.)

**DIMEREGRAMMA NANUM** (Gregory) Ralfs

(Pritchard, Inf., p. 790, pl. 4, fig. 33; Van Heurck, Synopsis, pl. 36, fig. 11.)

**DIMEREGRAMMA OPULENS**, new species

Plate 15, figs. 6–7

Valve elongated, naviculoid, constricted at the middle, then enlarged and again constricted, whence the sides either run parallel to the rounded apices or slightly approach each other; the entire valve, except the apices, crossed transversely by massive moniliform costae, divided into four parts by three narrow longitudinal lines, two of them midway between the center and the sides, and one median line; each of the four parts thus formed is two or three beads wide; apices elevated above the rest of the valve, almost hyaline, but obscurely marked with fine radiating beading.

Length, 0.056–0.079; width, 0.014–0.017; costae, 5.5 in 0.01 mm.

*Type*.—Cat. No. 43620, U.S.N.M.

**DIMEREGRAMMA PRISMATICUM**, new species

Plate 15, fig. 8

Valve elliptical, prismatic, with acute apices; sides parallel at the middle for one-third the length of the valve, then converging in straight lines to the acute but rounded apices; valve transversely crossed by heavy moniliform costae unequally divided into four parts by three longitudinal and narrow lines, the median line being widest at the center and narrowing toward the apices; the two outer or marginal parts of the four divisions of the costal area one-half the width of the two inner parts, each of the former ornamented with two beads and each of the latter with four beads; apical area small, triangular, elevated above the rest of the valve, and hyaline.

Length 0.045; width 0.017; costae 5 in 0.01 mm.

*Type*.—Cat. No. 43621, U.S.N.M.

**Genus DITYLUM** Bailey**DITYLUM BRIGHTWELLII** (West) Grunow

(Van Heurck, Synopsis, pl. 114, figs. 3–9; Micro. Journ., 1860, pl. 8, figs. 1, 5, 8.)

It is not advisable to change Bailey's spelling of the generic name to *Ditylium*.

**Genus DONKINIA** Ralfs

For a discussion of the reasons for separating this and *Rhoicosigma* from *Pleurosigma* see under those two genera.

**DONKINIA CARINATA** (Donkin) Ralfs

(Pritchard, Inf., p. 921, pl. 8, fig. 49; H. L. Smith, Types, No. 143; Peragallo, Pleuro., pl. 9, fig. 6.)

**DONKINIA RETICULATA** Norman

(Greville, Diat., So. Pacific, pl. 3, figs. 13-14; Peragallo, Pleuro., pl. 9, fig. 2.)  
Greville's figure is ideal and Peragallo's poor.

**ECHINODISCUS**, new genus

Valve circular, slightly convex to the elevated rim, then turned vertically downward to form deep sides perpendicular to the central portion of the valve, and finally expanded into a narrow hyaline flange, where the valve joins the girdle; central portion of the valve irregular, covered with circular splotches united by veriform lines into larger or smaller patches, thickly (but irregularly) scattered over the surface; the elevated rim and the vertical sides of the valve closely covered with a fringe of irregularly shaped prickles, and at one point on the rim a broad lunate or hemispherical process.

**ECHINODISCUS VERMICULATUS**, new species

Plate 16, fig. 1

Characters those of the genus.

Diameter 0.169 mm.; depth of vertical side 0.01 mm.

It is probable that the two unnamed figures in Schmidt's Atlas plate 164, figure 6 and plate 202, figure 3, from the near-by locality of Jeddo, Japan, are examples of the same genus. If so, the vermiculate character of the markings here represented can be looked upon as a somewhat abnormal phase of the more regular radiating pattern shown in Schmidt's two figures. In that case, the specific name here given should apply only to the spines or prickles covering the rim and sides. It is evident that none of these forms can be referred to the genus *Stephanopyxis*, as Schmidt suggests. A much closer affinity exists between this and *Endictya*, to which further specimens may prove it belongs. The above-mentioned lunate process on the rim, in that view of the case, would only be an aberrant occurrence confined to those clearly fantastic specimens. I have, however, thought best to represent this interesting diatom exactly as it is, leaving its validity subject to the foregoing remarks.

*Type*.—Cat. No. 43622, U.S.N.M.

**Genus ENDICTYA** Ehernberg**ENDICTYA MARGARITIFERA**, new species

Plate 15, figs. 9-10

Surface of the valve barely concave to the rim, which is elevated above the inner portion and sharply turned downward to form the deep vertical sides, to the lower edge of which the girdle is attached; both

the circular portion of the valve included within the rim and the vertical sides or flange are ornamented with massive, polished disks or flattened beads, irregularly placed and variable in size, those near the center usually averaging somewhat the larger; the rim is further ornamented with a row of large, elevated pearls or spherical beads, best seen in the girdle view.

Diameter, 0.096–0.124; width of vertical sides of flange, about 0.037 mm. Beads average 0.006 mm. in diameter.

It is possible the *Endictya* form in Schmidt's Atlas, plate 62, figure 8 (unnamed), from Celibes should be included here, as Schmidt states its rim is ornamented with "zahlreichen knötchen tragenden Stacheln." There is a close but fictitious resemblance to the Philippine Islands form in the Report of the Challenger Expedition (pl. 22, fig. 4); for, if the description on page 162 is taken into account, that diatom has so convex a valve that Castracane suspects it should be placed in (*Stephanopyxis*) *Pyxidicula*; and furthermore, its entire valve is ornamented with "tuberculate processes having hexagonal bases."

It is advisable that the genus *Endictya* shall not be combined with *Coscinodiscus*, as is done by Rattray (Rev. Cosc., p. 450), an arrangement accepted by me in my Diatoms of the Albatross Voyages. It should be retained to accommodate such forms as have valves sharply bent downward at the rim to form vertical sides or flanges at right angles to the surface of the circular portion. This is the position taken by Van Heurck and others. It is, however, further to be said that those forms which Castracane includes in his new genus *Ethmodiscus* should perhaps also be considered to be *Endictyae*, their structure differing from such species as the below *E. oceanica* mainly in the fineness of their markings and the general delicacy of their entire frustules. This would leave for the genus *Coscinodiscus* that large class of diatoms the valves of which, whether flat, concave, or convex, terminate at the rim, where they join the girdle and are not bent vertically down to form deep sides or flanges ornamented with markings continuous with those of the rest of the valve. In fact *Endictya* is much more closely related to *Stephanopyxis*, or even to that subdivision of *Melosira* called *Orthosira* than to *Coscinodiscus*.

*Type*.—Cat. No 43623, U.S.N.M.

#### ENDICTYA MINOR A. Schmidt

(Schmidt, Atlas, pl. 65, figs. 14–16.)

Although this species follows very closely the structural plan of the genus type, *E. oceanica*, specimens of it, both fossil and recent, are so uniform that it can not be classed as a small and robust variety of that species. The type of the present species was found at the near-by Celibes Islands.

**ENDICTYA OCEANICA** Ehrenberg

(Ehrenberg, Mikrogeologie, pl. 35A, sec. 18, figs. 6-7; Schmidt, Atlas, pl. 65, figs. 12-13.)

**Genus EPITHEMIA** Kützing**EPITHEMIA ZEBRA** (Ehrenberg) Kützing

(Smith, Brit. Diat., pl. 1, fig. 4; Van Heurck, Synopsis, pl. 31, figs. 9, 11-14; Schmidt, Atlas, pl. 252, figs. 1-21.)

The natural habitat of this diatom is probably fresh water; but it often occurs in marine gatherings, not as detritus, but as a member of the flora. It also appears in fresh-water fossil deposits. It is rare in the material examined for this paper.

**Genus EUODIA** Bailey**EUODIA JANISCHII** Grunow

See *Leudugeria janischii*.

**Genus FRAGILARIA** Lyngbye**FRAGILARIA ANGUSTATA** Cleve and Grove

(Le Diat., 1891, pl. 8, figs. 19-20.)

Scarce at the Philippine Islands.

**FRAGILARIA DUBIA** Grunow

(Grun, Oester. Diat., pl. 7, fig. 28; Van Heurck, Synopsis, pl. 36, fig. 18.)

As the specific name suggests, it is doubtful if this diatom belongs to the genus *Fragilaria*.

**Genus GLYPHODESMIS** Greville

No adequately sharp line of demarcation between this genus and *Plagiogramma* can be drawn. The ideal *Glyphodesmis* may be said to be *G. williamsonii* (Gregory) Grunow, and the ideal *Plagiogramma*, *P. validum* Greville, and between these two there is a perfectly satisfactory difference. But this is not maintained between other species of the two genera. The most pronounced mark of demarcation is that *Plagiogramma* has an evident hyaline area across the middle of the valve, often with a ridgelike border, and bearing at its center a large disk or elevation, while *Glyphodesmis* has no hyaline central area; its beading also is heavy, closely set and liable to be quadrate rather than round, as in *Plagiogramma*. But in such forms as *P. tessellatum* Greville the beading is subquadrate and the hyaline central area is reduced to the dimensions of a large oval median disk or pseudonodule. It might be well to put this genus subgenerically under *Plagiogramma*, the older of the two.

## GLYPHODESMIS ACUS, new species

Plate 16, figs. 2-3

Valve long, narrowly prismatic, tapering at first rapidly from the broadened angular middle portion and then more slowly to the blunt apices, the two halves frequently (not always) unequal in length; crossed by strictly transverse, fine beaded lines, which are bisected by a delicate longitudinal median line, extending the entire length of the valve; the central knob or elevation is small and difficult to see, except in side view, because of its not being hyaline nor surrounded by a hyaline area, but marked with the same beaded crosslines which cover the rest of the valve; the two apical knobs are small but evident; in side (girdle) view the frustule is seen to be about six times as long as its width, the faces of two attached frustules being well separated, except where they touch at the apices and at the center by their terminal and median knobs.

Length, 0.042-0.068; width, 0.010-0.012; lines, 16-17 in 0.01 mm.

This species might be easily mistaken for a *Fragilaria*, if seen with a low magnification and only in its face view. Its true generic position is however made clear by the side aspect, which is therefore here illustrated. Its minute size makes it easily overlooked, but in many of the Philippine Islands gatherings it is quite abundant, especially in one from Jolo Jolo.

*Type*.—Cat. No. 43624, U.S.N.M.

## GLYPHODESMIS ELONGATA Cleve and Grove

(Le Diat., 1891, pl. 8, figs. 12-14.)

The original came from the near-by Macassar Straits.

## GLYPHODESMIS MARGARITACEA Castracane

(Castracane, Chall. Exp., p. 44, pl. 18, fig. 10; Schmidt, Atlas, pl. 209, figs 51-53.)

See remarks under genus above.

## Genus GRAMMATOPHORA Ehrenberg

## GRAMMATOPHORA FUNDATA, new species

Plate 16, figs. 4-5

Valve flat, but appearing to be crossed by heavy undulations, about 12 to 14, caused by underlying tortuous septa; sides parallel and straight; ends round, generally same width, sometimes slightly swollen; surface of the valve covered with coarsely cut quincunx markings; medial line obscure or absent; median area oval, its longer axis transverse and reaching to the sides; in side (girdle) view the frustule is seen to be three to three and one-half times as long as broad; the tortuous septa are massive, evenly undulating and terminate near the center in heavy blunt, triangular ends.

Length, 0.080–0.205; width, 0.011–0.017; lines, 15 in 0.01 mm.

The nearest affinity is *G. flexuosa* Grunow and less so *G. serpentina* Ehrenberg, and *G. longissima* Petit.

*Type*.—Cat. No. 43625, U.S.N.M.

**GRAMMATOPHORA ISLANDICA** Ehrenberg

(Van Heurek, Synopsis, pl. 53, fig. 7.)

**GRAMMATOPHORA MARINA** (Lyngbye) Kützing

(Smith, Brit. Diat., pl. 42, fig. 314; Van Heurek, Synopsis, pl. 53, figs. 10–11.)

**GRAMMATOPHORA OCEANICA** Ehrenberg

(Ehrenberg, Mikrogeologie, pl. 17, fig. S7; pl. 19, fig. 36a; Van Heurek, Synopsis, pl. 53bis, figs. 15–16.)

**GRAMMATOPHORA PROBATA**, new species

Plate 16, figs. 6–7

Valve four times laterally constricted, resulting in one central, two terminal, and two intermediate enlargements, which are of equal width, the sinuses between being longer than the enlargements; ends rounded, hyaline; all the rest of the valve surface covered with strong quincunx markings; median line wanting; central area circular, not oval; along each margin fine, short, sharp prickles, extending to (but not around) the rounded ends of the valves; these prickles sometimes entirely absent. In side (girdle) view the two septa are seen to have two soft undulations, the inner ones smaller; ends of the septa slightly enlarged and curved inward toward the girdle line.

Length 0.045–0.093; width 0.010–0.013; lines 14 in 0.01 mm.

The difficulties of uniting this with *G. punctata* Leuduger-Fortmorel as figured and described in *Diatomeés d'Afrique*, page 21, plate 4, figure 5, are that the African species is much less constricted, is greatly enlarged at the center, is marked with coarse transverse lines, has prominent oval hyaline areas at the two ends, has a very oval central area, and is ornamented along each side with strong beads or pearls, none of which is true of this species. As to the last, it is hardly supposable that Leuduger-Fortmorel mistook for pearls the delicate prickles of the above by seeing them out of focus. Both, however, are so unlike other known examples of this genus that the supposition of their being the same is admissible.

*Type*.—Cat. No. 43626, U.S.N.M.

**Genus GYROPTYCHUS** A. Schmidt

See *Actinodiscus* Greville.

Genus **HEMIDISCUS** Wallich

Wallich's generic name in the *Microscopical Journal* for 1860 (p. 42) antedates that of Bailey, *Euodia* (Pritchard, *Inf.*, p. 852). It has the incidental advantage of being far more descriptive than *Euodia*. Cleve evidently prefers *Hemidiscus* for regarding "*Euodia arcuata* sp. n" in Schroder's *Phytoplankton Napelo* he says it is *Hemidiscus cuneiformis*.

**HEMIDISCUS CAPILLARIS** Brun

(Brun, *Espec. Nouv.*, p. 26, pl. 17, fig. 4.)

**HEMIDISCUS CUNEIFORMIS** Wallich

(*Micro. Journ.*, 1860, p. 42, pl. 3, figs. 3-4; H. L. Smith, *Types*, No. 161.)

**HEMIDISCUS HARDMANIANUS** (H. L. Smith) Mann

(H. L. Smith, *Types*, No. 287.)

H. L. Smith places this diatom in *Palmeria*, Greville's perfectly unnecessary genus.

**HEMIDISCUS INORNATUS** Castracane

(Castracane, *Chall. Exp.*, p. 149, pl. 12, fig. 1.)

**HEMIDISCUS JANISCHII** Grunow

See under *Leudugeria*.

**HEMIDISCUS RADIATUS** (Castracane) Mann

(Castracane, *Chall. Exp.*, p. 150, pl. 12, fig. 4.)

**HEMIDISCUS VENTRICOSUS** (Castracane) Mann

(Castracane, *Chall. Exp.*, p. 150, pl. 12, fig. 5.)

**HENSHAWIA**, new genus

Front (valve) view a narrow ellipse, its long axis three to six times the length of the transverse one, the elliptical outline perfect at the margin of the valve where it joins the girdle, but irregular on the apparent upper plane of the valve, the valve being very deep or convex, as shown in side (girdle) view; a deep groove extends up the sides and across the middle of the valve, dividing it into two symmetrical halves, and in the center of this groove is a rosette of oval beads, the outer ring close set and regular, the inner beads irregularly arranged; the rest of the valve is covered with rows of oval beads, punctate, and with an evident central dot, the rows being symmetrically and radially arranged, with reference to the central rosette; in side (girdle) view the frustule is rectangular, each valve being as deep as it is long, and the two valves being joined by a very broad girdle; the length of the frustule, measured from the outer surfaces of the valves, is therefore two to three times the length of the valves, resembling in this respect some specimens of *Biddulphia pulchella*



and "*B. balaena*"; corners of the rectangular frustule not produced, generally broadly rounded, sometimes sharply angular; sides of the valves marked with vertical rows of beads, continuous with the radiating rows of the upper surface, the beads oval or round and punctate; girdle covered with rows of beads continuous with those on the surface of the valves and therefore arranged across the girdle, not around it; its beads smaller than those of the valves and always round; the groove across the center of each valve appears in side view as a deep notch.

This remarkably formed diatom has unmistakable affinities with *Biddulphia*, but is wholly without knobs, horns, or other processes or modifications at the apices of the valves. The type species somewhat suggests "*Biddulphia balaena*" (*Trigonium*) and the now generally discarded genus *Odontella*. But its strikingly different front view, its deep tranverse groove, and the well-marked central rosette of beads make it impossible to refer this form to any known genus.

I take pleasure in naming it after my friend and efficient colaborer, Mr. Henry W. Henshaw, former chief of the United States Biological Survey.

**HENSHAWIA BIDDULPHIOIDES, new species**

Plate 17, figs. 1, 2

Characters those of the genus.

One of the remarkable things about this diatom is the apparently haphazard variation in the form of the four corners (apices of the two valves) as seen in the side or girdle view. It is not unlikely that the frustules grow in chains, attached by their corners or by the faces of the valves, although no example of this was actually found. But even so, this would not explain the variation of the corners. Usually they are evenly rounded; sometimes, however all four are sharply angular or pointed, and specimens were found with both corners rounded on one valve and both pointed on the other valve of the same frustule. The depth of the frustule, that is, its height as seen in girdle view, also varies greatly. Generally the frustule, is about as broad as high, that is, its depth equals the length of the valves, but small specimens are occasionally four or more times as high as broad, reminding one of occasional small specimens of *Biddulphia pulchella* Gray. Thus a specimen in my collection measures in girdle view 0.034 mm. in width and 0.153 mm. in height.

Length of valve 0.034–0.210; width of valve 0.028–0.039; depth of frustule 0.084 to 0.190 mm.

Generally present in Philippine Islands dredgings and in some abundant.

*Type*.—Cat. No. 43627, U.S.N.M.

Genus **HERCOTHECA** Ehrenberg

The strong suspicion that the forms composing this genus are only endocysts escaped from frustules of *Rhizosolenia* or kindred general has resulted in its general abandonment; and it is included here with no actual belief in its validity, but because as yet these bodies are impossible to definitely assign elsewhere. Whether endocysts or not, they represent certain species of diatoms that exist in the flora in which they occur, and should therefore be so included until a better assignment can be made.

**HERCOTHECA INERMIS**, new species

Plate 18, figs. 1-2

Front views of the two valves dissimilar; both circular, both having the entire surface closely wrinkled into a strong network of anastomosing lines, both with an inner concentric circle and a small central dot or knob; but the inner circle of one valve obscure and near the margin, of the other distinct and midway between the margin and the center; the side (girdle) view explains the difference, one valve being almost evenly hemispherical or dome-shaped, with a slight undulation in the curve near the margin; the other having its hemispherical contour compressed to an almost conical elevation, the basal width of which is one-half that of the valve; girdle narrow, thin, and hyaline.

Diameter, 0.062-0.073; width of frustule, 0.053-0.059 mm.

Although this species shows no trace of the circle of spearlike spines which arise vertically from each valve of the uncommon genus *Hercotheca* in each of its two known species, *H. mammillaris* Ehrenberg (Mikrogeologie, pl. 33, sec. 18, fig. 7; Pritchard, Inf., pl. 7, fig. 35) and *H. brevispina* Grunow (Cleve and Moll, Diat., No. 215) it differs in no other essential respect. In fact the side views are otherwise identical, and the chief characteristic, the dissimilarity of the two valves, is quite pronounced. Therefore, although a new genus was planned to receive this unique form, the interests of taxonomy seem to be better met by assigning it to *Hercotheca*.

As mentioned above, the assumption may be made that it is an ornate and unusually large example of endocyst of some cylindrical diatom, like *Rhizosolenia*; and there is a possibility that future research may prove it to be so. But although this form is frequent in several Philippine Islands dredgings and the dominant object in one of them, I have not been able to find a trace of any diatom to which it can be referred. If one were to suppose that the investing diatom was so delicate and pellucid as to escape detection in examinations of the uncleaned material and to be entirely obliterated by the acid process of cleaning, the classification of this form as an endocyst would be possible. But after much consideration, the above assign-

ment seems to be justified. Of course the perfectly circular form of the valves is against an attempt to refer to it as an endocyst of some unknown *Chaetoceros*. However, attention should here be called to the similarity between *Hercotheca* and the endocyst of *Chaetoceros coronatum* Grunow (Nordsk. Nord. Exp., pl. 2, figs. 28-31.)

*Type*.—Cat. No. 43628, U.S.N.M.

#### Genus **HYALODISCUS** Ehrenberg

For the reasons for including this and *Podosira* Ehrenberg in one genus see my Diatoms of the Albatross Voyages (p. 240) and for giving the preference to this instead of to the older *Podosira* see discussion in the introductory part of this paper.

#### **HYALODISCUS ANNULUS**, new species

Plate 18, fig. 3

Valve slightly convex, the curvature small until near the rim; umbilicus large, heavily rugose, separated from the rest of the valve by a wide, hyaline and glistening, sutural ring; outside of this the valve rather coarsely marked with diagonal, curved crosslines—"watch-milling" pattern—uniform to the border or rim; the latter wide, with a single row of closely set, minute beads on the inner edge, the outer nearly hyaline, with faint crosshatching.

Diameter, 0.071; diameter of umbilicus, 0.023 mm.

Several unnamed figures of this occur, a good one in Janisch's Diatoms of the Gazelle Expedition (pl. 20, fig. 4).

*Type*.—Cat. No. 43629, U.S.N.M.

#### **HYALODISCUS ARGUS** (Grunow) Mann

(Journ. Roy. Micro. Soc., 1879, pl. 21, fig. 6.)

#### **HYALODISCUS ASPERSUS**, new species

Plate 17, figs. 3-5

Valve circular, the middle portion about one-half the diameter, very convex, progressively less so to the margin, where it is nearly flat; covered with fine, closely set beading in quincunx pattern, producing thereby a watch-milling effect, spattered with small irregular beads or blotches crowded about the middle part and flung radially outward, thus curiously imitating a spattered ink blot, scanty half-way to margin, there becoming more abundant; umbilical center very small and obscure; a strong narrow rim, finely crosslined and further marked with a single row of closely set rectangular beads.

Diameter 0.082; width of rim 0.0024 mm.

*Type*.—Cat. No. 43630, U.S.N.M.

**HYALODISCUS CERVINUS** Brightwell

(Quart. Journ. Micro. Sci., 1860, p. 95, pl. 5, fig. 9.)

This delicate diatom, which Ralfs (Pritchard, Inf., p. 831), O'Meara (Irish Diat., p. 262), and Rattray (Rev. Cosc., p. 145) have decided to be a *Coscinodiscus* has been carefully studied with numerous specimens from the Philippine Islands. It proves to be, as Brightwell thought, a *Hyalodiscus*. Its umbilicus is very small, in some cases almost obliterated, but in others it is quite evident. It is probable Brightwell found such specimens when he named it.

**HYALODISCUS HIRTUS**, new species

Plate 18, fig. 4

Valve circular, moderately and evenly convex; umbilicus large, heavily rugose, separated from the rest of the valve by a heavy irregularly serrate suture; between this and the rim the valve is marked with closely set rows of beading, generally radial, but somewhat modified to form broad and imperfect fascicles, which are marked off by indistinct intervening rays; midway between the umbilical center and the rim is an indefinite ring of short and blunt spines, superimposed upon the beading; rim very stout, finely cross-marked by rows of indistinct beads, the outermost beads larger and forming a marginal ring.

Diameter, 0.077; diameter of umbilicus, 0.026; width of rim, 0.005; lines of beading, 13.5 in 0.01 mm. midway.

There is a faint resemblance between this and *Stephanopyxis robusta* Leuduger-Fortmorel (Diat. Malaisie, p. 46, pl. 4, fig. 6).

*Type*.—Cat. No. 43631, U.S.N.M.

**HYALODISCUS LAEVIS** Ehrenberg

(Ehrenberg, Mikrogeologie, pl. 33, sec. 15, fig. 17.)

The umbilicus of this species is always much larger than that of Bailey's *H. subtilis* and its marking, coarser; but even so, the two are rather too close.

**HYALODISCUS PROPEPLANUS**, new species

Plate 18, fig. 5

Valve practically flat, except for a slight convexity near the rim; umbilicus large, with strong rugose or vermiform marking, separated from the rest of the valve by a narrow irregular suture; outside of this the valve covered with closely set, perfectly radial rows of minute beads, becoming barely smaller near to the rim; its surface further marked with frequent dashes or lines, very evenly distributed and radial; rim relatively narrow, marked, with a single row of obscure beads.

Diameter, 0.170; diameter of umbilicus, 0.064 mm.

There is an evident resemblance between this delicate species and the coarser and much more convex *H. maximus* Petit, which may be considered as a variety of *H. radiatus* (O'Meara) Grunow, especially as it is figured by Peragallo, Diatomees, France, plate 119bis, figure 6.

*Type*.—Cat. No. 43632, U.S.N.M.

**HYALODISCUS STELLIGER** Bailey

(Van Heurek, Synopsis, pl. 84, figs. 1-2; Schmidt, Atlas, pl. 139 fig. 7.)

An excellent figure of this is also given by Smith (Brit. Diat., pl. 49, fig. 328) under the name *Podosira maculata* W. Smith.

**HYALODISCUS SUBTILIS** Bailey

(Pritchard, Inf., p. 815, pl. 5, fig. 60; Janisch, Diat., Hond., pl. 1, fig. 16.)

**Genus HYDROSILICON** Brun

**HYDROSILICON RIMOSA** (O'Meara) Brun

(Micro. Journ., 1871, pl. 3, fig. 1; see also Brun, Espec. Nouv., pl. 21, fig. 8.)

**Genus ISTHMIA** Agardh

**ISTHMIA MINIMA** Bailey and Harvey

(H. L. Smith, Type No. 205; Schmidt, Atlas, pl. 136, figs. 4, 8, 9; pl. 145, figs. 1, 9; Walker and Chase, New and Rare Diat., p. 5, pl. 5, fig. 9; Grunow, Diat., Hond., p. 182, pl. 196, figs. 1. *a-d*; and the rather crude original figure in Wilkes Exped., vol. 17, pl. 9, fig. 11.)

This form is well illustrated in Schmidt's Atlas, plate 136, figure 8, which he suggests may be a new species. It proves to be only a rather wide variety of the above. Specimens on the H. L. Smith Type slide No. 205, which are uniformly accepted as correctly named *I. minima*, agree perfectly. It is quite probable that *I. lindigiana* Grunow (Diat. Honduras, Monthly Micro. Journ., 1877, pl. 196, fig. 1), and *I. capensis* Grunow (Monthly Micro. Journ., p. 182) are merely varieties of the same. The latter, Kitton in a footnote suggests, may be the above, and it is certain that the figure in Schmidt's Atlas, plates 136 and 145, are not specifically separate, an opinion held by Witt and recorded in plate 145, figure 5. H. L. Smith writes in connection with his above No. 205 that *I. minima* Bailey and Harvey equals *I. lindigiana* Grunow. Grunow justifies his two specific names by saying that *I. capensis* is distinguishable from *I. lindigiana* solely on the grounds of the presence of certain dim club-shaped bodies enclosed within the frustules of the latter. That these are no essential part of the diatom is unquestionable and they may be dropped out of consideration. The only difficulty in the foregoing is that Grunow's figure of *I. lindigiana* represent the coarser markings to be truly rectangular and filled with closely set beading and the markings of the girdle to be elongated bars; whereas in *I. minima* and in my

own specimen the markings are round or oval blotches with fine but evident beading around their margins only, and the markings of the girdle are not bars but at most oval, and are often rounded into disks set in quincunx order.

It is interesting to note that Professor Bailey mentions this diatom as occurring in the "Sooloo Sea" where I also have found it, as well as in other localities in the Philippine Islands.

Long diameter of valve, 0.107–0.135; width of frustule, 0.152–0.180 mm.

#### Genus LEUDUGERIA Tempere

##### LEUDUGERIA JANISCHII Grunow

(Van Heurck, Treat., p. 539, fig. 287; Van Heurck, Synopsis, pl. 127, figs. 1–4, misnamed.)

This coarse but handsome species is common in the Philippine Islands. Its early assignment to *Euodia-Hemidiscus*, rested merely on its obscure resemblance in outline to members of that genus, in which respect it more closely agrees with *Epithemia*. In fact, *Epithemia? monilifera* Petit, (Diat. Camp. Isl., p. 241, pl. 14, fig. 10) is so close to this that I suspect the two are the same; in which case the name should become *Leudugeria monilifera* (Petit) Mann.

#### Genus LICMOPHORA Agardh

##### LICMOPHORA DEBYI (Leuduger-Fortmorel) Mann

Plate 18, fig. 6

(Leuduger-Fortmorel, Diat., Malaisie, pl. 5, fig. 3.)

This remarkably shaped diatom is placed in the genus *Pseudo-Synedra* by Leuduger-Fortmorel, an assignment that must be rejected. The looseness of that author's classification is seen by comparing his figure of this species with figure 2 of the same plate, also assigned to *Pseudo-Synedra*. Not only is its *Licmophora* character evident from a study of the valve view, but an entire frustule enabled me to fix its true position beyond question. In fact, it differs from certain specimens of *L. ehrenbergii* Kützing merely in having its anterior end lengthened into a club-shaped extension, like the neck of a bottle. (Compare with the figures of *L. ehrenbergii* Peragallo, Dia. France, pl. 85, figs. 4–5.)

##### LICMOPHORA OVATA (W. Smith) Grunow

(Van Heurck, Synopsis, pl. 47, figs. 12–13; Smith, Brit. Diat., pl. 24, fig. 226.)

#### Genus MASTOGLOIA Thwaites

Here are included most of those *Cocconeis*-like forms with chambered bands along the sides of each valve, but under and disconnected from them, and with a central rhabde on each valve, generally classified

under the generic name, *Orthoneis*. A careful study of both the valves and these peculiar chambered annuli makes the identity of the two certain. Cleve has adopted this view in his *Naviculoid Diatoms*, volume 2, page 142.

**MASTOGLOIA ACHNANTHIOIDES** new species

Plate 18, fig. 7

Valve fusiform with acute apices, slightly narrowed at the middle, crossed by fine and very close beaded lines, somewhat flaring on either side of the central nodule, otherwise diagonally inclined from the center, none transverse; marginal chambers small, uniform, extending almost to the apices; median longitudinal area very narrow, so that the beading extends almost to the tortuous rhaphe.

Length 0.051–0.084; width 0.021–0.022; 12 to 13 lines in 0.01 mm.

Its nearest relative is *M. constricta* Cleve as given in *Le Diatomiste*, page 159, plate 23, fig. 5; also in Cleve's *Naviculoid Diatoms*, volume 2, page 154; but that is a narrower and more angular form with finer markings, 21 lines in 0.01 mm., which are strictly transverse and with their beading so spaced as to produce wavy longitudinal lines. It also has some affinity with *M. fallax* Cleve (*Nav. Diat.*, vol. 2, p. 153, pl. 2, fig. 16) from Java, which differs from it in form and in the oval character and arrangement of the beading.

*Type*.—Cat. No. 43633, U.S.N.M.

**MASTOGLOIA CAPAX**, new species

Plate 19, fig. 1

Valve broadly fusiform, apices not produced, marked with finely beaded, closely set lines practically transverse, but slightly diagonal toward the apices; median area very narrow; a small stauroslike hyaline expansion on either side of the central nodule, made by the withdrawal of the beaded lines; rhaphe slightly tortuous, delicate; central and terminal nodules minute; chambers next to the margin small and uniform in size, longer than wide, rounded on inner side, the rows reaching to the apices.

Length 0.087–0.101; width 0.042; 15–16 lines in 0.01 mm.

It is nearest to the doubtfully named figure of *M. affirmata* Leuduger-Fortmorel in Schmidt's *Atlas*, plate 188, figure 31, which however has coarser markings, no stauros and straight rhaphe. It may be the same as the unnamed figure from Japan in Schmidt's *Atlas*, plate 204, figure 14, as Cleve's suggestion there recorded, that it may belong to *M. angulata* Lewis, is not acceptable. In case the marginal chambers of Schmidt's *Atlas*, plate 187, figure 41, also unnamed, are the same as the above, it could be included here as a somewhat attenuate variety.

*Type*.—Cat. No. 43634, U.S.N.M.

## MASTOGLOIA CEBUENSIS, new name

Plate 19, fig. 2

This is well illustrated in Cleve's *Naviculoid Diatoms* (vol. 2, p. 159, pl. 11, fig. 26), but misnamed *M. lemniscata* Leuduger-Fortmorel. I have compared it with several specimens of the latter, which is fairly abundant in the Philippine Islands, and unless we are to admit here variations wide enough to obliterate many of the accepted species of this genus, including the distinctions between *M. lemniscata* and *M. leudugeri* Cleve and Grove, this form can not be referred to *lemniscata*; its general shape, its convexly bowed longitudinal ridges, its tortuous rhapshe, etc., being quite distinct. Nor can it include *M. decora* Leuduger-Fortmorel, as Cleve suggest. I have therefore put Cleve's form with my own into a separate species. (See *M. lemniscata* Leuduger-Fortmorel, *Diat.*, Ceylan, p. 35, pl. 3, fig. 29.)

## MASTOGLOIA COCCONEIFORMIS Grunow

(Schmidt, *Atlas*, pl. 188, fig. 43; Cleve, *Nav. Diat.*, vol. 2, pl. 2, fig. 20.)

## MASTOGLOIA CRUCIATA (Leuduger-Fortmorel) A. Schmidt

(Schmidt, *Atlas*, pl. 187, fig. 50; Leuduger-Fortmorel, *Diat.*, Ceylan, pl. 2, fig. 19.)

## MASTOGLOIA EGREGIA A. Schmidt

(Schmidt, *Atlas*, pl. 186, fig. 16.)

## MASTOGLOIA ELEGANS Lewis

(Lewis, *White Mt. Diat.*, pl. 2, fig. 16; Schmidt, *Atlas*, pl. 186, fig. 19; H. L. Smith, *Types*, No. 212.)

The faint longitudinal lines near to and parallel with the rhapshe, which Schmidt (*Atlas*, pl. 186, fig. 19) seems to think are typical, are not so. Specimens both with and without them were found in the Philippine Islands, and those in H. L. Smith's types, made from the original material, are without them.

## MASTOGLOIA FUSIFORMIS, new species

Plate 19, fig. 3

Valve fusiform with very acute apices; marked with beaded lines, strictly transverse until near the apices, there slightly oblique outward, reaching almost to the rhapshe, so that a barely perceptible hyaline space remains on either side of it; the beads elongated and so spaced in the alternate lines as to produce a brick-wall pattern; parallel to the rhapshe on either side run double lines formed by slightly enlarged beads, the outer of the parallel lines slightly shorter than the inner, and both flaring at the ends near to the center of the valve; the chambered loculi along the sides of the valve are unusually narrow and relatively long and extend to the apices.

Length 0.105; width 0.040; lines 10.3 in 0.01 mm.; loculi 0.0045 by 0.0012 mm.



This is possibly the same as the unnamed figure in Schmidt's Atlas, plate 187, figure 36, from Cebu. Rare, in only one dredging.

*Type*.—Cat. No. 43635, U.S.N.M.

**MASTOGLOIA GRUENDLERI** A. Schmidt

(Schmidt, Atlas, pl. 188, fig. 26.)

This is another species found only at Campeche Bay and the Philippines Islands.

**MASTOGLOIA IMITATRIX**, new species

Plate 19, fig. 4

Valve convex, narrowly oval in outline, slowly tapering to the blunt rounded apices; the rhaphe is strongly oblique, that is to say, it is diagonal to the long axis, but runs straight until near the apices where its two ends curve strongly to opposite sides; adjacent to either side of the rhaphe is a parallel line; the central nodule is slightly dilated but is not surrounded by a hyaline central area; the valve markings are delicate, closely set lines obscurely crossed-marked, reaching the parallel lines bordering the rhaphe, transverse until near the ends and there slightly oblique; the lateral rows of chambers lie next to the rim, are all of the same size, the terminal ones being tapered and do not reach the apices; in side (girdle) view there is seen to be a slight depression of the valve across its middle; the ends are bluntly rounded; the girdle is hyaline and is not oblique.

Length 0.071; width 0.047; 15 lines in 0.01 mm., 3 chambers in 0.01 mm.

The striking imitation by this unmistakable *Mastogloia* of *Scolio-pleura tumida* Brébisson raises interesting questions of relationship, especially when taken in connection with the fact that W. Smith called the latter *Navicula jenneri* and Cleve restores it to that genus under the name *N. tumida* (Brébisson) Cleve, and also when we remember that many examples of *Mastogloia* differ from *Navicula* only in the presence of the chambered compartments along both sides of the valve. For we are herein led to ask if these internal rows of chambers are anything more than persistent craticular structures, homologous with the craticular plates sometimes observed in certain *Naviculae*, such as *N. cuspidata* Kützing. *N. ambigua* Ehrenberg, etc. It was my good (or bad) fortune to disturb the specimen here illustrated after it had been mounted in face view and its compartments had been studied and measured; so that it turned over into side (girdle) view and thereby enabled me to see that the lateral rows of chambers occupy their usual position within each valve. It is true this species is different from *Scolio-pleura tumida*, in having more truly transverse and somewhat finer lines of sculpture, in the absence of any hyaline

oval area about the central nodule or alongside of the rhapshe, and in the presence of a definite line bordering this rhapshe on either side and continuous across the middle of the valve. But such bordering lines are to be seen in other species of *Scoliopleura*, as *S. peisonis* Grunow and *S. schneideri* (Grunow) Cleve. It will be well for diatomists to take note of any close similarities between members of the genus *Navicula* and the genus *Mastogloia*.

*Type*.—Cat. No. 43636, U.S.N.M.

**MASTOGLOIA JAVANICA** Cleve

(Cleve, Nav. Diat., vol. 2, p. 159, pl. 2, figs. 22–23; Schmidt, Atlas, pl. 188, fig. 38.)

Cleve's species agrees poorly with the above figure in Schmidt's Atlas, although he seems to accept it.

**MASTOGLOIA JELINECKIANA** Grunow

(Grunow, Reise F. Novara, p. 99, pl. 1A, fig. 11; Schmidt, Atlas, pl. 187, figs. 39, 49; H. L. Smith, Types, No. 213.)

**MASTOGLOIA LEMNISCATA** Leuduger-Fortmorel

(Leuduger-Fortmorel, Diat., Ceyl., pl. 3, fig. 29; Schmidt, Atlas, pl. 186, fig. 15.)

**MASTOGLOIA LEUDUGERI** Cleve and Grove

(Schmidt, Atlas, pl. 186, fig. 13.)

**MASTOGLOIA LINEATA** Cleve and Grove

(Le Diat., p. 59, pl. 9, fig. 11.)

This species is very close to *M. exarata* Cleve (Nav. Diat., vol. 2, p. 156, pl. 2, fig. 35) also to *M. albifrons* Brun, according to Schmidt in his Atlas, plate 187, figure 38.

**MASTOGLOIA OCUIFORMIS** Brun

(Schmidt, Atlas, pl. 187, fig. 39.)

Probably only a small variety of *M. jelineckiana* Grunow.

**MASTOGLOIA OVATA** Grunow

Plate 19, fig. 5

(Cleve and Grunow, Aret. Diat., p. 17, pl. 1, fig. 2.)

**MASTOGLOIA OVUM-PASCHALE** (A. Schmidt) Mann

(Schmidt, Atlas, pl. 8, fig. 56; misnamed; Peragallo, Diat., France, pl. 5, fig. 13, misnamed.)

This remarkably individual diatom was placed in *Navicula* by Schmidt in 1885, probably because he did not have a complete frustule and thus missed seeing the marginal rows of chambers by which alone *Mastogloia* can be safely distinguished from *Navicula*. Peragallo later called it *Orthosira aspera* in the above-cited reference.

The original specimen came from Yokohama.

## MASTOGLOIA PULCHELLA Cleve

(Cleve, Nav. Diat., vol. 2, p. 157, pl. 2, figs. 27-29.)

## MASTOGLOIA QUINQUECOSTATA Grunow

Plate 19, figs. 6, 7

This is Grunow's species as figured and described in his *Neue und Ungenügend Bekannte Algen*, page 578, plate 5, figure 8, and undoubtedly includes figures 10 and 17 and probably 18 in Schmidt's *Atlas*, plate 186. Here too may be included *M. sinuata* A. Schmidt (*Atlas*, pl. 186, fig. 11) and possibly the unnamed plate 186, figure 12; because Brun's suggestion of considering the latter to represent *M. elongata* Leuduger-Fortmorel is a very doubtful one. Leuduger-Fortmorel expressly indicates in figure and description (*Diat. Ceylan*, p. 35, pl. 3, fig. 31) that his specimens are destitute of beading set in transverse lines, a character hardly to be overlooked in this figure, where it is fully as evident as in other species figured on the same plate of Schmidt's *Atlas*. But Cleve, who favors this condensation in his *Naviculoid Diatoms* (vol. 2, p. 161), seems to have been obsessed by the idea that all *Mastogloias* having longitudinal lines on both sides of the rhapshe must be grouped in *M. quinquecostata* Grunow, for he assembles under that name species the marginal chambers, general outlines, and even the number and straightness of the longitudinal lines of which are wholly unlike each other. Thus he includes *Navicula egeria* Pantocsek (*Hung. Diat.*, vol. 3, pl. 42, fig. 578), *Mastogloia obscura* Leuduger-Fortmorel (*Diat.*, *Ceylan*, pl. 3, fig. 33), *M. grunowii* A. Schmidt (*Atlas*, pl. 186, figs. 1-7), *M. kerguelensis* Castracane (*Chall. Exp.*, pl. 15, fig. 11) *M. concinna* A. Schmidt (*Atlas*, pl. 186, fig. 9), none of which properly belong here, and hints that *M. mauritiana* Brun (*Schmidt, Atlas*, pl. 186, fig. 28) and *M. sansibarica* A. Schmidt (*Atlas*, pl. 187, fig. 44) may also prove to be this species. Doubtless *M. quinquecostata* Grunow shows variations; but if we make it as variable as the above, consistency demands that *M. lemniscata* Leuduger-Fortmorel, as figured by Cleve in the same work and a lot of other well-known species, should be added to the same heterogeneous mass. It need hardly be said that Schmidt's objection to the name *quinquecostata*, as not truly descriptive, is a worthless argument. His *M. grunowii* (*Schmidt, Atlas*, pl. 186, figs. 1-7) is however truly distinct from *M. quinquecostata*, as he and Brun assert. The markings, and especially the marginal chambers, are strikingly different. My specimens measure; Length, 0.070-0.099; width, 0.023-0.028; lines, 14 in 0.01 mm.

## MASTOGLOIA RHOMBUS (Petit) Cleve

(Schmidt, *Atlas*, pl. 187, figs. 33-35; *Le Diat.*, vol. 1, p. 58, pl. 9, fig. 12. See Petit, *Diat.*, *Camp. Isl.*, p. 242, pl. 14, fig. 12.)

This is another species found both at Campeche Bay and Philippine Islands.

**MASTOGLOIA SANSIBARICA** A. Schmidt

(Schmidt, Atlas, pl. 187, fig. 44.)

**MASTOGLOIA SERIATA** Cleve and Grove

(Le Diat., vol. 1, p. 66, pl. 10, fig. 6.)

**MASTOGLOIA SINUATA** A. Schmidt

(Schmidt, Atlas, pl. 186, fig. 11.)

**MASTOGLOIA SPLENDIDA** (Gregory) Cleve

(Van Heurck, Synopsis, pl. 28, figs. 1-2.)

Cleve has rightly united *Orthonoëis* with *Mastogloia*.**MASTOGLOIA SQUAMOSA** Brun

(Schmidt, Atlas, pl. 188, fig. 19.)

Cleve's attempt to unite this with *Navicula affirmata* Leuduger-Fortmorel (Diat., Ceylan, pl. 2, fig. 22) can not be approved.**Genus MELOSIRA** Agardh**MELOSIRA CORONARIA** Mann

(Mann, Diat., Alb. Voyages, p. 237, pl. 51, figs. 1-2.)

**MELOSIRA DURA**, new species

Plate 20, figs. 1, 2

Valve circular, very convex inside of the narrow flat rim; marked with fine watch-milling, over which are thickly scattered short, stout but sharp pointed spines, increasing slightly in size and abundance toward the margin; rim having a single row of beads.

Diameter 0.041-0.044 mm.

Spine-bearing and convex forms like the above are frequently referred to the genus *Stephanopyxis*; as for example the quite similar "*Stephanopyxis robusta*" Leuduger-Fortmorel (Diat. Malasie, p. 46, pl. 4, fig. 6). But it is questionable if any form with a distinct rim and radially arranged puncta can be referred to this genus, solely because they are convex and spiny. They stand much closer to the nearly related genus *Melosira*, many authentic species of which are more or less spiny, as for instance, *M. setosa* Greville (Schmidt, Atlas, pl. 182, figs. 42-46), *M. hispida* Janisch (Schmidt, Atlas, pl. 182, figs. 54-55). For this and other reasons I think that the union of the members of the genus *Trochosira* should be grouped with that subgenus of *Melosira*, "*Skeletonema*," rather than united with *Stephanopyxis*, as is done by Van Heurck. It is true that all these forms are closely similar in their chain-forming method of growth and their convex spiny valves. But if the chief purpose of taxonomy is to classify and render available the objects of nature, rather than to show generic relationships—the only view present possible with the

diatoms—the arrangement above indicated seems to me the best. It should be added that some undoubted members of *Stephanopyxis* are destitute of spines, as for instance, *Stephanopyxis turris*, var. *arctica* forma *inermis* Grunow (F. Jos. Land, pl. 5, fig. 18). The superficially similar *S. robusta* Leuduger-Fortmorel above referred to has a large hyaline central area (*Hyalodiscus*?) outside of which are radiating lines of fine beading. It is also a much larger diatom and resembles more closely my *Hyalodiscus hirtus*, new species.

*Type*.—Cat. No. 43637, U.S.N.M.

MELOSIRA GOWENII A. Schmidt

Plate 20, figs. 3-4

(Schmidt, Atlas, pl. 176, figs. 4-6; name on pl. 180.)

This appears to be a marine phase of *M. undulata* Kützing. It may, however, be accorded specific rank, as the Philippine Islands specimens are clearly the same as the type form found at San Francisco, Calif. My specimen shows the umbilicuslike center common in *M. undulata*. It is rather close to what Schmidt in his Atlas, plate 180, figure 22, calls *M. bisereata* Ehrenberg, which, however, is not the same as that diatom as shown in Ehrenberg's *Mikrogeologie*, plate 33, section 12, figure 18. In the girdle illustration here given note the difference in contour of the two adjacent valves.

Diameter of valve, 0.084; depth of frustule, 0.060 mm.

MELOSIRA INCOMPTA, new species

Plate 20, fig. 5

Frustule an elongated cylinder terminating at each end in a truncated cone, the whole exactly resembling a gelatine capsule; a shallow groove around each valve where it joins the narrow girdle; both valves, but not the girdle, sparingly and irregularly spotted with small beads becoming somewhat denser toward the ends.

Length of frustule, 0.073; width of frustule, 0.017 mm.

This apparently unfinished diatom is not at all uncommon in Philippine Islands dredgings.

*Type*.—Cat. No. 43638, U.S.N.M.

MELOSIRA MADAGASCARENSIS A. Schmidt

(Schmidt, Atlas, pl. 181, fig. 79.)

This anomalous diatom is placed here for convenience, although its being a *Melosira* is very doubtful. It is abundant in Philippine Islands material and ranges from small tubular frustules with rounded apices (valves) to comparatively huge specimens, massively built, with frustules little if at all longer than broad. Although the coarse, irregular blotches which constitute the marking of the vertical sides (flanges) and convex tops of the valves are separated into a central

and outer area by a crude hyaline ring about midway between the center and edge of each valve, there is no central scar or other indication that the frustules grow attached in filaments, nor have I ever found them so united. If they have that habit of growth, the fact would go far toward fixing the position of this diatom in *Melosira*. As it is, it looks very unlike any member of that genus but does not seem to fit into any other assignment.

**MELOSIRA MEDITERRANEANA** Grunow

(Van Heurek, Synopsis, pl. 91, figs. 3, 5.)

This also is a doubtful member of this genus. De Toni (Syl. Alg., p. 1157) refers it to *Skeletonema*, to which it has about equal affinities

**Genus NAVICULA** Bory

**NAVICULA ABRUPTA** Gregory, var.?

(Schmidt, Atlas, pl. 2, fig. 34, misnamed, and compare pl. 3, fig. 21.)

**NAVICULA ACROSPHAERIA**(Brébisson) Kiitzing

(Schmidt, Atlas, pl. 43, fig. 16.)

The union with *N. tabellaria* Kiitzing in De Toni's Sylloge Algarum, page 26, is unwarranted. Its presence here is as a fresh-water interpolation in some of the Philippine Islands bays.

**NAVICULA AESTIVA** Donkin

(Donkin, Diat., Northumb., p. 32, pl. 3, fig. 18; Donkin, Brit. Diat., pl. 1, fig. 3.)

**NAVICULA ANGULOSA** Gregory

(Gregory, Glenshira Diat., pl. 5, fig. 8; Donkin, Brit. Diat., pl. 4, fig. 4.)

Van Heurek and De Toni put this as a variety of *N. palpebralis* Brébisson, an admissible assignment.

**NAVICULA ANTILLARUM** (Cleve) Mann

(Cleve, W. I. Diat., p. 8, pl. 2, fig. 11.)

Cleve suggests that this diatom may belong to *Navicula*, but prefers his new genus, *Alloioneis*. As with Van Heurek, Schmidt, and others, I do not recognize the latter as anything but a subgeneric division of *Navicula*, the alternative of Cleve is here adopted. I see nothing but the inadequate fact of a lightly diagonal rhaps to sustain Pelletan's idea of this belonging to *Scoliopleura*, a view followed by De Toni (Syl. Alg., p. 265).

**NAVICULA APPROXIMATA** Greville

(Edin. N. Phil. Journ., vol. 10, pl. 4, fig. 10; Greville, Cal. Guano, pl. 4, fig. 4.)

Grunow's var. *substauroneiformis* in Schmidt's Atlas, plate 2, figures 20-21, was also found and is another case of forms peculiar to Campeche Bay and the Philippine Islands.

## NAVICULA ASPERA Ehrenberg

(Ehrenberg, Mikrogeologie, pl. 35A, sec. 20, fig. 5; Donkin, Brit. Diat., pl. 10, fig. 1; Schmidt, Atlas, pl. 48, figs. 2-6.)

Many varieties of this truly cosmopolitan marine diatom occur in the gatherings examined.

## NAVICULA BARBITOS A. Schmidt

(Schmidt, Atlas, pl. 129, fig. 5.)

## NAVICULA BEYRICHIANA A. Schmidt

(Schmidt, Atlas, pl. 69, figs. 16-17.)

Fricke's Index to Schmidt's Atlas incorrectly unites this with *N. gemmatula* Grunow (see the latter in Schmidt, Atlas, pl. 13, figs. 20-21). It has far more affinity with *N. crabro* (Ehrenberg) Kützing.

## NAVICULA BICLAVATA Cleve and Grove

(Le Diat., vol. 1, p. 66, pl. 10, fig. 7.)

Resembles *N. clavigera* Cleve in Naviculoid Diatoms, volume 1 page 56, plate 1, figure 3.

## NAVICULA BIFORMIS (Grunow) Mann

Plate 20, figs. 6, 7

(Grunow, Neu Ung. Diat., pl. 13, fig. 7; Peragallo, Diat., France, pl. 7, fig. 5; Greville, So. Pac. Diat., pl. 4, fig. 13.)

There is no more reason for making a new genus, *Mastoneis*, for this diatom because of its double markings, than for the same reason to put into new genera *N. beyrichiana* A. Schmidt; or those double-marked *Coscinodisci*: *C. asteromphalus* Ehrenberg, *C. convexus* A. Schmidt, and *C. biangulatus* A. Schmidt, the elaborate beading within the network of which is lacking in most species of *Coscinodiscus*. Both Grunow and Greville assign this *Navicula* to *Stauroneis*, because of its obscure stauros. As Cleve points out, it also has a sort of family resemblance to *Mastogloia*.

## NAVICULA BIGEMMATA, new species

Plate 21, fig. 1

Valve fusiform, with acute apices, covered with radial (not transverse) rows of fine beading, the beads irregularly spaced, so that the valve presents a wavy, shagreenlike appearance; a distinct line running on each side of the rhapshe, in general midway between it and the margin, but at the center curved rapidly inward toward the central nodule and having at this inner point a distinct bead, one therefore on each side of the central area; the portion of the valve included within these hyaline lines is slightly more elevated than the outer portions, as in *Navicula carinifera* Grunow; a hyaline band crosses the center between the two beads; the rhapshe is straight.

Length, 0.113 to 0.143; width, 0.037 to 0.038; 8.2 lines in 0.01 mm.

This beautiful form has affinities with several species, like *Navicula* (*Pseudo-Amphiprora*) *stauroptera* Bailey, called *N. arctica* by Cleve in his Arctic Diatoms, plate 3, figure 13; but especially with *N. jugata* Cleve (New and Little-Known Diat., p. 13, pl. 3, fig. 39). It differs in its more prismatic outline, its very acute apices, its radial and irregular beading, and in the sharp central incurve of its hyaline lines, with the two strong beads at the central area. As Cleve (Nav. Diat., vol. 1, p. 71) unites his species with *N. pensacola*, a form impossible to include with mine, the dissimilarity of this and *N. jugata* is emphasized. Cleve's species is from the Gallapagos Islands and its variety from Florida.

I can not see the advantage of the new genus *Pseudo-Amphiprora*, created by Cleve to accommodate his *N. jugata* and some similar species, which would include this one also. The chief distinction, the elevated central portion extending the length of the valve, is not at all infrequent in *Navicula*, for example, *N. carinifera* Grunow, and the side lines and stauroslike central area are nothing more than a union of the frequent *N. lyra* style of marking with a carinate central elevation. That it indicates a well-marked subgeneric division is admitted, but to separate it from *Navicula* is to create confusion for diatom students.

*Type*.—Cat. No. 43639, U.S.N.M.

**NAVICULA BLEISCHIANA** Janisch and Rabenhorst

(Janisch and Rabenhorst, Diat., Hond., p. 9, pl. 2, fig. 10; Schmidt, Atlas, pl. 50, figs. 22–25.)

Written *N. bleischii* on the plate and is so given by Schmidt.

**NAVICULA BOMBOIDES** A. Schmidt

(Schmidt, Nordsee Diat., pl. 1, fig. 2; Schmidt, Atlas, pl. 13, figs. 36–40.)

**NAVICULA BRANCHIATA**, new species

Plate 21, fig. 2

Valve figure eight (8) in shape, that is, round-panduriform; cross-barred with smooth and wavy costae, slightly connivant near the middle, but progressively curved from the middle as they approach the two ends, where they attain an almost longitudinal direction; wholly unbeaded except for a single bead in the slightly enlarged marginal end of each costa; median area on either side of rhaps broad and bordered with a single row of imperfect beads or blotches corresponding in number and position to the adjacent rows of costae; widest transverse diameter of each half of the valve exactly midway between the center and the end.

Length, 0.093; width, 0.028; costae, 6.2 in 0.01 mm.



This diatom is nearest to the original type form of *N. pandura* Brébisson, as figured in his *Diatomées de Cherbourg*, plate 1, figure 4, and in Schmidt's *Atlas*, plate 11, figure 4; but its peculiarly rounded contour, wavy costal bars, etc., make its specific distinctness much more evident to the eye than any verbal description could indicate.

*Type*.—Cat. No. 43640. U.S.N.M.

**NAVICULA BRASILIENSIS** Grunow

(Schmidt, *Atlas*, pl. 6, figs. 19–21; pl. 23, fig. 25.; pl. 31, fig. 33.)

**NAVICULA BULLATA** Norman

(*Micro. Journ.*, 1861, pl. 2, fig. 7; Schmidt, *Atlas*, pl. 3, figs. 8–9.)

Its value as a separate species solely because of the blotches in the lyrate hyaline area is very questionable, these blotches being variable in character and number and not infrequent in other species.

**NAVICULA CAECA**, new species

Plate 21, fig. 3

Valve long, narrow, constricted at the middle, gently curving outward to slightly less than one-half the distance to the apices, then narrowing to the rounded apices; crossed by very fine, closely set obscurely moniliform lines, which are strictly transverse except close to the apices, where they are barely diagonal; median hyaline area hardly perceptible, except for a slight oval unsymmetrical space at the center; rhaphe strong, hooked at the apices, very slightly bent to one side at the center.

Length, 0.0732; width, 0.0162; lines, 22 in 0.01 mm.

This is essentially the unnamed species in Schmidt's *Atlas*, plate 50, figure 34, which came from King Mill Island. My specimen is somewhat narrower and the bend of the rhaphe ends at the center is less pronounced. The gentle curves of this specimen give to it a very graceful outline. Rare.

*Type*.—Cat. No. 43641; U.S.N.M.

**NAVICULA CALIFORNICA** Greville

(Greville, *Cal. Guano*, p. 29, pl. 4, fig. 5; Schmidt, *Atlas*, pl. 3, figs. 6, 15–16, 19.)

Although all the above may be considered to be varieties of *N. hennedyi* the type form is far from close. Variety *campechiana* is another diatom common both to Campeche Bay and the Philippine Islands.

**NAVICULA CAMPYLODISCUS** Grunow

(Schmidt, *Atlas*, pl. 8 figs. 9–10, 12; pl. 70, figs. 64, 65.)

This species is another form common to both Campeche Bay and the Philippine Islands.

**NAVICULA CARIBAEA** Cleve

(Schmidt, *Atlas*, pl. 2, fig. 17; pl. 6, figs. 10–12; pl. 70, fig. 48.)

**NAVICULA CARINIFERA** Grunow

(Schmidt, Atlas, pl. 2, figs. 1-2; pl. 70, fig. 42.)

This is another species common to both Campeche Bay and the Philippine Islands. No other localities are recorded except Jamaica Island by Kitton.

**NAVICULA CASTRACANEI** Grunow

(Cleve, New and Little Known Diat., p. 12, pl. 3, fig. 33.)

**NAVICULA CHERSONENSIS** Grunow

(Schmidt, Atlas, pl. 69, fig. 21.)

Another species common to both Campeche Bay and the Philippine Islands. The curved vertical lines, formed by separation of the beading, should distinguish it from *N. splendida* Gregory.

**NAVICULA CIRCUMSECTA** Grunow

(Cleve and Grunow, Aret. Diat., p. 42; Schmidt, Atlas, pl. 3, figs. 26-27, misnamed.)

This Schmidt wrongly identifies as a variety of *N. polysticta* Greville, quite a different thing, as is seen by comparing with that diatom in Greville's paper on Naviculæ in California Guano, plate 4, figure 2. Fricke's index attempts to correct this by making it a variety of *N. hennedyi* W. Smith, which it certainly is not. It is near to the questionable variety of *N. californica* shown in Schmidt's Atlas, plate 3, figure 6; but Grunow's new specific name for it is the best arrangement.

**NAVICULA CLAVATA** Gregory

(Micro. Journ., 1856, pl. 5, fig. 17; Donkin, Brit. Diat., pl. 2, fig. 8; Schmidt, Atlas, pl. 70, fig. 50.)

The reducing of this well-marked diatom to a variety of *N. hennedyi*, suggested by Van Heurck and carried into effect by De Toni (Syl. Alg., p. 104) has nothing to commend it.

**NAVICULA CLEPSYDRA** Donkin

(Donkin, Brit. Diat., p. 63, pl. 10, fig. 2; Schmidt, Atlas, pl. 48, figs. 38-39; H. L. Smith, Types, No. 257.)

**NAVICULA COARCTATA** Ehrenberg

(Ber., 1842, p. 265; Schmidt, Atlas, pl. 11, figs. 30-32; pl. 69, fig. 11.)

This species is well illustrated by Schmidt; but it is doubtful if it can be proven to be what Ehrenberg so names. It is another one of the species peculiar to both Campeche Bay and the Philippine Islands.

**NAVICULA CONSORS** A. Schmidt

(Schmidt, Atlas, pl. 48, figs. 24-27.)

## NAVICULA CORPULENTA, new species

Plate 21, fig. 4

Valve unusually broad at the center, rapidly narrowed to the rounded ends; marked with a broad band of fine beaded lines, radially arranged along each side, narrowing and disappearing at the margins at the point where the broad central part passes into the clavate ends; these ends marked by similar beaded lines on either side of the rhaphe, which gradually narrow as they approach the center of the valve, and stop with the ends of the rhaphe at the central nodule; the rest of the valve is hyaline, rarely rugose, thus forming an oval median area within the marginal bands of beading and divided by the clavate beading bordering the rhaphe.

Length, 0.055–0.096; width, 0.038–0.056; lines, 18 in 0.01 mm.

This minute and constant diatom is plainly of the *N. clavata* group, but too widely divergent from it to be specifically identical.

It is very abundant in the Philippine Islands.

*Type*.—Cat. No. 43642, U.S.N.M.

## NAVICULA CRABRO (Ehrenberg) Kützing

(Donkin, Brit. Diat., pl. 7, fig. 1; Schmidt, Atlas, pl. 69, fig. 1; Nordsee Diat., pl. 1, figs. 5–6; Ehrenberg, Mikrogeologie, pl. 19, figs. 29a–c.)

It is probable this variable and widely distributed diatom will always present difficulties in defining its specific boundaries; for it represents a group of the *Naviculae* that embraces more species than any other, perhaps more species than any other shape of diatom—that of a figure 8. But for that very reason a convenient and workable classification can be secured only by avoiding too sweeping condensations. Thus, the union here of such forms as *N. multicosmata* Grunow, *N. pandura* Brébisson, etc., is not at all helpful. (See the latter in Diat. Cherbourg, pl. 1, fig. 4; Schmidt, Atlas, pl. 11, figs 1–2, 4, 8–9, and the former in Schmidt's Atlas, pl. 11 figs. 14–20.) On the other hand, the line of demarcation becomes difficult to see between *N. crabro* and *N. separabilis* A. Schmidt (pl. 11, figs. 28–29) despite its assertive name.

## NAVICULA CUSPIDATA Kützing

(Smith, Brit. Diat., pl. 16, fig. 131; Donkin, Brit. Diat., pl. 6, fig. 6; Van Heurck, Synopsis, pl. 12, fig. 4.)

This fresh-water diatom probably came as detritus into the marine samples of Philippine flora.

## • NAVICULA CYCLOPS, new species

Plate 21, fig. 5

Valve broadly oval, ends not produced, beading of very fine lines which are radial near the margin but elsewhere broken up into a wavy pattern; arranged in four bands, two along the margin, about one-seventh the length of the transverse axis at the center, and

becoming narrower toward the ends; two narrow bands midway between the sides and the middle, curving with the curve of the sides, except at the center of the valve, where they bend inward toward the central nodule; similar wavy beading on either side of the rhaphe, narrow at the apices, then broadening until near the center; rhaphe straight, with hooked apical ends, both bent toward the same side; a conspicuous ocellus set to one side of the central nodule.

Length, 0.090–0.132; width, 0.068–0.087; lines (margin), 11 in 0.01 mm.

The nearest affinity to this rather frequent Philippine diatom is *N. caliginosa* Cleve and Grove (Le Diat., vol. 1, pl. 10, fig. 9) from Macassar Strait.

*Type*.—Cat. No. 43643, U.S.N.M.

NAVICULA DELECTA, new species

Plate 24, figs. 5–7

Valve panduriform, considerably narrowed at the middle, apices slightly prolonged, acute; widest diameter of each half midway between middle and apex; markings of widely spaced, smooth or slightly granular costae, beginning with enlarged ends, a short distance inward from the margin and running nearly to the rhaphe, their length being in strict proportion to the width of the valve, so that the outer ends are everywhere equidistant from the margin; those near the middle slightly reflexed, absolutely transverse only at the widest diameter of the two halves and becoming more diagonal toward the apices; a row of short costae forming a border around the entire margin and extending downward over its curved edge; equal in number to and continuous with the longer costae, from which they are separated by a narrow hyaline space; rhaphe strong, straight, its middle ends well separated, its outer ends reaching the apices, with an evident median area on either side.

Length, 0.068–0.124; width, 0.028–0.035; lines, 4 in 0.01 mm.

There is an easily seen relationship between this ornate and graceful species and *N. bartholomei* Cleve (W. I. Diat., p. 6, pl. 1, fig. 5) which, however, is closer to *N. powellii* Lewis than to this form and is so classified in Fricke's index. *N. bartholomei* lacks the produced and acute apices of his species; its costae are broader, fewer, are all transverse, and "a row of small granules" replaces the marginal costae of *N. delecta*. Cleve's parallel between his species and varieties of *N. marginata* Lewis (*N. strangulata* Greville, etc.) is very fanciful. Nor, despite the similarity, should Fricke's classification of it as a variety of *N. powellii* be considered necessary. Frequent.

*Type*.—Cat. No. 43644, U.S.N.M.

## NAVICULA DIDYMA Ehrenberg

(Smith, Brit. Diat., pl. 17, fig. 154; Van Heurck, Synopsis, pl. 9, figs. 5-6; H. L. Smith, Types, No. 265.)

## NAVICULA DIFFUSA A. Schmidt

(Schmidt, Atlas, pl. 2, fig. 28.)

Another form in both Campeche Bay and the Philippine Islands.

## NAVICULA DIPLOSTICTA Grunow

(Schmidt, Atlas, pl. 13, figs. 25-30.)

This is another diatom found at Campeche Bay and the Philippine Islands.

## NAVICULA DURANDII Kitton

Plate 21, fig. 6

(Schmidt, Atlas, pl. 129, figs. 1-3.)

A blotched variety is named *N. bullata* Norman by Castracane in his Report of the Challenger Expedition, plate 28, figure 7. Another interesting variety is here figured.

## NAVICULA ELONGATA Grunow

(Schmidt, Atlas, pl. 50, figs. 27-29; Nordsee Diat., pl. 2, fig. 42.)

It is most doubtful if this can be accepted as *N. elongata* of Ehrenberg in his Mikrogeologie, page 77, which seems to be a *nomen nudum*. It would be well to give this a new name.

## NAVICULA ERYTHRAEA Grunow

(Grunow, Neu. Gek. Diat., pl. 3, fig. 17A; Schmidt, Atlas, pl. 6, fig. 22.)

Cleve, I think unnecessarily, makes this a variety of *N. cluthensis* Gregory (New and Little-Known Diat., p. 10.)

## NAVICULA EUDOXIA A. Schmidt, variety

(Schmidt, Atlas, pl. 8, figs. 39-40, 45.)

Philippine specimens seem to belong to this species as figured above, especially with the unnamed figure 45, in the absence of any lateral enlargement of the rectangular central area. It is also what Schmidt formerly called *N. mediterranea* Grunow? in Nordsee Diatomaceen, plate 2, figure 10, which, though earlier (1874), can not be preferred, as it is preempted in Kützing's Bacillarien, plate 3, figure 17, (1844). Here also might be included two unnamed figures in Schmidt's Atlas, plate 8, figure 28 and plate 70, figure 68; possibly also what Peragallo misnames *N. (Diploneis) cynthia*, var. *intermedia* (Diat. Samoa, p. 5, pl. 1, fig. 16). Cleve (N. Diat., vol. 2, p. 82) has made this species a variety of *N. contigua* A. Schmidt, the type figure of which is in Schmidt, Atlas, plate 8, figure 43. Not only is this union not advantageous, but the preference for this latter name over

*N. eudoxia* is unwarranted. The idea advanced by Cleve (N. Diat., vol. 2, p. 82) of all these forms being corroded specimens of *N. gemmata* Greville is not worth consideration.

NAVICULA EXCAVATA Greville, wide variety

Plate 21, fig. 7

(Micro. Journ., 1866, pl. 12, fig. 15; Schmidt, Atlas, pl. 3, figs. 22-25.)

This is another diatom common to both Campeche Bay and the Philippine Islands.

NAVICULA EXIMIA Grunow

(Schmidt, Atlas, pl. 212, fig. 7.)

The type specimen came from the nearby Cebu.

NAVICULA EXPEDITA A. Schmidt

(Schmidt, Atlas, pl. 69, fig. 6.)

So far as I know, this species has not been found before except in the fossil material from Moron, Spain.

NAVICULA FORCIPATA Greville

(Micro. Journ., 1859, pl. 6, figs. 10-11; Donkin, Brit. Diat., pl. 2, fig. 4; Schmidt, Atlas, pl. 70, fig. 17; Nordsee Diat., pl. 2, figs. 16, 18; Van Heurck, Synopsis, pl. 10, fig. 3.)

The variety called var. *densestriata* in Schmidt's Atlas, plate 70, figures 14-16, is one of the forms found. It is another form common to both Campeche Bay and the Philippine Islands.

NAVICULA FORMICINA Grunow

(Schmidt, Atlas, pl. 160, figs. 38-41; Cleve, W. I. Diat., pl. 1, fig. 6.)

Another species confined exclusively to Campeche Bay and the Philippines.

NAVICULA FUNICULATA, new species

Plate 22, figs. 1-2

Valve very convex, oval-lanceolate, with blunt, slightly produced apices, the markings of which are not continuous with those of the rest of the valve; these latter consist of strong and well-separated rows of cross-barred lines, set diagonal to the longitudinal axis of the valve, approaching the rhapshe but leaving an evident median line, which is slightly enlarged at the depressed central nodule into a circular hyaline area; rhapshe slightly bent, especially toward its outer ends, which terminate in beads some distance removed from the rounded apices of the valve; in side (girdle) view each valve is seen to be marked with heavy cross-barred lines above mentioned, except at each end where a triangular space occurs, marked with the same cross-barred lines, but running *at right angles to those on the rest of the valve*; the whole frustule is subrectangular, with an indentation at the center of each valve; the girdle is broad and hyaline.

Length, 0.070–0.087; width, 0.016–0.017; depth of frustule, 0.043 to 0.051; 4.5 lines in 0.01 mm.

This species has some affinity with those in Schmidt's Atlas, plate 46, figures 41–42 and 71–72, erroneously named in Fricke's Index and in Cleve's Naviculoid Diatoms (p. 30), var. *gregorii* Ralfs of *N. cancellata* Donkin. But if compared with *N. cancellata* Donkin itself, there is very little similarity, (Donkin, Brit. Diat., p. 55, pl. 8, fig. 4) nor with Ralf's *N. gregorii* (see Pritchard, Inf., p. 901 and Gregory, Glenshira Diat., p. 41, pl. 4, fig. 21, which equals *Pinnularia apiculata* Gregory). In face view the valve reminds one of *N. impressa* Lagerstedt (Diat. Bohus., p. 33, pl. 1, fig. 3) the costae of which, however, are smooth. In side view all resemblance disappears.

*Type*.—Cat. No. 43645, U.S.N.M.

#### NAVICULA FUSCA (Gregory) Ralfs

(Gregory, Diat., Clyde, p. 14, pl. 1, fig. 15; Donkin, Brit. Diat., pl. 1, fig 5; Schmidt, Atlas, pl. 7, figs. 2–4; Van Heurck, Synopsis, Supp., pl. B, fig. 24.)

For discussion of the boundaries of this species see *N. ingens*, new species.

#### NAVICULA GEMMATA Greville

(Greville, Cal. Guano, p. 30, pl. 4, fig. 7; Schmidt, Atlas, pl. 70, figs. 72–74.)

Several variations from the type, as var. *peristio-phora* as well as the type form, were found.

#### NAVICULA GEMMULATA Grunow

(Schmidt, Atlas, pl. 13, figs. 19–21.)

#### NAVICULA GLABRISSIMA, new species

Plate 22, fig. 3

Valve wholly glabrous, narrowly oval, slightly prismatic in outline; convex; apices rounded, blunt; rhapshe strong, straight, ending in beads at the apices and the center; median area on either side of rhapshe very narrow

Length, .065–0.070; width, 0.023–0.026 mm.

This diatom gives no evidence of surface markings under the best 1.8 oil-immersion objective, with either direct or oblique illumination. The specimens might be considered to be immature or auxisporial forms were it not for the perfect finish of the entire frustules, including rhapshe. Rare found only at Jolo Jolo, Sulu Islands.

*Type*.—Cat. No. 43646, U.S.N.M.

#### NAVICULA GRAEFFII Grunow

Plate 22, fig. 4

(Schmidt, Atlas, pl. 7, figs. 5–6; pl. 8, fig. 33; and Cleve, Nav. Diat., vol. 1, p. 93.)

Another species common to both Campeche Bay and the Philippine Islands. It also occurs in the nearby islands of Celebes and Java.

## NAVICULA (ALLOIONEIS) GRUENDLERI Cleve

See *N. inexacta*, new name.

## NAVICULA HAMULIFERA Grunow

(Cleve, Nav. Diat., vol. 1, p. 154, pl. 3, figs. 16–19.)

## NAVICULA HENNEDIYI W. Smith

(Gregory, Glenshira Diat., pl. 5, fig. 3; Donkin, Brit. Diat., pl. 2, fig. 3; Schmidt, Atlas, pl. 3, fig. 18; Van Heurck, Synopsis, pl. 9, fig. 14.)

As above mentioned, the including here of *N. clavata* Gregory is unwarranted. This common species occurs in both Campeche Bay and the Philippine Islands.

## NAVICULA HOSPES A. Schmidt

(Schmidt, Atlas, pl. 8, fig. 32.)

So far as I know, this unique diatom has been found elsewhere only at Samoa.

## NAVICULA IMITANS, new species

Plate 22, figs. 5–6

Valve broadly oval with produced, rounded apices; marked with closely set rows of small well-rounded beads, the rows diagonal to the longitudinal axis, barely so at the middle of the valve, progressively more so toward the apices; the beading interrupted by a double-lyrate or H-shaped hyaline design similar to that of the type form of *N. lyra* Ehrenberg, its four horns wide apart, slightly connivant toward their ends, stopping short of the sides of the valve; the two halves of the rhabdium straight except at the apical ends, where they are sharply twice bent or hooked, the ends at the center approaching closely and enlarged.

Length, 0.090–0.168; width, 0.053–0.083; 14.3 lines in 0.01 mm.

This diatom is abundant in the Philippine Islands and is very uniform in appearance. It resembles wide varieties of *N. lyra* Ehrenberg and of *N. approximata* Greville. Naviculae with a double-lyrate design occur in great variety. It would be a disadvantage to attempt their classification under a single specific name.

*Type*.—Cat. No. 43647, U.S.N.M.

## NAVICULA INDICA Greville

(Micro. Journ., 1862, pl. 9, fig. 13.)

De Toni (Syl. Alg., p. 105) makes this *N. macraei* Rabenhorst on the basis of a too meager description, and without illustration, in Rabenhorst's Flora Europaea Algarum, volume 1, page 226. Without much question, it should rather be taken to be a variety of *N. clavata* Gregory, where the hyaline H-shaped area is charged with a heavy granulation. If this view were taken the name of Gregory would have precedence, 1856.



## NAVICULA INDIGENS, new species

## Plate 23, fig. 1

Valve elliptical, massive, cross-barred with heavy costae, which are finely rugose but not beaded except near their pointed marginal ends, where each bears a single large bead, the beads thus forming a strong row parallel with and slightly distant from the margin of the valve; a single row of similar beads running on either side of the rhapshe, slightly distant from the inner ends of the costae and equaling them in number; rhapshe heavy, straight, its ends at the center distant, its apical ends not reaching the margin; a conspicuous hyaline area at each apex.

Length 0.096–0.129; width 0.037–0.068; lines 3–3.5 in 0.01 mm.

This species belongs to the *N. crabro* Ehrenberg-*N. pandura* Brébisson group, but can not be united with either as a variety without doing violence to any workable image of those species. It is quite abundant in the Philippine Islands.

*Type*.—Cat. No. 43648, U.S.N.M.

## NAVICULA INEXACTA, new name

## Plate 22, fig. 7

This is what Cleve and Grunow name *Alloioneis grundleri* Cleve (West Ind. Diat., p. 7, pl. 2, fig. 10), but the genus as constituted by Schumann (Diat. H. Tatra, 1867, p. 73) and accepted by Cleve, is too loosely defined and too uncalled for to justify its adoption. Cleve himself abandons this arrangement (Nav. Diat., vol. 2, p. 51). Such forms would naturally be recognized as *Naviculae*, and therefore to call them something else is to complicate rather than simplify taxonomy. But to change this into *Navicula grundleri*, as is done by Cleve in his Naviculoid Diatoms (vol. 2, p. 51, 1896), is to upset *N. grundleri* A. Schmidt, in Schmidt's Atlas, plate 12, figure 35, published August 1, 1885. I have therefore renamed it *N. inexacta*, referring to the broken pattern of the markings and the unsymmetrical rhapshe.

This is another species found in both Campeche Bay and the Philippine Islands.

## NAVICULA INGENS, new species

## Plate 22, fig. 8

Valves broadly elliptical, closely set with beading of two kinds; in the wide areas along either side, representing something over one-third the width of the valve, the beading is massive, arranged in regular rows, transverse at the middle and increasingly radial toward the ends of the valve, the lines and the beads so closely set that many of the latter are rectangular by lateral pressure; the second kind of beading, that of the narrow elliptical central area, which is less than one-third

the width of the valve and bisected by the rhaphe line and extending clear to the ends of the valve, is covered by equally closely set but much smaller beading, arranged in double rows, in zigzag formation, each double row continuous with the coarser single rows of the outside area and extending inward to the rhaphe line; the rhaphe is heavy, reaching to the ends of the valve; the hyaline area of the central nodule is small and oval.

Length, 0.13; width, 0.053; lines, 6.5 in 0.01 mm.

This species belongs to the *Navicula fusca* group. Its outer beading is similar to that species, but much coarser and denser; its inner double beading is similar to that of *N. smithii* Brébisson. There is a great confusion between these two latter and *N. aestiva* Donkin. The muddle is not at all helped by Cleve's attempt in *Naviculoid Diatoms*, volume 1, page 93, where he excludes the figure and description of *N. fusca* in Donkin's *British Diatoms*, page 7, plate 1, figure 5, making it *Diploneis borealis* (Grunow) Cleve and includes the utterly irrelevant *N. subfusca* Pantocsek, var. *oamaruensis* Cleve, which he figures on his plate 2, figure 3. A careful study of these related forms, in which the Philippine Islands gatherings are quite rich, makes it evident that we have three or perhaps four well-marked types. In *N. smithii*, a species of broadly oval shape, the beading is always in double rows between costal lines, both in the outer portion of the valve and in the inner elliptical portion, the double beading of the latter however being fainter. In *N. aestiva* the beading is delicate, in single rows without costal lines, both in the outer portions and in the elliptical central portion. In *N. fusca* (based on "*N. smithii* var. *B. fusca* Greg." in *Diatoms of the Clyde*, p. 486, pl. 9, fig. 15) the beading is also in single rows in both inner and outer portions, but so much more massive than that of *N. aestiva* that the two can only with difficulty be taken as variations of each other; the central part of *N. aestiva* being also much less angular in outline than that of *N. fusca*. In the new species here presented we have a fourth form, where the beading of the outer portions is even more massive than in *N. fusca*, while the strongly contrasting central portion is covered with double rows of fine beading separated by costal lines. That this never occurs in *N. fusca* is shown by the careful drawing by Tuffen West of the original type in *Diatoms of the Clyde*, plate 9, figure 15, in the figure in Donkin's *British Diatomaceae*, plate 1, figure 5, also by Tuffen West; in the figure in Schmidt's *Atlas*, plate 7, figures 1-4; in Peragallo's *Diatomées de France*, plate 20, figures 6-7; and in the express statement of Gregory above cited; in the statement by Ralfs in Pritchard's *History of Infusoria*, page 899; in that of Donkin's *British Diatomaceae*, page 7; and that of De Toni in *Sylloge Algarum*, page 87.

*Type*.—Cat. No. 43649, U.S.N.M.

## NAVICULA INHALATA A. Schmidt

Plate 23, fig. 2

(Schmidt, Atlas, pl. 2, fig. 30.)

I have figured the form of Philippine Islands diatoms which I have assigned to this species because there is some doubt that the two are the same. Schmidt's type came from Samoa and Pantocsek reports it and his var. *biharensis* from the fossil beds in Hungary. The resemblance of both these to *N. spectabilis* Gregory is evident.

## NAVICULA INTERCEDENS A. Schmidt

(Schmidt, Atlas, pl. 160, figs. 3-4.)

This is another species exclusive to Campeche Bay and the Philippine Islands. It is not to be confused with *N. musca* Gregory (Schmidt, Atlas, pl. 160, figs. 1-2).

## NAVICULA INVENUSTA Mann

(Mann, Diat., Alb. Voyages, p. 346, pl. 53, fig. 6.)

## NAVICULA IRIDIS Ehrenberg

(Donkin, Brit. Diat., pl. 5, fig. 6; Van Heurck, Synopsis, pl. 13, fig. 1; Schmidt, Atlas, pl. 49, fig. 2.)

Infrequent specimens of this fresh-water diatom appear in the marine Philippine material, probably introduced with other detritus from inflowing rivers or streams.

## NAVICULA JEJUNA A. Schmidt

(Schmidt, Atlas, pl. 46, fig. 16; Castracane, Chall. Exp., pl. 20, fig. 12.)

## NAVICULA JUGATA Cleve

See remarks under *N. bigemmata*, new species.

## NAVICULA LACRIMANS A. Schmidt

(Schmidt, Atlas, pl. 12, figs. 59-60.)

The placing of this under *N. gemmatula*, Grunow, in Fricke's Index, can not be sustained. It is doubtful if var. *fossilis* Pantocsek in Hungarian Diatoms, part 2, plate 2, figure 18, is close enough for a mere variety. The type form was from Campeche Bay, another instance of diatoms peculiar to that locality and the Philippine Islands.

## NAVICULA LIBER W. Smith

(Smith, Brit. Diat., p. 48, pl. 16, fig. 133; Schmidt, Atlas, pl. 50, figs. 16-18; Van Heurck, Synopsis, pl. 12, fig. 36.)

Varieties of this approach varieties of *N. maxima* Gregory, but the two should be recognized as distinct.

## NAVICULA LITTORALIS Donkin

(Donkin, Brit. Diat., p. 5, pl. 1, fig. 2; Schmidt, Atlas, pl. 7, fig. 12; Van Heurck, Synopsis, Supp., pl. B, fig. 25; H. L. Smith, Types, No. 291.)

This is like, possibly identical with *N. ovulum* Grunow (N. Ung. Gek. Diat., pl. 1, fig. 19; and Schmidt, Atlas, pl. 70, fig. 13).

## NAVICULA LONGA (Gregory) Ralfs

(Donkin, Brit. Diat., pl. 8, fig. 3; Schmidt, Atlas, pl. 47, fig. 68.)

Another species occurring at both Campeche Bay and the Philippine Islands.

## NAVICULA LYRA Ehrenberg

(Ehrenberg, Amer., pl. 1, sec. 1, fig. 9a; Gregory, Diat., Clyde, pl. 1, fig. 13; Schmidt, Atlas, pl. 2, figs. 24-25; pl. 3, figs. 11-12; Van Heurek, Synopsis, pl. 10, figs. 1-2.)

The type form of this cosmopolitan species is not common in the Philippine Islands, but is mainly represented by several of its many varieties, as var. *recta* (Schmidt, Atlas, pl. 2, fig. 18), var. *subcarinata* (Schmidt, Atlas, pl. 2, fig. 5). Var. *insignis* (Schmidt, Atlas, pl. 2, fig. 27), and var. *elliptica* (Schmidt, Atlas, pl. 2, fig. 34) also present, hardly belong to this category and might receive separate names.

## NAVICULA MADAGASCARENسيس Cleve

Plate 25, fig. 4

(Le Diat., vol. 1, p. 23, pl. 4, fig. 2.)

The type locality was Tamatava, Madagascar. A very robust form of this rare diatom is here figured, the measurements of which are—Length, 0.110; width, 0.056; lines, 6.5 in 0.01 mm.

## NAVICULA MARGARITA A. Schmidt

(Schmidt, Atlas, pl. 174, fig. 17.)

This species is also exclusively a Campeche Bay-Philippine Islands form.

## NAVICULA MARGINATA Lewis

(Lewis, New and Rare Diat., p. 62, pl. 2, fig. 1; Schmidt, Atlas, pl. 160, figs. 21, 28, 31.)

This strikingly beautiful and variable diatom is widely dispersed. Among other places it is found both at Campeche Bay and the Philippine Islands, especially the variety which Castracane calls *N. janischii* in the Report of the Challenger Expedition, plate 30, figure 5, and to which Cleve has appended the unnecessary term, "forma *brevis*." Its artful simulation of the genus *Mastogloia* caused Brun and Grunow to put varieties of it in that genus, and Cleve to name a variety without the usual median constriction "*Dictyoneis thumii*" (Cleve, Nav. Diat., vol. 1, pl. 5, fig. 33).

## NAVICULA MAXIMA Gregory

(Gregory, Glenshira Diat., pl. 4, fig. 19; Schmidt, Atlas, pl. 50, figs. 19-21, 33, 36.)

The resemblance of this species to *N. liber* W. Smith causes De Toni (Syl. Alg., p. 158) to remove Gregory's own example in Diatoms of the Clyde, plate 1, figure 13, to *N. liber*., as well as that of

Ralfs in Pritchard, Infusoria, plate 7, figure 75. Lagerstadt (Diat., Bohusl., p. 43.) names a specimen, *N. liber*, var. *maxima*. Admitting the nearness of some of the varieties to each, it is best to keep the dissimilar types in separate species.

NAVICULA MENDICA, new species

Plate 23, fig. 3

Valve convex narrow, lanceolate, the sides running straight from middle to apices, which are not produced but are rounded and massive because of a thickening of the silica wall; markings of short, beaded, slightly diagonal lines in four rows, two inner and two marginal; all four rows have the lines set wide apart, the interspaces being twice the width of the lines; the two marginal rows are alike, their lines very short; the two inner rows are unlike, one being close to and parallel with the rhapshe and made up of very short lines, the other of longer lines, midway between the margin and the rhapshe and parallel with the margin; rhapshe straight, the middle ends approaching closely, the outer ends stopping short of the apices.

Length, 0.062; width, 0.016; 4.7 lines in 0.01 mm.

That this is close to *N. biseriata* Petit (Journ. Roy. Micro. Soc., 1878, p. 241, pl. 32, fig. 33) and to *N. richardsoniana* O'Meara (Irish Diat., p. 339, pl. 32, fig. 33) is evident; but it differs from both by its very angular outline, by the unsymmetry of median rows of lines, and by the shortness of these lines in three of the four rows. It further differs from *N. richardsoniana* in the remoteness of the rhapshe ends from the apices of the valve, and from *N. biseriata* in the absence of the "semistauros" at the central nodule. In other words, there is, with a certain resemblance, the same degree of valid difference between these as between *N. californica* Greville and *N. hennedyi* W. Smith. O'Meara says his species closely resembles *N. nitescens* Gregory, which it certainly does; but it would be difficult to trace any resemblance between that diatom and the present species. While dealing with the above combination it may be in place to remark that to those who can not accept Cleve's subdivision of the genus *Navicula* as of generic rank, his arbitrary changing of *N. biseriata* Petit into *Caloneis biseriata* (Petit) Cleve and then appropriating that name for another *Navicula*—"Diploneis biseriata Cl."—causes much confusion. This latter diatom I have also found in the Philippine Islands and my position, with that of Van Heurck and many other diatomists being against the dismemberment of *Navicula*, has compelled me to give to Cleve's species a new name *Navicula mimula* Mann, which see.

*Type*.—Cat. No. 43650, U.S.N.M.

## NAVICULA MEXICANA (Heiden) Mann

(Schmidt, Atlas, pl. 264, figs. 3, 7.)

This is named in the above *Caloneis mexicana*, a genus the validity of which is here denied.

## NAVICULA MIMULA, new name

Plate 23, fig. 4

As was mentioned under *N. mendica* Mann, this diatom is probably a variety of "*Diploneis biseriata* Cl." (Nav. Diat., vol. 1, p. 102, pl. 2, fig. 16) although the biserial quality is here lacking, as there is only a single series of beads on either side of the valve. But the shape, general sculpture, including the hyaline apical areas and the straight rhapshe in both, makes any specific distinction undesirable. As has been said, Cleve's appropriation of the name *biseriata* for this form makes it necessary for those who do not follow his classification to give another name to the present species, so as to avoid confusion with *Navicula biseriata* Petit (Journ. Roy. Micro. Soc., 1878, pl. 14, fig. 15). It may be said at this place that the use of one specific name for two diatoms that will undoubtedly be considered by some diatomists as belonging to the same genus is as unfortunate as it is unnecessary.

Length, 0.093; width, 0.036; 3.6 lines in 0.01 mm.

This diatom is rare.

## NAVICULA MIRABILIS Leuduger-Fortmorel

(Leuduger-Fortmorel, Diat., Ceyl., p. 31, pl. 2, fig. 21.)

This rare diatom, found heretofore only in Ceylon, should not be confused with the later named (1879 and 1886) *N. mirabilis* Castracane (Chall. Exp., pl. 30, fig. 10). The last De Toni renames *N. philippinica* (Syl. Alg., p. 87).

## NAVICULA MOLESTA, new species

Plate 23, fig. 5

Valve very convex, long-elliptical or fusiform in outline, with gently curved sides and rounded apices; markings of finely set, beaded lines, all radial, almost reaching to the rhapshe, at the center more loosely spaced, resulting in an imperfect, flaring, stauroslike, lateral extension of the central area; rhapshe rigidly straight, its central ends almost touching.

Length, 0.085; width, 0.023; 18 lines in 0.01 mm.

It has some resemblance to the much coarser, fresh-water, *N. bott-nica* Grunow, the original material of which is in H. L. Smith, Types, No. 682, and the original figure in Van Heurck's Synopsis, plate 7,

figure 33; also to *N. digito-radiata* Gregory, well illustrated in Peragallo's Diatomaceae of France, plate 12, figure 28, and to *N. solaris* Gregory, in the Microscopical Journal for 1856, plate 5, figure 16. My specimens came from Jolo Jolo, and are of striking delicacy.

*Type*.—Cat. No. 43651, U.S.N.M.

**NAVICULA MULTICOSTATA** Grunow

(Grunow, N. Ung. Gek. Diat., pl. 1, fig. 13; Schmidt, Atlas, pl. 11, figs. 14, 20; pl. 12, figs. 71-72.)

Rather generally held to be a phase-form of *N. crabro* Ehrenberg. The variety shown in Schmidt's Atlas, plate 11, figure 20 is common to both Campeche Bay and the Philippine Islands.

**NAVICULA NEBULOSA** Gregory

(Gregory, Diat., Clyde, pl. 1, fig. 8; Donkin, Brit. Diat., pl. 2, fig. 2; Schmidt, Atlas, pl. 3, fig. 14.)

This species is similar to *N. hennedyi* W. Smith and some authors have published it as a variety of that species. But it is much more delicately formed and sculptured, appearing constant from a great many localities.

**NAVICULA NITESCENS** Ralfs

(Donkin, Brit. Diat., pl. 1, fig. 7; Schmidt, Atlas, pl. 7, figs. 37-41; Gregory, Diat., Clyde, pl. 1, fig. 16.)

This species is common to both Campeche Bay and the Philippine Islands.

**NAVICULA NOTABILIS** Greville

(Micro. Journ., 1863, p. 18, pl. 1, fig. 9.)

The original locality is unknown. I have found it also in material from Hilo, Hawaiian Islands.

**NAVICULA NUMMULARIA** Greville

(Greville, Cal. Guano, p. 30, pl. 4, fig. 6.)

This is close to *N. forcipata* Greville.

**NAVICULA OAMARUENSIS** Grunow

(Schmidt, Atlas, pl. 129, fig. 9; pl. 204, fig. 13.)

I do not like this identification; but my specimens are so nearly like this hitherto local, fossil species that a new name is not justified.

**NAVICULA OBESA** (Greville) Mann

Plate 23, fig. 6; plate 24, fig. 1

This is Greville's *Stauroneis obesa*, in Diatoms from the South Pacific, page 237, plate 3, figure 12. Under my *Cocconeis citronella*, new species, the under valve of which is strikingly similar to this diatom, I have mentioned the fact that Cleve rather arbitrarily united

this and the unnamed specimens figured in Schmidt's Atlas, plate 198, figures 35, 36, and 40, because he failed to consider that Greville might have been dealing with an unquestionable *Navicula* ("*Stauroneis*") proven by both valves being identical in markings and both having raphes. By means of such specimens I have been able to reestablish the validity of Greville's classification, and I include two photographs for comparison with that of the under valve of *C. citronella*. It will be seen that the identity claimed by Cleve is deceptive, because both in form and in the pattern and coarseness of the beading there are easily overlooked but genuine differences. Thus Greville's type form gives 8.5 to 9.5 lines in 0.01 mm., my typical specimen 9.4 and my varietal specimen 9.2 lines in 0.01 mm., while Cleve says that the corresponding valves in his combination give 21 to 25 lines in 0.01 mm. The arrangement of the lines is also different, as is especially evident about the center of the valve and adjacent to the small stauros.

NAVICULA OCELLATA, new species

Plate 24, fig. 2

Valve an accurate oval, crossed by fine, closely set unbeaded lines, leaving a lenticular median area about one-quarter the width of the valve, which gradually narrows to a mere thread at the apices; a row of similiar but very short beaded lines on either side of the raphe somewhat flared outward at their beginning near the center, and stopping somewhat short of the apices, to which the raphe continues; raphe line depressed; a large central nodule; the inner ends of the raphe bent right and left above and below it; on either side of the center the crosslines are interrupted by two indential large ovate hyaline areas or ocellae; occasionally one of these is more obscure than the other, though not wanting entirely; rim stout and hyaline; crosslines transverse only at the middle, progressively curved outward as they approach the apices.

Length, 0.062–0.082; width, 0.026–0.037; 11 to 14 lines in 0.01 mm.

A slight resemblance to this species is found in the rather questionable figure of "*Stauroneis robusta*" Petit, as given in Peragallo's Diatomees, France, plate 29, figure 9, the original figure being in Petit Journal of Royal Microscopical Society, 1878, plate 15, figure 16.

*Type*.—Cat. No. 43652, U.S.N.M.

NAVICULA OPHIOCEPHALA Cleve and Grove

(Le Diat., vol. 1, p. 57, pl. 9 fig. 13; Schmidt, Atlas, pl. 212, fig. 6.)

NAVICULA OSCITANS A. Schmidt

(Schmidt, Atlas, pl. 6. fig. 41.)

What is called var. *subundulata* Cleve and Grove in Le Diatomiste, page 67, plate 10, figure 10, is not a variety of this but a separate species and is here included as *N. suboscitans*, which see.



## NAVICULA O'SWALDII Janisch

(Schmidt, Atlas, pl. 70, fig. 46.)

I follow here the lead of other diatomists in recording this as separate from *N. excavata* Greville, but the two are not satisfactorily distinguishable.

## NAVICULA PACIFICA (Castracane) Mann

(Castracane, Chall. Exp., p. 23, pl. 20, fig. 9.)

This is placed in the genus *Stauroneis* by Castracane, an ill-defined and to me unnecessary separation from the genus *Navicula*.

## NAVICULA PANDURA Brébisson

(Brébisson, Diat. Cherb., p. 15, pl. 1, fig. 4; Schmidt, Atlas, pl. 11, figs. 1-2; Van Heurck, Synopsis, pl. 9, fig. 1.)

As stated under *N. crabro* (Ehrenberg) Kützing, I do not recognize this to be a variety of that species.

## NAVICULA PARTITA, new species

Plate 24, fig. 3

Valve narrow panduriform, the median constriction broad and gently concave; the greatest width of each half of the valve is midway between the center and the apex, the apical part being somewhat wedge-shaped; on either side of the valve extends a marginal band of short, heavy costae ending inwardly in a bead, the interspaces between the costae being hyaline except for an obscure rounded blotch near the margin; the width of this band varies in exact proportion to the width of the valve, being widest midway between the center and the apices and narrowing to the middle and to the apices; the longitudinal central area of the valve bisected by the rhapshe line is crossed by continuations of the costae in the outer bands; but these continuations are broad, flat, and indistinct; no rows of beads bordering the sides of the rhapshe; a small but conspicuous rectangular central nodule; rhapshe straight, ending in beads at the apices and at the center, the latter touching the rectangular central nodule.

Length, 0.104-0.107; width, 0.031-0.037; 3 lines in 0.01 mm.

One is here reminded of *N. coarctata* A. Schmidt (Atlas, pl. 11, fig. 30, and pl. 174, fig. 22) and even more so of *N. exempta* A. Schmidt (pl. 11, fig. 29) although the original figure of the latter in Schmidt's Nordseef. Diatomaceen, plate 2, figure 5, shows less similarity. The marking, especially the absence of rows of beading next to the rhapshe line, sets this diatom off as a distinct species.

*Type*.—Cat. No. 43653, U.S.N.M.

## NAVICULA PATRICIA, new species

Plate 24, fig. 4

Valve of the *N. crabro* form, but deeply constricted at the middle, the two halves ovate, tapering to the rounded ends; markings in three series; an outer band of coarse rectangular divisions, obscurely double-headed, widest at the center of each half, narrowing toward the ends and disappearing at the constricted middle portion of the valve; within this outer band and continuous with its divisions, coarse and perfectly smooth bars, reaching to the third of the series of markings, these last bordering the central rhaps area; like the outer band, these coarse median bars decrease in length toward the apices and disappear entirely at the constricted middle area of the valve; the third series of markings, running on either side of the rhaps, correspond in number to the divisions of the other two series; they are coarse, rectangular, increasing regularly in size from the apices of the valves toward the middle, where they replace the other two series and form the only markings between the central nodule and the margin; the rhaps is massive, its inner ends very widely separated, the central nodule thus left being rectangular, its longer axis corresponding with that of the valve.

Length 0.082; width 0.023; 6 lines in 0.01 mm.

The only species at all closely resembling this is *N. coarctata* A. Schmidt, figured in Schmidt's Atlas, plate 11, figure 30, and plate 174, figure 22. It is rare in the Philippine Islands. One specimen has been found also at the Galapagos Islands.

*Type*.—Cat. No. 43654, U.S.N.M.

## NAVICULA PELAGI A. Schmidt

(Schmidt, Atlas, pl. 7, fig. 26.)

Fricke's Index records the above figure as a variety of *N. fusca* (Gregory) Ralfs, to which I do not agree. This species is another example of diatoms peculiar to Campeche Bay and the Philippine Islands.

## NAVICULA PETITIANA Grunow

(Cleve, New and Little Known Diat., pl. 3, fig. 34; Schmidt, Atlas, pl. 212, figs. 26-29.)

## NAVICULA PHILIPPINARUM, new species

Plate 25, fig. 1

Valve broadly oval, marked by a broad marginal band of strong beading set in radially directed rows, which are not closely placed but separated by interspaces as wide, or some times twice as wide as the rows, the beads in each row also not being crowded but slightly separated; short interpolated rows next to the margin not infrequent, this outer band is of nearly equal width except at the middle where

it is suddenly widened and close to the two ends where it is rapidly narrowed and disappears, leaving a small triangular hyaline space beyond each end of the rhaphe; rhaphe straight, strong, sharply hooked toward the same side at the outer ends, the inner ends well separated; short and similar rows of beads run parallel to the rhaphe on either side, they are narrowest at the outer ends and widest at the center of the valve; the rest of the valve is loosely spattered with larger but shadowy beads, showing a tendency to a radial arrangement.

Length, 0.079–0.125; width, 0.059–0.087; 3.7 lines in 0.01 mm.

Very clearly this brilliantly sculptured diatom is in that large group of *Naviculae* of which *N. excavata* Greville and *N. caribaea* Cleve are typical. But when compared, it can not be united as specifically identical with any of them, however difficult it might be to draw a clear line of distinction between them by means of an unillustrated description. It is the most abundant *Navicula* in the Philippine dredgings, including those from the Sulu group. It is of unvarying uniformity as to its markings and all specimens are relatively large.

*Type*.—Cat. No. 43655, U.S.N.M.

#### NAVICULA PINGUIS Mann

(Mann, Diat., Alb. Voyages, p. 350, pl. 53, fig. 5.)

The original type form was from Bering Sea.

#### NAVICULA PLICATULA Grunow

Plate 24, figs. 8–9

(Cleve, Nav. Diat., vol. 1, pl. 3, fig. 28; Castracane, Chall. Exp., pl. 28, fig. 13, unnamed.)

This is the unnamed *Navicula* in Report of the Challenger Expedition, plate 28, figure 13, from Tahiti. It is also very probable that *N. parallela* Castracane shown in the same work, plate 28, figure 12, is the same species, although the two figures seem to be quite different. For in Philippine Islands material I have found all transitions between these two, both as to straight or undulating rhaphe and as to bluntly oval or appressed apices. A study and measurement of a large series indicates beyond much doubt that this difference is merely a varietal one. The average length of my specimens is 0.084 to 0.138 mm., and the width from 0.031 to 0.038 mm. All are strongly convex, very diaphanous, with identical markings, namely, very fine transverse beaded lines; all have about 18 lines in 0.01 mm., measured midway between center and apex of valve; all have a shadowy line parallel to the margin running midway between the margin and the center on each side of the rhaphe. This smaller central oval or ellipse, thus dimly marked out, Cleve refers to as a "slight depression." If therefore plate 28, figure 12, and plate 28, figure 13, as shown in the Report of the Challenger Expedition, are identical

*N. parallela* Castracane (1886) would replace *N. plicatula* Grunow (1894). But as there still may be some doubt about this identity I accept Grunow's name and include here only the unnamed figure given in the Report of the Challenger Expedition, plate 28, figure 13. The fact that Castracane saw a difference between this figure and his *N. parallela* makes the decision to leave the latter out of this combination a safe one, despite the suspicious similarity above noted. I give here an illustration of the typical form with undulating rhaphe and of the variety with straight rhaphe.

**NAVICULA PRAETEXTA Ehrenberg**

(Gregory, Diat., Clyde, pl. 1, fig. 11; Schmidt, Atlas, pl. 3, figs. 30-34; Van Heurck, Synopsis, pl. 9, fig. 13.)

This species is represented by many variations in the Philippine Islands.

**NAVICULA PRISTIOPHORA Janisch**

(Schmidt, Atlas, pl. 70, fig. 72.)

The only previously recorded locality for this species is Leton Bank. Fricke's Index incorrectly makes it a variety of *N. gemmata* Greville.

**NAVICULA PROBABILIS A. Schmidt**

(Schmidt, Atlas, pl. 50, fig. 46.)

Although the specific name is an implication of uncertainty on the part of Schmidt, I think its separate rank is worth while. It is another species found only at Campeche Bay and the Philippine Islands.

**NAVICULA PRODIGA Mann**

(Mann, Diat., Alb. Voyages, p. 352, pl. 53, fig. 4.)

The type specimen came from the Hawaiian Islands.

**NAVICULA PSEUDO-CLAVATA, new species**

Plate 25, fig. 2

Valve broadly elliptical, with produced, rounded ends; sides in the middle portion nearly straight; markings of very fine, closely set rows of beading, radial and parallel to each other near the margin, becoming wavy toward the center; the rows interrupted by long narrow hyaline spaces extending diagonally from near the apices on each side the rhaphe toward but not reaching, the middle of the valve, and also by a small flaring central stauros; rhaphe straight, ending in beads at the middle and in minute hooks turned to the same side at the apices.

Length, 0.141; width, 0.073; 11.5 lines in 0.01 mm.

With this may be compared *N. transfuga* Grunow in Cleve's Vega Diatoms, plate 35, figure 15, from Seychelles Islands and a doubtful variety of the same in Schmidt's Atlas, plate 204, figure 17.

*Type*.—Cat. No. 43656, U.S.N.M.

## NAVICULA PUDENS, new species

Plate 26, fig. 3

Valve, narrow elliptical, with rounded ends; crossed by coarse rows of beading, the rows as well as the beads in each row not closely set; rows strictly transverse except near to the ends of the valve; outside bead in each row larger than the rest, thus forming a marginal series around the valve and slightly distant from the hyaline rim; longitudinal median area one-fifth the width of the valve, slightly broadened at the center to form an oval hyaline median area; rhabdium inclosed by parallel ridges on each side, straight, the middle ends widely separated.

Length, 0.047; width, 0.014; 7 lines in 0.01 mm.

This is practically the same diatom as the unnamed form in Schmidt's Atlas, plate 7, figure 49, from Campeche Bay. It also is closely related to *N. sejuncta* A. Schmidt (Nordsee Diat., pl. 1, fig. 18, and Schmidt, Atlas, pl. 212, figs. 9-10).

*Type*.—Cat. No. 43657, U.S.N.M.

## NAVICULA PUELLA A. Schmidt

(Schmidt, Atlas, pl. 12, figs. 13-15; pl. 69, figs. 15-25.)

The making this a variety of *N. splendida* Gregory in Fricke's Index is open to doubt, at least in the case of plate 12, figures 13-14, and plate 69, figure 15, above. It is another diatom common to both Campeche Bay and the Philippine Islands.

## NAVICULA PUGIO, new species

Plate 26, fig 4

Valve convex, narrow lanceolate, tapering from the middle to the acute apices; markings of diagonally directed parallel rows of coarse, round or oval beads, the rows, as well as the beads in each row, somewhat distant; a flaring central stauros extending almost to the sides and depressed below the beaded portions of the valve; rhabdium not reaching the apices, its middle terminations almost touching and slightly bent to one side.

Length, 0.110; width, 0.017; 5 lines in 0.01 mm.

This very narrow and coarsely marked diatom belongs to the *N. aspera* Ehrenberg group. It is somewhat rare.

*Type*.—Cat. No. 43658, U.S.N.M.

## NAVICULA PULVULENTA, new species

Plate 25, fig. 3

Valve long, hexagonal, with straight, parallel sides and wedge-shaped ends; slightly convex and slightly depressed transversely across the middle; at the margin the valve bends quickly downward to form vertical sides which join with the girdle; a thin hyaline line

marks this marginal bend and extends around the entire valve, including its apices; entire surface of the valve, including the vertical sides, dotted with small widely separated beads, showing a slight tendency to form transverse rows; a small oval hyaline area at the center; rhaps very slightly sinuous, its middle terminations distant and bent in opposite directions.

Length, 0.090–0.099; width, 0.030–0.033 mm.

This delicate and peculiarly ornamented species reminds one of *N. (Alloioneis) grundleri* Cleve and Grunow, also found in the Philippine Islands material and figured in Cleve's West India Diatoms, plate 2, figure 10, and here recorded under the new name *N. inexacta* Mann, and illustrated on plate 22 figure 7 for comparison as a Philippine Islands form.

*Type*.—Cat. No. 43659, U.S.N.M.

**NAVICULA RAEANA (Castracane) Cleve**

(Castracane, Chall. Exp., p. 25, pl. 15, fig. 3.)

Cleve's idea (Nav. Diat., vol. 2, p. 69) that this species may be a variety of *N. yarrensensis* Grunow can not be commended. In general shape, in the character of its rhaps and in its costal markings it is clearly distinct. The original type form also came from the Philippine Islands.

**NAVICULA RECTANGULATA Gregory**

(Gregory, Diat., Clyde, p. 7, pl. 9, fig. 7; Donkin, Brit. Diat., pl. 10, fig. 5; Van Heruck, Synopsis, Supp., pl. A, fig. 7.)

**NAVICULA RETINENDA A. Schmidt**

(Schmidt, Atlas, pl. 212, fig. 17.)

Schmidt's contention that this form offers satisfactory distinctive mark from *N. liber* W. Smith seems to be correct. The type specimen came from the not distant Sumbawa, East Indies.

**NAVICULA RETROSTAUROS, new species**

Plate 25, fig. 5; plate 26, figs. 1–2

Valve quite convex, narrow oval or spindle-shaped, the sides sloping from the middle gently to the rounded ends; covered with fine closely set lines diagonal to the long axis and rather obscurely beaded, the beading of each line being slightly irregular, resulting in a faint wavy appearance in the sculpture; interrupted by a faint but persistent longitudinal line on each side near to the margin and parallel with it; at the center a strong stauros, at first narrow but suddenly broadened out at the outer ends into triangular enlargements and just touching the two faint longitudinal side lines above mentioned; this stauros perceptibly sunken in the surface of the valve, so that its vertical side boundaries are strongly accentuated; rhaps a trifle

tortuous, especially near the center, its outer ends curved and reaching the apices of the valve, its inner ends well separated; in side (girdle) view the sunken stauros shows as a deep central notch.

Length, 0.090–0.141; width, 0.029–0.035; lines, 10.6–11 in 0.01 mm.

Compare with *N. impleta* Cleve and Grove (Le Diatomiste, p. 58, pl. 1, figs. 1–2) from Macassar Straits, and *N. crucifix* Tempère and Brun, Diatomées du Japon (p. 42, pl. 7, fig. 10) fossil at Sendai, Japan.

*Type*.—Cat. No. 43660, U.S.N.M.

#### NAVICULA RHOMBICA Gregory

(Micro. Journ., 1856, pl. 5, fig. 1, Cleve, Nav. Diat., vol. 1, p. 152.)

There is some question as to this species being a true *Navicula*, chiefly because of its peculiar rhaps, which is heavy, rodlike, with ends terminating at some distance from the apices of the valve. Nevertheless, as no other assignment seems to be more satisfactory, this one is provisionally adopted. Specimens from recent dredgings from the Philippine Islands as well as from other localities do not agree exactly with Brun's form from the fossil deposit at Sendai Japan, *Navicula (Schizonema) japonica* (Brun) Cleve (Brun Espec. Nouv., pl. 14, fig. 6), but the two can hardly be separated. Somewhat similar is *Brebissonia weisflogii* Grunow (Cleve, W. I. Diat., pl. 1, fig. 9).

#### NAVICULA ROBUSTA Grunow

(Schmidt, Atlas, pl. 50, figs. 1–2.)

#### NAVICULA SAMOENSIS Grunow

(Schmidt, Atlas, pl. 50, figs. 43–44.)

#### NAVICULA SEDUCTILIS A. Schmidt

(Schmidt, Atlas, pl. 2, fig. 35.)

That this is a mere variety of *N. lyra* Ehrenberg, as claimed by O' Meara, De Toni, and others, may be doubted.

#### NAVICULA SEMISTAUROS, new species

Plate 26, fig. 5

Valve convex, spindle-shaped, with narrow, rounded apices, unsymmetrically marked on its two sides; one side having closely set diagonal beaded lines, broken here and there by wider spacing between the beads and also by single beads being larger than the rest, these two irregularities producing a wavy appearance in the markings; a central stauros is also unsymmetrical, its half on this side being very small, while on the other side it is strong, flaring, and reaches about halfway to the margin; the rows of beading on this last-mentioned side having the flaring half stauros, are even more irregular as to the

spacing and size of beads than on the opposite side, and the last bead in each row, adjacent to the rhaphe, is enlarged, which is not the case on the opposite side; the central nodule is conspicuous and is unsymmetrically placed nearer to this side, the middle terminations of the rhaphe also being bent toward this side.

Length, 0.141-0.211; width, 0.034-0.045; 8 lines in 0.01 mm.

One is reminded by this species of *N. (Alloioneis?) kurzii* Grunow (Cleve, W. I. Diat., p. 8, pl. 2, fig. 12). It is not infrequent in several of the Philippine Islands dredgings.

*Type*.—Cat. No. 43661, U.S.N.M.

**NAVICULA SEPARABILIS** A. Schmidt

(Schmidt, Atlas, pl. 11, figs. 3-5, 7, 10.)

This is another species common to both Campeche Bay and the Philippine Islands. The claim implied in its specific name is probably justified, although it is rather close to *N. crabro* Ehrenberg.

**NAVICULA SERRATULA** Grunow

Plate 26, fig. 6

(Schmidt, Atlas, pl. 7, figs. 42-43.)

This is another species peculiar to Campeche Bay and the Philippine Islands, unless the unnamed figure of a Samoa diatom in Schmidt's Atlas, plate 8, figure 11, is this species. Fricke's Index considers it the same, probably correctly so. The Philippine Islands form is here illustrated.

**NAVICULA SIMULATOR**, new species

Plate 26, fig. 7

Valve nearly flat, very broadly elliptical, with straight sides and rounded ends, densely covered, except in the narrowly elliptical median area that is bisected by the rhaphe, with fine but strongly beaded, closely set lines, a single row of beads to each line, transverse at the middle part of the valve, increasingly diagonal and curved toward each end, until at the extreme ends they become truly longitudinal; the middle area of the valve is narrow, barely elliptical not widened at its center and not tapering; its ends set some distance back from the rounded ends of the valve; the rhaphe bisecting this middle area is heavy, its apical ends forked and turned toward the same side of the valve; the central nodule is slightly dilated; the middle area is, on either side of the rhaphe, marked with very obscurely beaded continuations of the beaded lines covering the outer portions of the valve.

Length, 0.095; width, 0.051; 9 lines in 0.01 mm.

This elegantly sculptured diatom has its nearest affinity in *N. aestiva* Donkin, which, however, has less clearly cut beading than *N.*



*smithii* Brébisson (Donkin says, "Less granular"), whereas this species is much more sharply cut; *N. aestiva's* rows of beading are less curved as they approach the apices of the valve, and it has a more spindle-shaped median area, the ends of which are not set back from the ends of the valve. (See Donkin, Brit. Diat., p. 6, pl. 1, fig. 13; also Schmidt's questionable figure of *N. fusca* Gregory in Schmidt's Atlas, pl. 7, fig. 4, comparing these with the typical figure of *N. fusca* in Gregory's Diatoms of the Clyde, pl. 9, fig. 15.)

This species is quite rare.

*Type*.—Cat. No. 43662, U.S.N.M.

#### NAVICULA SMITHII Brébisson

(Schmidt, Atlas, pl. 7, fig. 19; Van Heurck, Synopsis, pl. 9, fig. 12; Supp., pl. B, fig. 23.)

Next to the figure 8 forms of *Navicula* represented by *N. crabro*, the long elliptical form, of which this species may be taken as the model, is the most frequent shape of marine *Naviculae*, both as to the abundance of individuals and the number of different species. Consequently much confusion exists because of the careless multiplication of new names, and some of the older valid species seem thereby to have lost any satisfactory boundary lines of demarcation. This is particularly true of *N. smithii*, *N. fusca*, *N. elliptica*, etc. A discussion of this subject has already been given under my new species, *N. ingens*.

#### NAVICULA SPECTABILIS Gregory

Plate 27, figs. 1-2

(Gregory, Diat., Clyde, p. 9, pl. 9, fig. 10; Donkin, Brit. Diat., pl. 2, fig. 5; Schmidt, Atlas, pl. 3, figs. 20-21.)

A Philippine Islands form, not far from the typical one of Gregory's beautiful species, is here illustrated for comparison with some new species which simulate but do not truly agree with it.

#### NAVICULA SPICULIFERA, new species

Plate 26, fig. 8

Valve flat or barely convex in the middle but strongly convex toward the sides; somewhat spindle-shaped but with very blunt rounded ends; marked with strong, widely spaced and perfectly smooth costae inclined diagonally outward, their inner ends some distance from the raphic line; raphic strong, flanked by a faint elevated ridge on either side, its median ends well separated, its outer ends some distance back from the convex apices of the valve, and each ending in (or adjacent to) a small spine; the central nodule slightly depressed.

Length, 0.083-0.084; width, 0.021-0.025; 6-6.6 lines in 0.01 mm.

This species is near to Schmidt's Atlas, plate 47, figure 34, incorrectly named *N. impressa* Lagerstedt, and equally incorrectly renamed

*N. cancellata* Donkin in Fricke's Index. The latter slightly different diatom has its type figure in Donkin, British Diatoms, page 55, plate 8, figure 4. Schmidt's similar figure, however, has moniliform, not smooth, costae.

*Type*.—Cat. No. 43663, U.S.N.M.

NAVICULA SPLENDIDA Gregory

(Gregory, Glenshira Diat., pl. 5, fig. 14; Schmidt, Atlas, pl. 12, figs. 13-15; pl. 13, figs. 31-34; pl. 69, fig. 22.)

The fine variety figured in Schmidt's Atlas, plate 69, figure 22, is peculiar to Campeche Bay and the Philippine Islands.

NAVICULA SUBACUTA (Ehrenberg) Ralfs

(Schmidt, Atlas, pl. 43, figs. 31-33; Ehrenberg, Mikrogeologie, pl. 35A, sec. 6, fig. 12.)

NAVICULA SUBOSCITANS, new name

(Le Diat., vol. 1, p. 67, pl. 10, fig. 10.)

There named *N. (oscitans* var. ?) *subundulata* Cleve and Grove; this being preempted in Sylloge Algarum, page 159, for Schmidt's Atlas, plate 49, figure 16, I propose the above name.

NAVICULA SUFFOCATA, new species

Plate 27, fig. 3

Valve somewhat panduriform, deeply indented at the middle, then rapidly broadened to the maximum width, then barely if at all narrowed for one-half the distance to the apices, and finally narrowed rapidly to the rounded ends; markings of narrow costae, the inner end of each slightly enlarged, the outer end terminating in a candle-flame shaped enlargement, in the center of which is a single bead; the costae near the middle of the valve are sharply curved or reflexed backward; in the area of greatest width they are transverse and from there progressively curved forward; the spaces between the costae are heavily rugose or obscurely beaded; a conspicuous hyaline area at each apex and a small rectangular one at the center; rhaps robust, slightly wider in the central part of each half, bordered on either side by a single row of large beads.

Length, 0.096; width, 0.035; 4.5 lines in 0.01 mm.

Perhaps this should be considered to be a wide variety of *N. adonis* Brun (Diat. Japon, p. 41, pl. 5, fig. 3) found fossil at Jeddo, from which it differs both in outline and in the strongly dotted spaces between the costae, which Brun states are hyaline in his specimens and which are so figured in Schmidt's Atlas, plate 174, figures 18-21.

*Type*.—Cat. No. 43664 U.S.N.M.

NAVICULA SULCATA Greville

See *Cymatoneis sulcata* (Greville) Cleve.

## NAVICULA (DICTYONEIS) THUMII Cleve, misnamed.

(Cleve, Nav. Diat., vol. 1, pl. 5, fig. 33.)

See under *N. marginata* Lewis.

The separation of this form from the many variants of *N. marginata* solely on the ground of its lacking a median constriction would be at least debatable, were there not all possible gradations of this one quality. The extremely constricted type is seen in *N. strangulata* Greville (Micro. Journ., 1866, pl. 12, fig. 24) less sudden in constriction in *N. jamaicensis* Greville (fig. 23 of the same plate) then comes Lewis's type (Schmidt, Atlas, pl. 160, fig. 21, followed by figs 30 and 31 of the same plate), and finally Cleve's figure above. All have the same irregularly set beading, the same rhaps, the same marginal row of rectangular markings, simulating the marginal chambers of *Mastogloia*, and the same central area. It is one of the most widely distributed and (consequently?) most variable of all the diatoms. Were Cleve's species valid a new specific name would be needed to transfer it into *Navicula* on account of *N. thumii* Pantocsek (Hung. Diat., 1886, vol. 1, pl. 10, fig. 85).

## NAVICULA TRANSLUCENS, new species

Plate 26, fig. 9

Valve convex, broadly lanceolate or spindle-shape, with small but rounded apices; markings of very finely beaded, closely set lines running diagonally outward, but less so toward the ends, where they become more nearly transverse, approaching very close to the rhaps but leaving a thin hyaline median area; at the center this median area is slightly broadened to form the oval hyaline nodule; on either side and parallel with the margin the beading is interrupted by an indistinct line running about midway between the sides and the rhaps; rhaps straight, its inner ends joined together by a faint ridge, so that it appears to run continuously across the oval hyaline central nodule; outer ends of the rhaps not reaching the apices of the valve, very slightly bent at the tips, not terminating in beads.

Length, 0.101–0.135; width, 0.028–0.040; 11–12.5 lines in 0.01 mm.

This delicate species has close affinity with *N. my* Cleve (Nav. Diat., vol. 2, pl. 1, fig. 17) from China and some likeness to *N. belgica* Van Heurck (Belg. Antarct, pl. 1, fig. 9.)

*Type*.—Cat. No. 43665, U.S.N.M.

## NAVICULA TURGESSENS, new name

This is *Diploneis platessa* Cleve and Grove, in *Naviculoid Diatoms*, volume 1, page 97, plate 2, figure 6. That genus, as elsewhere stated, is not accepted by Van Heurck, Schmidt, De Toni, and others, including the author. But *Navicula platessa* is not available, being pre-empted by Cleve in his *New and Little-Known Diatoms*, plate 1,

figure 12, necessitating the adoption of a new name for this diatom. One specimen found was strongly suggestive of *N. nitescens* Ralfs, to which indeed the species as a whole bears some resemblance. The type specimen came from Macassar Straits.

**NAVICULA VACILLANS A. Schmidt**

(Schmidt, Atlas, pl. 8 fig. 61; Van Heurck, Synopsis, pl. 9, fig. 9.)

This rare species has been found also at Ostend, Belgium, and at Cape of Good Hope. Fricke's Index incorrectly includes here Schmidt's Atlas, plate 8, figure 37, and plate 12, figures 42-43, 52-53.

**NAVICULA VELATA A. Schmidt**

(Schmidt, Atlas, pl. 48, figs. 33-34.)

**NAVICULA VENUSTA Janisch**

Plate 27, figs. 4-5

(Janisch, Gaz. Exp., pl. 15, fig. 17; Peragallo, Diat., France, pl. 25, figs. 14-15.)

The typical form and an interesting variety of this rare diatom are here figured. Pantocsek subsequently gave this name to a wholly different diatom (Hung. Diat., vol. 2, p. 56, pl. 5, fig. 81). Cleve does not correct this because he transfers the latter to his genus *Caloneis* the validity of which is here denied.

**NAVICULA VESPARELLA, new name**

Plate 27, fig. 6

This sharply marked species was found by Cleve in material from Java and is named *Diploneis vespa* and figured in Naviculoid Diatoms, volume 1, page 97, plate 2, figure 5. To diatomists who can not find in Cleve's restoration of the Ehrenberg genus *Diploneis* any characteristics which mark off its members from the rest of the *Naviculae*, this would become *N. vespa* (Cleve) but the name is inadmissible because of *N. vespa* (Ehrenberg) Ralfs, as well as of *N. vespa* O'Meara. I have therefore given to it the similar name *vesparella*. One of the Philippine Islands specimens is typical, except that the rhomboidal angles are not so pronounced as in Cleve's specimen, and is much larger 0.090 by 0.024 mm., with 7 lines in 0.01 mm., Cleve's being 0.050 by 0.012 mm., with 11 lines in 0.01 mm. Two other Philippines specimens are exactly like the unnamed figure in Schmidt's Atlas, plate 160, figure 14, from Celebes, which must be considered as being only an unimportant variety of this species and which have measurements that are like Cleve's type, 0.05 by 0.018; with 10 lines in 0.01 mm., and 0.052 by 0.018; with 10.5 lines in 0.01 mm.

**NAVICULA VULPECULA A. Schmidt**

(Schmidt, Atlas, pl. 12, fig. 56.)

The type came from Celebes Island.

## NAVICULA WEISSFLOGII A. Schmidt

Plate 27, fig. 7

(Schmidt, Atlas, pl. 12, figs. 26-32; Van Heurck, Synopsis, Supp., pl. B, fig. 21.)

This species is here represented by a rather wide variety (see my figure), in which the beading is finer and more closely set than in the type. It is probably the same species as *N. diversa* Greville (Diat., So. Pac., pl. 4, fig. 14, 1863) which if so, would replace the above name (1873). Only an examination of Greville's type specimen can determine this, as his figure is manifestly somewhat fanciful. This is another species found in both Campeche Bay and the Philippine Islands.

## NAVICULA YARRENSIS Grunow

(Schmidt, Atlas, pl. 46, figs. 1-6.)

This striking species of massive sculpture occurs in a fossil state in Hungary, as well as now living at widely separated localities, United States Atlantic Seaboard, Samoa, Kiel, Germany, and the Philippine Islands.

## NAVICULA ZOSTERETI Grunow

(Grunow, N. Ung. Gek. Diat., pl. 2, fig. 23; Schmidt, Atlas, pl. 47, figs. 42-44.)

## Genus NITZSCHIA Hassall

## NITZSCHIA ALATA Leuduger-Fortmorel

See *N. campechiana* Grunow.

## NITZSCHIA BISCULEPTA, new species

Plate 28, figs. 1-2

Valve broadly elliptical, slightly constricted at the middle, with rather acute, wedge-shaped ends; finely marked with close beading arranged in quincunx lines, the sculpturing being bisected longitudinally by a narrow ragged, median, hyaline line, slightly curved, toward the dorsal side; the half on the ventral side of this line is further marked by a prominent overlay of short, more or less vermiform shining dashes; wanting on the dorsal half; costal band on the dorsal margin small and finely cross-barred, interrupted by a nodule in the sinus of the median constriction.

Length, 0.133-0.170; width, 0.050-0.062; decussating lines, 12-13 in 0.01 mm.; costae of dorsal band, 5.5-6 in 0.01 mm.

This curiously marked diatom, belonging to the *N. panduriformis* group, is rather abundant in the Philippine Islands. I have found it also at Hilo, Hawian Islands. It bears a slight resemblance to *N. nicobarica* Grunow.

*Type*.—Cat. No. 43666, U.S.N.M.

## NITZSCHIA CAMPECHIANA Grunow

Plate 28, figs. 3-4

(Grunow, New Species, Nitz. Micro. Journ., 1880, p. 395, pl. 13, fig. 16.)

This is identical with *N. alata* Leuduger-Fortmorel (Diat. Malaisie, p. 24, pl. 2, fig. 11, 1892). It is quite probable that *N. superba* Leuduger-Fortmorel (Diat. Ceyl., p. 40, pl. 8, fig. 83, 1879) is also the same, although the double row of unskillfully formed beads at the middle of the valves, found in *N. campechiana* and *N. alata*, is lacking in *N. superba*, and the ends are slightly more pointed. All are abundant in the Philippine Islands; and a series of many intermediate forms goes far to prove that the above-mentioned marks of distinction vary individual cases in every conceivable way. I have, at least temporarily, held *N. superba* separate, as thereby simplifying identification; but a specific difference will probably eventually be found untenable. In that case, the oldest name, *N. superba*, would replace *N. campechiana* and *N. alata*. The similar *N. bukensis* Peragallo (Diat., Samoa, pl. 2, fig. 6, 1911) should also be mentioned here as an important variety of *N. superba*. Of course, all of these may be said to belong to the *N. nicobarica* Grunow group of *Nitzschiae*. (See this in Reise F. Nov., pl. 1A, fig. 4.)

As the name indicates, this is another species found in Campeche Bay and the Philippine Islands.

## NITZSCHIA COCCONEIFORMIS Grunow

Plate 28, fig. 5.

(Grunow, New Species, Nitz., p. 395, pl. 12, fig. 5; Peragallo, Diat., France, pl. 75, fig. 15.)

Both the type form and an interesting variety of this rare diatom were found, the latter figured here.

## NITZSCHIA DISTANS Gregory

(Geogory, Diat., Clyde, p. 58, pl. 14, fig. 103; Van Heurck, Synopsis, pl. 62, fig. 10.)

Both the type form and the curious variety which Grunow calls var. *tumescens* were found, the latter being another example of diatoms common to the floras of Campeche Bay and the Philippine Islands.

## NITZSCHIA FLUMINENSIS Grunow

(Grunow Oest. Diat., Wien. Verh., 1862, p. 581, pl. 12, fig. 35; Van Heurck Synopsis, pl. 62, figs. 3-4.)

Here is included Grunow's *N. majuscula*, which Van Heurck rightly considers to be a variety of this species; figured in Van Heurck, Synopsis, plate 62, figure 5. The type is found in both Campeche Bay and the Philippine Islands, var. *majuscula* in only these two places.

**NITZSCHIA GRAEFFEI** Grunow

(Cleve, W. I. Diat., p. 20, pl. 5, fig. 32; Grunow, New Species, Nitz., pl. 12, fig. 4.)

**NITZSCHIA GRANULATA** Grunow

(Cleve and Grunow, Arct. Diat., p. 68; Grunow, New Species, Nitz., pl. 12, fig. 7; Van Heurck, Synopsis, pl. 57, fig. 5.)

**NITZSCHIA INSIGNIS** Gregory

Plate 28, fig. 6

(Gregory, Glenshira Diat., pl. 1, fig. 46; Peragallo, Diat., France, pl. 75, fig. 5.)

The type form and several varieties were found, one of which is here figured.

**NITZSCHIA LITTORALIS** Grunow

(Van Heurck, Synopsis, pl. 59, figs. 1-3; Peragallo, Diat., France, pl. 69, fig. 17.)

The form common in the Philippine Islands is exactly that figured in Van Heurck's Synopsis, plate 59, figure 1.

**NITZSCHIA MAJUSCULA** Grunow

See under  $\frac{3}{2}$  *N. fluminensis* Grunow.

**NITZSCHIA MARGINULATA** Grunow

(Cleve and Grunow, Arct. Diat., p. 72, pl. 5, fig. 93; Van Heurck, Synopsis, pl. 58, figs. 12-14; Peragallo, Diat., France, pl. 70, figs. 14-17.)

It is noteworthy that the form prevalent in the Philippine Islands is the one common also in Campeche Bay, namely, *N. marginulata*, var. *subconstricta* Grunow, it being another example of the similarity of these two floras; it is figure 12 above.

**NITZSCHIA OBESA** Castracane

(Castracane, Chall. Exp., p. 67, pl. 13, fig. 11.)

I greatly question there being any essential difference between this and Leuduger-Fortmorel's previously named *N. granulosa* (Diat. Ceyl., pl. 3, fig. 37). Coming from approximately the same part of the world, the figures and descriptions of the two are remarkably alike. Castracane does not give the dimensions of his species, but says it is twice as long as broad. The measurements by Leuduger-Fortmorel agree, namely, 104 by 48. *N. obesa* is said to have fine decussating rows of beading, and although a decussating order is not evident in the figure of *N. granulosa* it must be discoverable in so evenly and closely set beading as there indicated. Castracane's type came from the Philippine Islands and I give his name, with the above statement that it is probably identical with the Ceylan Island form.

**NITZSCHIA PANDURIFORMIS** Gregory

(Gregory, Diat., Clyde, p. 57, pl. 14, fig. 102; Van Heurck, Synopsis, pl. 58, figs. 1-3.)

**NITZSCHIA PULCHERRIMA** Kitton

(Micro. Journ., 1874, pl. 81, figs. 1-3; Peragallo, Diat., France, pl. 76, fig. 2.)

This is another species common to both Campeche Bay and the Philippine Islands.

**NITZSCHIA SPATHULATA** Brébisson

(Smith, Brit. Diat., pl. 31, fig. 268; Van Heurck, Synopsis, pl. 62, figs. 7-8; H. L. Smith, Types, No. 370.)

**NITZSCHIA SUPERBA** Leuduger-Fortmorel

(Leuduger-Fortmorel, Diat., Ceyl., p. 40, pl. 8, fig. 83.)

For discussion of the probable identity of this and *N. campechiana* Grunow, see the latter. Typical specimens of *N. superba* were found.

**NITZSCHIA TRYBLIONELLA** Hantzsch

(Peragallo, Diat., France, pl. 69, figs. 11-13; Van Heurck, Synopsis, pl. 59, fig. 6.)

This minute variety of the type form is put as a separate species, *N. salinarum* Grunow, in the above reference to Van Heurck's Synopsis. It is better to retain Grunow's original idea of making it a variety of *N. tryblionella*. (See Cleve and Grunow, Arct. Diat., p. 70.)

**NITZSCHIA TUBICOLA** Grunow

(Van Heurck, Synopsis, pl. 69, fig. 14.)

Unquestionable examples of this rare diatom were found, which, so far as I know, has been previously reported only from Sonderberg (Denmark), occurring there "in the tubes of *Navicula grevillei*."

**NITZSCHIA VALIDA** Cleve and Grunow

(Cleve, W. I. Diat., pl. 3, fig. 19; Van Heurck, Synopsis, pl. 65, fig. 4.)

This is another species common to both Campeche Bay and the Philippine Islands.

**NITZSCHIA VERMICULATA** Castracane

(Castracane, Chall. Exp., p. 68, pl. 13, fig. 12.)

It differs from *N. superba* Leuduger-Fortmorel (Diat., Ceyl., pl. 13, fig. 16) almost wholly in the peculiar vermiculate arrangement of the beading. Perhaps only a Philippine Islands variety of that species, Castracane's type having been found at Zebu.

**NITZSCHIA WEISSFLOHII** Grunow

(Peragallo, Diat., France, pl. 76, figs. 3-4.)

This species also is limited to Campeche Bay and the Philippine Islands.



## NITZSCHIA ZEBUANA, new species

Plate 28, fig. 7

Valve linear, with rounded ends; median indentation barely evident; very delicate transverse lines along both dorsal and ventral sides; the median portion, about one-third the width of valve, hyaline or very faintly lined; dorsal band very narrow and marked with fine, distant crosslines.

Length, 0.139; width, 0.015; fine lines, 27 in 0.01; coarse dorsal lines 10-11 in 1.01 mm.

It is possible this may be related to *N. plana*, var. *zebuana* Castracane (Chall. Exp., p. 67, pl. 13, fig. 10) the measurements and fineness of markings of which are not given. At any rate, that form is too wide from *N. plana* W. Smith to be accepted as a variety. (See Smith, Brit. Diat., vol. 1, p. 42, pl. 15, fig. 114.)

*Type*.—Cat. No. 43667, U.S.N.M.

## Genus OMPHALOPSIS Greville

## OMPHALOPSIS AUSTRALIS Greville

(Greville, Diat., So. Pac., p. 537, pl. 1, figs. 10-11; Van Heurck, Treat., p. 335, fig. 92.)

This rare diatom has been previously found only in the Seychelles Island and Woodlark Island, new Guiana. The genus is closely allied to *Plagiogramma*.

## Genus PLAGIOGRAMMA Greville

## PLAGIOGRAMMA ANTILLARUM Cleve

Plate 29, fig. 1

(Cleve, Diat. W. I., pl. 3, fig. 16; not Schmidt, Atlas, pl. 209, fig. 10.)

Schmidt's figure above should not be referred to this species. A somewhat finer beaded variety of *P. antillarum* is named *P. truanii* Pantocsek (Hung. Diat., vol. 3, pl. 15, fig. 224.)

## PLAGIOGRAMMA APPROXIMATUM A. Schmidt

See under *P. polygibbum* Cleve and Grove.

## PLAGIOGRAMMA ATTENUATUM Cleve

Plate 29, fig. 2

(Cleve, W. I. Diat., p. 10, pl. 3, fig. 18.)

This rare diatom was found in the nearby island of Ceylon and the type in St. Bartholomew, W. I. It is here illustrated, as the original figure by Cleve is poor.

## PLAGIOGRAMMA DISTINCTUM, new species

Plate 29, fig. 3

Valve narrow spindle-shaped, distended at the middle; the central space is a narrow, transverse, hyaline rectangle, heavily outlined; the two terminal spaces are thimble-shaped, heavily outlined, faintly dotted; exclusive of these three spaces, the valve is covered on either side with diagonal rows of beads, the spaces between being wider than the rows; the beading of the sides approach inwardly, but leave an evident median longitudinal line (pseudorhaphé).

Length, 0.208; width, 0.040; 2.6 lines in 0.01 mm.

This diatom might be looked upon as a not at all obese variety of *P. obesum* Greville as figured in the Quarterly Journal of Microscopical Science for 1859, plate 10, figure 12, except that the beading on Greville's species is in strictly transverse, not diagonal, rows which are not widely separated, as they are in the above. Its nearest relative is, however, *P. constrictum* Greville (So. Pac. Diat., pl. 1, fig. 8), especially as figured Schmidt's Atlas, plate 211, figure 10, from Cebu, in which the diagonal and wider spaced rows of beads are closely similar. The absence of any constriction should probably justify their separation. Compare also the incorrectly named *P. gregorianum*, var. *robusta* Brun in Diatomees Japon, plate 9, figure 7.

*Type*.—Cat. No. 43668, U.S.N.M.

## PLAGIOGRAMMA GREGORIANUM Greville

(Micro. Journ., 1859, pl. 10, fig. 1; Van Heurck, Synopsis, pl. 36, fig. 2.)

It is not well to disturb this well-known name for the uncertain identity of it with *Denticula staurophora* Gregory (Diatoms of the Clyde, p. 497, pl. 10, fig. 37).

## PLAGIOGRAMMA NANKOORENSE Grunow

(Grunow, Reise F. Novara, p. 95, pl. 1A, fig. 8; Schmidt, Atlas, pl. 210, fig. 31.)

Castracane names this *Glyphodesmis challengerensis* in his Report of the Challenger Expedition, plate 18, figure 13, and in Leuduger-Fortmorel's Diatomees Ceylan, plate 5, figure 59, it is called *P. ceylanense* Leuduger-Fortmorel.

## PLAGIOGRAMMA OBESUM Greville?

See remarks under *P. distinctum*, new species.

## PLAGIOGRAMMA PAPILIO Cleve and Grove

(Le Diat., vol. 1, pl. 8, fig. 17; Schmidt, Atlas, pl. 211, fig. 13.)

This and *P. Atomus* Greville are closely alike. The type specimen came from the near-by Macassar Straits.

**PLAGIOGRAMMA POLYGIBBUM** Cleve and Grove

(Le Diat., vol. 1, pl. 8, figs. 7-11; Schmidt, Atlas, pl. 211, figs. 2-5.)

Here also belong *P. quadrigibbum* Brun (Schmidt, Atlas, pl. 211, fig. 1) and *P. approximatum* A. Schmidt (Schmidt, Atlas, pl. 211, fig. 7).

**PLAGIOGRAMMA SULCATUM** Cleve and Grove

(Le Diat., vol. 1, pl. 8, figs. 1-3; Schmidt, Atlas, pl. 210, fig. 5.)

This departs so widely from other species of *Plagiogramma* as to awaken doubt of its belonging here.

**PLAGIOGRAMMA TESSELATUM** Greville

(Micro. Journ., 1859, pl. 10, fig. 7; Schmidt, Atlas, pl. 209, figs. 42-50.)

Castracane's *Glyphodesmis murrayana* (Chall. Exp., pl. 18, fig. 12) belongs here.

**Genus PLEUROSIGMA** W. Smith

This genus stands out with unusually sharp distinctness, if we include in it *Donkinia* Ralfs, *Rhoicosigma* Grunow, and *Toxonidia* Donkin, which in fact are nothing more than subgeneric divisions of *Pleurosigma*, but are accorded generic rank to facilitate identification. All are characterized by a more or less sigmoid outline, both as to the contour of the valve and the shape of the rhaps; and all are strikingly alike in the simplicity and elegance of marking that covers the entire valve—a delicate network of closely appressed beading, arranged in one of three ways—in transverse and longitudinal rows, in decussating rows of three directions, with a divergence of approximately  $60^\circ$ , one being transverse and the other two oblique, and thirdly, in oblique rows of two directions with a divergence of approximately  $90^\circ$ , there being no transverse arrangement of rows. This last has not been recorded; but a careful inspection of some species grouped with the three-row decussating type shows that the angle between the lines is  $90^\circ$  with no trace of a transverse arrangement. A notable example of this is *P. japonicum* Castracane, in the Report of the Challenger Expedition, page 38, plate 29, figure 14, correctly illustrated as having only two sets of lines, though the fact is not commented upon. This species is recorded below, being not uncommon in the Philippine Islands, and invariably shows only two rows by oblique as well as by direct lighting. The same is true of my new species *P. obesum*, under which is discussed the reason for the disappearance of the third line. The attempt to divide *Pleurosigma* proper into two genera—*Pleurosigma* for species with decussating rows of three directions and *Gyrosigma* for species with two direction lines, transverse and longitudinal—has nothing to comment it. Not only would it necessitate a third genus to accommodate those forms above mentioned, which have neither of these arrangements of beading, but

to be consistent, it would require the subdivision of both *Donkinia* and *Rhoicosigma* into two genera each, as both contain species with transverse-longitudinal lines as well as other species with three direction decussating lines. Although, as above mentioned, this genus stands out sharply defined, the simple and unique uniformity of its structure renders clear-cut demarcation between its species a difficult thing. For we are confined to only three factors for our specific marks of distinction—size, a very unstable and misleading quality; difference in contour, as relative width, sharpness or bluntness of apices, etc.; and lastly, fineness or coarseness of marking. In consequence of this, species have been unduly multiplied, and, on the other hand, cautious students have grouped with known species some new forms that should be held specifically distinct. In short, *Pleurosigma* in its species represents one of the most difficult subjects in diatom taxonomy. One has, so to speak, to sense the species as one recognizes individuals among our fellow men. Some distinctions are of course easily made; one can say at a glance that *P. formosum* W. Smith is not *P. angulatum* W. Smith, that *P. balticum* W. Smith is not *P. littorale* W. Smith. But many cases of classification in Peragallo's admirable monograph on this genus will continue to be approved or rejected by different investigators. The several new species here described and figured will appear to some as unimportant phases of some already established. But in no case has a new species been created here without careful study and an effort to assign it to an existing one.

PLEUROSIGMA ACUS, new species

Plate 29, figs. 4-5

Valve very narrow lanceolate, straight; ends sharp; markings quincunx, transverse lines obscure; terminal beads of rhaps prominent; hyaline space around central nodule small.

Length 0.162-0.258; width 0.012-0.022; 13.5-13.8 lines in 0.01 mm.

*P. acus* has close affinity with *P. intermedium* W. Smith, not so much with the typical form as given in Smith's British Diatoms, page 64, plate 21, figure 200, in Van Heurck's Synopsis, plate 18, figure 6, in H. L. Smith's Types No. 405 (itself an English sample), etc., as in certain perhaps permissible variations, notably, plate 5, figure 27, in Peragallo's Monographie du genre *Pleurosigma*. But *P. acus*, though a much smaller diatom, averaging 0.170 by 0.016 mm., as against 0.370 by 0.021 mm., is relatively much more coarsely marked, 13.5-13.8 lines as against 22 lines in 0.01 mm., and the two oblique lines are so nearly at right angles, instead of at 60°, that the transverse lines are barely discoverable. Abundant specimens having supplied an opportunity for repeated comparisons between this and *P. intermedium* I do not hesitate to class it as a new species. All my Philippine specimens are from Jolo Jolo, Sulu Islands; but I have

found it also at Puna, Hawaii, the Hawaiian specimens being relatively narrower, as their ratio of length to width is sometimes as high as 17 to 1.

*Type*.—Cat. No. 43669 U.S.N.M.

**PLEUROSIGMA AFFINE** Grunow

(Van Heurck, Synopsis, pl. 18, fig. 9; Peragallo, Pleuro, pl. 4, figs. 2, 3, 5, 8.)

Neither Ralf's *P. normanii* nor H. L. Smith's *P. virginicum* should be included here, although so grouped by Peragallo.

**PLEUROSIGMA ANGULATUM** W. Smith

(Smith, Brit. Diat., pl. 21, fig. 205; Peragallo, Pleuro., pl. 5, figs. 3-5; H. L. Smith, Types, Nos. 389-390.)

De Toni (Syl. Alg., pp. 231-234) has attempted an impossible condensation of species under this head. Peragallo, with some reason, expresses doubt of the general custom of considering *P. quadratum* as a variety of *P. angulatum*.

**PLEUROSIGMA BALTICUM** (Ehrenberg) W. Smith

(Smith, Brit. Diat., pl. 22, fig. 207; H. L. Smith, Types, No. 396; Peragallo, Pleuro., pl. 7, figs. 19-20.)

**PLEUROSIGMA DOLOSUM**, new species

Plate 29, fig. 6

Valve narrow elliptical, not sigmoid, ends not produced, blunt, rounded; markings quincunx; rhaps straight, outer ends beaded, reaching to the margin; central area small, oval not laterally extended.

Length 0.083; width 0.015; 25 lines in 0.01 mm.

Jolo Jolo, Sulu Islands; rare.

This very divergent species of the true *Pleurosigmae* differs from others only in its Naviculoid form. Under low magnification it might easily be overlooked as a rather minute specimen of *Navicula iridis* Ehrenberg. But its rhaps, central area, and delicate, uniform quincunx marking fix clearly its generic character.

*Type*.—Cat. No. 43670, U.S.N.M.

**PLEUROSIGMA ELEGANTISSIMUM** Castracane

(Castracane, Chall. Exp., p. 37, pl. 28, fig. 1; Peragallo, Pleuro., pl. 5, fig. 23.)

A slightly doubtful specimen of this diatom was found; the original was from Yeddo Bay, Japan. The uncertainty comes from Castracane saying that his species has extremely delicate striae, "striis delicatissimis"; but as no measurements of these are given the exact meaning of the expression can not be determined. The peculiar shape and the eccentric rhaps indicate that the Philippine specimens and the above are the same.

## PLEUROSIGMA ELONGATUM W. Smith

(Smith, Brit. Diat., pl. 20, fig. 199; Van Heurck, Synopsis, pl. 18, fig. 7; Pera-gallo, Pleuro., pl. 3, figs. 5, 7.)

This is one of several species which De Toni (Syl. Alg., p. 233) unwisely huddles together under *P. angulatum*.

## PLEUROSIGMA EXEMPTUM, new species

Plate 29, fig. 7-8

Valve broadly lanceolate, moderately sigmoid, tapering from the broad middle portion to the somewhat blunt ends; rhaps more sigmoid than the valve, thereby approaching opposite sides toward the ends; a slight lateral hyaline dilation around the central nodule; markings quincunx, but unusually arranged, in that the customary transverse lines are lacking, and are replaced by faint longitudinal lines. This is due to the angle between the oblique lines being not the normal  $60^\circ$  but slightly in excess of  $90^\circ$ , so that the beading becomes so spaced that longitudinal lines appear bisecting the obtuse angle.

Length 0.504-1.16; with 0.09-0.116; lines 10.3-11 in 0.01 mm.

Although the color of specimens is a very untrustworthy specific character, the almost uniformly heavy coloration of this species is noteworthy. Specimens are very conspicuous not only by reason of their great size but because they are a dark greenish-brown with a strong metallic luster.

Rather plentiful in most of the Philippine Islands gatherings and especially so in one from Jolo Jolo, Sulu Islands.

*Type*.—Cat. No. 43671, U.S.N.M.

## PLEUROSIGMA FALX, new species

Plate 30, fig. 1)

Valve lanceolate, sigmoid, tapering to the narrow but not acute ends; rhaps more sigmoid than the valve, being plainly oblique to its long axis at the middle, but approaching only slightly the opposite sides of the valve toward the two ends; a small lozenge-shaped central area; markings coarse, rigidly quincunx, the angles between the six lines from any given point being  $60^\circ$ . The valves are unusually robust and thick walled, so that the outline appears as a heavy dark line.

Length, 0.119; width, 0.0194; 15 diagonal lines in 0.01 mm.

There is some resemblance between this relatively coarsely marked species and small specimens of *P. decorum* W. Smith, except for the much more sicklelike swing of the latter and the nearer approach of its very sigmoid rhaps to the sides of the valve. This species is plentiful in some Philippine Islands material and it occurs occasionally in Galapagos Islands dredgings.

*Type*.—Cat. No. 43672, U.S.N.M.

**PLEUROSIGMA FORMOSUM** W. Smith

(Smith, Brit. Diat., pl. 20, fig. 195; Peragallo, Pleuro., pl. 1, fig. 1; H. L. Smith, Types, No. 694.)

Peragallo's figures of this fine species are all defective in outline. He designates his plate 1, figure 4, as the true type, which is far from the case, as can be seen by comparison with W. Smith's original figure. The nearest to this in Peragallo's monograph is his plate 1, figure 1.

**PLEUROSIGMA HAMULIFERUM** Brun

(Brun, Diat. Jap., pl. 9, fig. 5; Peragallo, Pleuro., pl. 5, fig. 31; also pl. 4, fig. 12, misnamed.)

This species with the curiously hooked rhabdium was first found in the fossil deposit at Sendai, Japan; but recent specimens were subsequently found in Yokohama Bay, Japan, and now in the Philippine Islands.

**PLEUROSIGMA HEROS** Cleve

(Cleve, Nav. Diat., vol. 1, p. 44, pl. 4, fig. 20.)

Previously found only at Macassar Straits.

**PLEUROSIGMA ITALICUM** Peragallo

(Peragallo, Pleuro., p. 8, pl. 3, fig. 10.)

The similarity of this species, hitherto found only at Naples, Italy, is so close to *P. marinum* Donkin that its independence is to be questioned.

**PLEUROSIGMA JAPONICUM** Castracane

(Castracane, Chall., Exp., p. 38, pl. 29, fig. 14.)

The unquestionable two-line oblique marking of this species has been noted in the discussion of this genus and its subdivisions.

**PLEUROSIGMA LANCEOLATUM** Donkin

(Micro. Journ., 1858, pl. 3, fig. 4; not Peragallo, Pleuro., pl. 5, fig. 14.)

Roper's *P. transversale* in the Quarterly Journal of Microscopical Science for 1858, plate 3, figure 11, is practically the same. As noted above, Peragallo's figure does not represent this diatom.

**PLEUROSIGMA LATUM** Cleve

(Cleve and Grunow, Aret. Diat., pl. 3, fig. 68; Peragallo, Pleuro., pl. 3, figs. 16-18.)

**PLEUROSIGMA NAVICULACEUM** Brébisson

(Brébisson, Diat., Cherb., pl. 1, fig. 7; Peragallo, Pleuro., pl. 4, figs. 19-22.)

**PLEUROSIGMA NICOBARICUM** Grunow

(Grunow, Reise F. Nov., p. 101, pl. 1A, fig. 20; Peragallo, Pleuro., pl. 4, fig. 9 (not pl. 4, figs. 10-12).)

The figures of Peragallo excluded above have no relation to this species. His No. 12, and perhaps No. 11, is *P. hamuliferum* Brun.

## PLEUROSIGMA NORMANII Ralfs

(Peragallo, Pleuro., pl. 4, fig. 6; Cleve and Grunow, Arct. Diat., pl. 3, fig. 67.)

A specimen found by Mr. E. Leonard, Liverpool, England, in Philippine Islands material supplied by me, agrees more closely with Peragallo's figure than with that in Cleve and Grunow's Arctic Diatoms. The union of this species with *P. affine* Grunow is questionable. Peragallo makes it a variety of the latter, while Cleve (Nav. Diat., vol. 1, p. 40) puts *P. affine* (1880) in *P. normanii* (1861).

## PLEUROSIGMA OBESUM, new species

Plate 29, fig. 9

Valve broad, sigmoid, tapering to the rather blunt rounded ends, the curve of one side from middle to end being strongly convex, that of the opposite side barely concave; rhaphe strongly oblique to the long axis at the middle of the valve, but running perfectly straight for half the distance to the ends, then curving strongly as it approaches the convex side from which it barely remains separated; terminal and middle ends of rhaphe beaded, the former not quite reaching the ends of the valve; central area expanded into a small transverse oval; markings oblique to the long axis, but crossing each other at right angles, so that no transverse or longitudinal lines are present.

Length, 0.312–0.351; width, 0.063–0.067; 11.2 lines in 0.01 mm.

There is a rather close resemblance between this species and *P. heros* Cleve (Nav. Diat., vol. 1, p. 44, pl. 4, fig. 20), but the markings of the latter are finer, its shape is relatively less obese, and its rhaphe is parallel with the long axis at the middle of the valve instead of strongly oblique to it.

In connection with the markings of this species it is in place to say that the generally accepted custom of dividing this genus into two groups, first, those with quincunx markings—that is, one set of lines transverse and the other two oblique—and, second, those with rectangular lines, one set transverse and the other longitudinal, is not correct. As stated in the discussion of the genus, one other pattern is more or less prevalent, namely, species having two sets of rectangular lines, not transverse and longitudinal, but both equally oblique to the long axis of the valve. In the truly quincunx forms, like *P. angulatum* W. Smith, *P. robustum* W. Smith and the next species *P. obtusum*, new species, the lines radiating from any given point are six in number, and the six angles between them are theoretically 60°; but in the above diatom there are but two sets of lines; that is, four radiating from any given point, and the angles between them are all 90°. The most conspicuous example of this arrangement is *P. japonicum* Castracane in his Report of the Challenger Expedition, plate 29, figure 14, which occurs abundantly in the Phil-



ippine Islands. Not only does Castracane correctly figure this with only two sets of lines, both oblique, but Peragallo in his *Monographie du genre Pleurosigma*, plate 3, figure 15, adds a question to the drawing of the transverse lines. The present species is equally destitute of transverse lines and its two oblique sets of lines are at  $90^\circ$  to each other. An even further departure from the normal quincunx marking is found in my *P. exemptum* (q. v.) where the upper and under angles between the oblique lines are actually in excess of  $90^\circ$ , so that a faint suggestion of a third set of lines, not transverse but longitudinal, is discoverable. It is evident that beads arranged in strictly transverse and longitudinal rows will give rise to only two sets of lines, which will stand at right angles to each other; that a strictly quincunx order will exist only when the three sets of lines subtend angles of  $60^\circ$  between each other, and that when the angle between the two sets of lines becomes greater than  $90^\circ$  a third set of lines will begin to appear as bisecting this wider angle. In the typical *P. angulatum* the upper and under angles between the two oblique lines is sometimes a trifle less than  $60^\circ$  and the four side-angles proportionally more than  $60^\circ$ , with the result that the transverse lines are then more easily seen than the oblique ones.

*Type*.—Cat. No. 43673, U.S.N.M.

**PLEUROSIGMA OBTUSUM**, new species

Plate 30, figs. 2-3

Valve slightly sigmoid and only slightly tapering, with broad, blunt, rounded ends; markings strictly quincunx, so that the two oblique and the transverse lines are equally visible and subtend angles of  $60^\circ$ ; rhabhe at the middle oblique to the long axis, at first barely, then more rapidly curved as it approaches the ends, where it is sharply curved, and approaches close to the more sigmoid side of the valve.

Length, 0.126; width, 0.029; 14-15 lines in 0.01 mm.

This species stands nearest to my *P. prisma* (q. v.). Rare.

*Type*.—Cat. No. 43674, U.S.N.M.

**PLEUROSIGMA PRISMA**, new species

Plate 30, fig. 4

Valve broad prismatic, only slightly sigmoid in outline, with very blunt, rounded ends; rhabhe slightly oblique to the long axis at the middle of the valve, perfectly straight until near the apices, then strongly curved, its apical beads elongated and close to the blunt ends, its central beads well separated; a relatively large transversely widened hyaline central area; markings quincunx, the diagonal lines more evident than the transverse.

Length, 0.129–0.130; width, 0.031–0.035; 13 lines in 0.01 mm.

This is one of the most heavily built and coarsely marked of the quincunx *Pleurosigmae*.

*Type*.—Cat. No. 43675, U.S.N.M.

**PLEUROSIGMA RHOMBEUM** Grunow

(Peragallo, *Pleuro.*, pl. 3, figs. 13–14.)

Found previously at Samoa and at Auckland, New Zealand.

**PLEUROSIGMA RIGENS**, new species

Plate 30, fig. 5

Valve prismatic or spindle-shape, with straight sides, not sigmoid except that the blunt ends tend very slightly to opposite sides and the rhaps somewhat more so; the valve narrows from middle to near the ends, then the sides become parallel; markings quincunx, the angle between the oblique lines a trifle less than 60°, so that the transverse lines are more prominent than the oblique; rhaps perpendicular to transverse axis at the middle; the central area expanded laterally into a small oval; markings about this area invariably rugose because of irregularly spattered blotches somewhat larger than the beading, so that the center of the valve always appears to be dirty.

Length, 0.094–0.127; width, 0.020–0.022; 16–17 oblique lines in 0.01 mm., 15 transverse lines in 0.01 mm.

Although this might be classified as a wide variety of *P. rigidum* W. Smith, I suggest a new name, because I find it to be very uniform in its much smaller size and its relatively coarser markings than that species. It is abundant in most of the Philippine Islands dredgings, including the Sulu group, and is at times associated with *P. rigidum*, from which it is readily distinguished by its deep brown color, its minuteness, and the blotched appearance of the valve around the central nodule. The known measurements of *P. rigidum* are length 0.30–0.44; width 0.04–0.068; 18–20 oblique lines, 17–19 transverse lines in 0.01 mm., which contrast strongly with those of this species.

*Type*.—Cat. No. 43676, U.S.N.M.

**PLEUROSIGMA RIGIDUM** W. Smith

(Smith, *Brit. Diat.*, pl. 20, fig. 198; H. L. Smith, *Types*, No. 410; Peragallo *Pleuro.*, pl. 6, figs. 3–6.)

Rather abundant and showing several variations from the type.

**PLEUROSIGMA SIMILE** Grunow

(Peragallo, *Pleuro.*, pl. 7, fig. 27.)

The suggestion of Peragallo that this may be a variety of *P. balticum* W. Smith can not be commended.

**PLEUROSIGMA STRIGOSUM** W. Smith

(Smith, Brit. Diat., pl. 21, fig. 203; H. L. Smith, Types, No. 414; not Peragallo, Pleuro., 5, figs. 1-2.)

There is not satisfactory ground for De Toni's uniting this with *P. angulatum*. H. L. Smith's Types, No. 414, is made of material from England, and exhibits on the same slide truly typical specimens of both species. Their points of dissimilarity are easily seen, and William Smith seems to have been warranted in considering the two to be separate species. The two figures in Peragallo's *Monographie du genre Pleurosigma* are very misleading.

**PLEUROSIGMA SUBRIGIDUM** Grunow

(Peragallo, Pleuro., pl. 2, fig. 3.)

**PLEUROSIGMA SULUENSE**, new species

Plate 30, fig. 6

Valve barely sigmoid, and only so toward the ends, one side of each half almost straight at the middle and progressively curving toward the end, the other side straight and becoming slightly concave toward the end; raphe straight until nearing the ends it approaches the concave side, at the middle almost at right angles to the transverse axis, hooked at its outer ends and without beads at the middle, the two halves being joined around one side of the central nodule; central area slightly dilated transversely; markings uniform over the entire valve, consisting of two sets of oblique lines at an angle of so nearly  $90^\circ$  that no transverse lines are visible, even by oblique light.

Length 0.529; width, 0.062; 11-11.2 in lines, 0.01 mm.

So far as the outline is concerned, this diatom is hardly separable from some other species. It very closely resembles the general build of *P. majus* Grunow (Cleve, Nav. Diat., vol. 1, p. 44, pl. 4, fig. 15), the markings of which are radically different. It is near to what Peragallo, in his *Monographie du genre Pleurosigma*, plate 2, figure 7, calls *P. decorum* W. Smith, but which does not remotely resemble that species either in form or in marking. (See Smith, Brit. Diat., pl. 21, fig. 196; H. L. Smith, Types, No. 694; Van Heurek, Synopsis, pl. 19, fig. 1, etc.) Diatom literature also contains figures named *P. speciosum* W. Smith and others *P. strigosum* W. Smith, which seem to approach closely to the present species; but the typical forms do not at all correspond. In both those species, which are only half or less the size of the present one, the markings are relatively much finer. Thus the average for *P. strigosum* is length 0.007-0.011 inch, with 44 lines in 0.001 inch; while *P. suluense* is length 0.0208 inch, with 27 lines in 0.001 inch. In fact this is a case in which only the comparison of actual specimens of different species will clearly reveal those adequate specific differences which verbal descriptions and photographs merely suggest.

*Type*.—Cat. No. 43677, U.S.N.M.

Genus **PODOCYSTIS** Kützing**PODOCYSTIS SPATHULATA** (Shadbolt) Van Heurck

(Van Heurck, Treat., p. 365; Peragallo, Diat., France, p. 261, pl. 68, fig. 12.)

The two above citations taken together go far toward clearing up a confusion of long standing regarding the two species of *Podocystis*—the one here recorded and *P. adriatica* Kützing. De Toni and others (Syl. Alg., p. 601) consider these and Bailey's *P. americana* to be *P. adriatica*; but as Van Heurck points out, that species is sharply distinct from Shadbolt's *Euphyllodium spathulatum* as figured in the Microscopical Journal for 1854, plate 1, figure 3, and excellently reproduced in the above citation in Peragallo's Diatomées de la France, where it is shown in contrast with the typical *P. adriatica* (fig. 11). This last has double or threefold rows of fine beading, the rows separated by costal lines; while the present species has single rows of coarse rectangular beading without separating costal lines. There is also in this species (not always, as Van Heurck implies, but very often) a heavy network of anastomosing costal bars which does not in reality belong to the surface of the valve but lies beneath the beading as a sort of craticular plate. *P. spathulata* is generally balloon shaped; and as the American species of *P. adriatica* are also balloon shaped, instead of cuneate like Kützing's type, Bailey considered he had a new species and called it *P. americana*. (New Sp. and Loc. Diat., pl. 1, fig. 38.) But his exceptionally good figure shows it to have the two to three rows of fine beading separated by costal lines of *P. adriatica*. H. L. Smith's Type, No. 418, the American form, also is conclusive as to this marking. A third name—*P. australica* Witt (figured in his Diatomaceen Südsee, Journ. Mus. Godeff., 1873, p. 70, pl. 8, fig. 10)—is evidently the same as Bailey's form. We have therefore at present two species, *P. spathulata* (Shadbolt) Van Heurck, and *P. adriatica* Kützing, including Bailey's American variety of this, resembling only in contour the other species.

Genus **PORPEIA** Bailey**PORPEIA QUADRICEPS** Bailey

(Pritchard, Inf., pl. 6, fig. 6; Greville, New and Rare Diat., pl. 6, figs. 18-19; Schmidt, Atlas, pl. 142, figs. 46-56.)

Genus **PSEUDO-EUNOTIA** Grunow**PSEUDO-EUNOTIA DOLIOLUS** (Wallich) Grunow

Plate 30, figs. 7-8

(Van Heurck, Synopsis, pl. 35, fig. 22; Peragallo, Diat., France, pl. 82, fig. 27.)

This is much nearer to the genus *Synedra* than to *Eunotia*.

## Genus RHABDONEMA Kützing

## RHABDONEMA ADRIATICUM Kützing

(Van Heurck, Synopsis, pl. 54, figs. 11-13; Schmidt, Atlas, pl. 217, figs. 17-29.)

## RHABDONEMA ARCUATUM (Lyngbye) Kützing

(Van Heurck, Synopsis, pl. 54, figs. 14-16; Schmidt, Atlas, pl. 220, figs. 17-29.)

In Smith's British Diatoms, plate 38, his figures 305 and 305+ are good illustrations of this species, but his figures 305*b*, *a'* and *b'* are *R. adriaticum* Kützing.

## RHABDONEMA MIRIFICUM W. Smith

(Quart. Journ. Micro. Sci., 1859, pl. 9, fig. 11; Schmidt, Atlas, pl. 217, figs. 1-3.)

Bailey and Harvey call this *Hyalosira punctata* in the Report of the Wilkes Expedition, plate 9, figure 29. Grunow (Oest. Diat., p. 424) creates the genus *Climacosira* for it. De Toni accepts this unnecessary assignment (Syl. Alg., p. 765).

## RHABDONEMA SUTUM, new species

Plate 31, figs. 1-2

Frustule in girdle view rectangular, slightly rounded at its four corners and crossed by continuous lines which represent the series of septa that become interpolated between the two ends or valves of the frustule during its process of growth; the two sides of the frustule bordered by bands about one-sixth its diameter, consisting of narrow, straight, closely set costal bars, not enlarged or curved, between which are single rows of small beads or blotches; these rows of beads continue across the frustule and join with those in the opposite band; two median bands, of similar costal bars and beads, but in number only one-half of those in the marginal bands and about twice as long, are separated from each other and from the marginal bands by narrow spaces. crossed only by the continuous beaded lines above mentioned; the costae of the two median bands are bordered on either side by a row of small beads and their ends are enlarged and slightly bent; the two valves and the interpolated septa are seen in face view to be very narrow, slightly dilated at the center and between the center and each end; a hardly perceptible median hyaline line bisects the rectangular beading covering the surface of the valves, the ends being smooth; the interpolated septa are each pierced by two openings, a small oval one, corresponding to one of the dilations near to the end; the other and larger opening beginning at the middle dilation and running to the small dilation near to the other end; the parts of the septum not pierced by openings is cross beaded like the valves and shows the same faint median bisecting line, or pseudorhaphé.

Valve and septum length, 0.133–0.219; width 0.006–0.008; width at middle dilation, 0.010–0.011 mm.

As the halves of each septum are different, one being beaded and the other perforated, and as each septum alternates with the next as to which end is perforated and which not, it follows as above stated, that the costae in the two marginal bands of the frustule are twice as many as those in the two inner bands; for the former, representing the beaded ends of *all the septa*, all show as costae, while the latter, representing the median portions of the septa, only half show as costae, the other half being perforations.

*Type*.—Cat. No. 43678, U.S.N.M.

**Genus RHAPHONEIS Ehrenberg**

**RHAPHONEIS AMPHICEROS Ehrenberg**

(Van Heurck, Synopsis, pl. 36, figs. 22–23; Peragallo, Diat., France, pl. 83, figs. 15–18.)

**RHAPHONEIS BILINEATA Cleve**

See *Dimeregramma bilineata* (Cleve) Mann.

**Genus RHIZOLENIA (Ehrenberg) Brightwell**

As practically all the material examined for this report was dredgings, any strictly plankton diatoms, like species of this genus and of *Chaetoceros*, may be considered as only accidentally present. A paragraph bearing on this will be found in the Introduction.

**RHIZOLENIA SETIGERA Brightwell**

(Micro. Journ., 1858, pl. 5, fig. 7; Peragallo, Rhizo., pl. 4, figs. 12–16.)

Gran (Nord. Plank Diat., p. 55) claims that *R. hebetata* Bailey is dimorphic, and one of his figures (fig. 67*b*) corresponds with the generally accepted idea of *R. setigera*, while his figure of that diatom is something quite unlike (p. 53, fig. 64). But Brightwell's original illustration cited above, that of Ralfs in Pritchard's Infusoria, plate 7, figure 31, and those of the carefully prepared monograph of Peragallo do not correspond with Gran's distinction. I am unable to throw any more light on the disagreement, but see no reason for changing the generally accepted image of Brightwell's species.

**Genus RHOICOSIGMA Grunow**

As noted under *Pleurosigma*, this and *Donkinia* are with difficulty separable by well-marked generic lines from *Pleurosigma*; but although these three with *Toxonidia* comprise an unusually compact group, well separated from other genera, and remarkably similar to each other, the division into four genera on rather slight distinctions is an undoubted aid to identification. This is of course ample justification for the arrangement. The distinctions between *Pleurosigma* and *Rhoicosigma* are chiefly two: First, *Rhoicosigma* is bent at the middle, like

*Achnanthes*, and generally somewhat twisted on its long axis, so that in girdle view the frustule has an angular or bowed outline; and second, the two valves being consequently dissimilar, their relative convexity is different and the trend of the two raphes is also different, one becoming more sigmoid than normal and the other less so.

**RHOICOSIGMA COMPACTUM (Greville) Grunow**

(Peragallo, Pleuro., pl. 10, figs. 7-8; Micro. Journ., 1857, pl. 3, fig. 9.)

**RHOICOSIGMA OCEANICUM Peragallo**

(Peragallo, Pleuro., pl. 10, figs. 5-6.)

**RHOICOSIGMA ROBUSTUM Grunow**

(Peragallo, Pleuro., pl. 10, figs. 2-3.)

**RHOICOSIGMA WEISSFLOGII Grunow**

(Peragallo, Pleuro., pl. 9, figs. 23-24.)

**Genus ROPERIA Grunow**

**ROPERIA TESSELATA (Roper) Grunow**

Plate 31, fig. 3

(Van Heurck, Synopsis, pl. 118, figs. 6-7; Quart. Journ. Micro. Sci., 1858, pl. 3, figs. 1a-b.)

Only one species of *Roperia* is known at present. But a variety so marked and constant as to almost deserve specific rank is a broadly ovoid form in which the pseudonodule is invariably located in the narrow end. The rim also is marked diagonally instead of transversely so that the outer marginal line has a fictitious wavy appearance, especially when slightly out of focus. This is the prevailing form in Philippine Islands material. Its deviation from the type is so striking that it is here illustrated.

**Genus RUTILARIA Greville**

**RUTILARIA PHILIPPINARUM Cleve and Gröve**

(Le Diat., 1891, p. 64, pl. 10, figs. 1-2.)

**RUTILARIA PULCHRA A. Schmidt**

(Schmidt, Atlas, pl. 183, fig. 20.)

Schmidt says of the locality merely "S. Monica." As Santa Monica, Calif., is on the seacoast and a fossil diatom deposit is there, this statement is ambiguous. Presumably his type specimen was from the fossil material which is given special prominence in his atlas. I have found it also in the fossil deposit at Jackson's Farm, Oamaru, New Zealand. In that case, the finding it in the Philippine Islands is especially interesting.

## RUTILARIA TENUICORNIS Grunow

(Van Heurck, Synopsis, pl. 105, fig. 10.)

Van Heurck hints at the possibility of this being a variety of *R. epsilon* Greville, and De Toni (Syl. Alg., p. 1021) takes that view of it. I dissent. *R. epsilon* is lightly and irregularly marked with crude blotches or beads and tapers gradually from the enlarged middle portion to the apices; *R. tenuicornis* is regularly marked with fine beading, has a relatively much larger middle portion which curves rapidly to the long, narrow, and almost parallel-sided arms. The peculiar lock catch, which joins each frustule with the next and resembles the Greek letter epsilon, is not confined to either of these species, but is general with the *Rutilariae*. (Compare Greville, Micro. Journ., 1863, pl. 9, fig. 1; *R. radiata* Grøve and Sturt in Schmidt, Atlas, pl. 183, fig. 22, etc.)

## Genus SCEPTRONEIS Ehrenberg

## SCEPTRONEIS CUNEATA Grunow

Plate 31, fig. 4

(Grunow, Diat., Hondu., p. 169, pl. 194, figs. 3a-d; Peragallo, Diat., France, pl. 78, figs. 1-2.)

Peragallo removes this diatom to *Synedra*, where it probably belongs. But I have retained its original name because cuneate forms like this can be with about equal justice referred to *Licmophora*. A girdle view of this diatom would settle this, according as it proves to be wedge-shaped or not.

## Genus SCOLIOPLEURA Grunow

## SCOLIOPLEURA PARTISTRIATA, new species

Plate 31, fig. 5

Valve broad linear, barely sigmoid, with pointed ends; hyaline median area conspicuous, strongly sigmoid, bisected by the delicate rhapshe; central nodule large; markings of strong, transverse, closely set costae, terminating in beads next to the median area, each costa having a large bead at the middle, the single row of larger beads thus formed running parallel to the rhapshe.

Length 0.145; width 0.021; 5.2 lines in 0.01 mm.

This is distinguished from *S. latestriata* (Brébisson), Grunow, as well as from the questionable *S. thumi* H. Heiden (Schmidt, Atlas, pl. 261, figs. 1-3) by both of these having double rows of zigzag beading and peculiarly marked borders on each side of the median area. Cleve's creation of the new genus *Scoliotropis* for these forms and his assignment of *S. tumida* (Brébisson) Rabenhorst to *Navicula* are not to be commended.

*Type*.—Cat. No. 43679, U.S.N.M.



Genus **SKELETONEMA** Greville**SKELETONEMA MEDITERRANEANUM** (Grunow) Brun

(Van Heurck, Synopsis, pl. 91, figs. 3, 5; Schmidt, Atlas, pl. 180, figs. 38-39.)

The question of placing this diatom here or under *Melosira* is about evenly balanced. Grunow and Schmidt favor *Melosira*, Brun and De Toni *Skeletonema*. If we take Greville's own idea of *Skeletonema* as based on *S. barbadense* (Micro. Journ., 1865, p. 43, pl. 5, fig. 1) this species can not be held generically separate. But if we compare it with more extreme forms, as *S. costatum* (which, strange to say, Greville puts in *Melosira*) or with *S. mirabile*, this assignment becomes questionable. A good illustration of the tangle of *Melosira* and *Skeletonema* for forms of this kind is to be found in Van Heurck's Synopsis, plate 91, figures 3, 4, 5, 6, and in Schmidt's Atlas, plate 180, figure 33, and plate 180, figure 40.

**SKELETONEMA MIRABILE** Grunow

(Van Heurck, Synopsis, pl. 83, ter, fig. 5.)

This essentially arctic diatom must have made its way to the Philippine Islands by the Japan current, it having been found previously only at Cape Wankarema.

Genus **STEPHANOPYXIS** Ehrenberg**STEPHANOPYXIS ACULEATA** (Ehrenberg?) Grunow

(Schmidt, Atlas, pl. 130, fig. 12.)

This should be distinguished from "*Stephanopyxis aculeata*" Ehrenberg in Mikrogeologie, plate 18, figure 124, which is an indeterminate figure, possibly a *Xanthiopyxis*. (Consult Grunow, Diat. F. Jos. Land, p. 91.)

**STEPHANOPYXIS BRUNII** A. Schmidt

(Schmidt, Atlas, pl. 164, fig. 5; Van Heurck, Belgica, pl. 6, figs. 90, 92.)

Though originally found in the fossil deposit at Sendai, Japan, Van Heurck subsequently found it in Antarctic dredgings. This third locality discovered is as incongruous as the two others.

**STEPHANOPYXIS TURRIS** (Greville) Ralfs

(Pritchard, Inf., p. 826, pl. 5, fig. 74; Schmidt, Atlas, pl. 130, figs. 42-43; Grunow, Diat. F. Jos. Land, pl. 5, fig. 7.)

This diatom is widely distributed and supplies many variations, some of which are identical with figures of *S. appendiculata* Ehrenberg, as for example, those in Schmidt's Atlas, plate 130. But Ehrenberg's figure in his Mikrogeologie, plate 18, figure 4, is not at all similar. De Toni unites the two but gives preference to the later name, which was created by Greville in a note added to Gregory's Diatoms of the Clyde, page 538.

## STICTOCYCLUS, new genus

Valve circular, almost flat until, at the apparent rim, it bends vertically downward at right angle to the surface of the disk to form a deep flange about one-third the disk radius in width, thus making each valve a shallow circular half box, the two valves joined by the girdle thus forming a thick frustule; the markings of the flange are the same as and continuous with those of the disk; in the middle of the valve is a small irregular central area, bearing a few minute scattered beads; from the center proceed 50 to 80 sharp but narrow radii extending to the apparent rim and over it to the lower edge of the flange; the spaces between the radii are ornamented with small, densely set beads only obscurely arranged in rows; a comparatively large but not typical pseudonodule is placed in from the apparent rim about one-fourth to one-eighth the radial distance; this is not a glistening body like the true pseudonodule of *Actinocyclus*, because it is not due to a lenticular thickening of the silica, but is like the similar spot in *Roperia* or the ocellus of *Pseudo-Auliscus*; the side (or girdle) view shows the continuity of the vertical flange with the rest of the valve and the flatness of the surface of the disk portion. Markings of the girdle unknown. Only the one species following is so far known.

This exquisitely ornate and delicate diatom, figured and described under the name "*Actinocyclus stictodiscus*," strangely resembles both these dissimilar genera, a fact indicated by the new name here proposed; but it can not be assigned to either one without introducing objectionable modifications. The vertical flange continuous with the disk, and its pseudonodule exclude it from *Stictodiscus*; the dissimilarity of this pseudonodule from that of *Actinocyclus*, the verticle flange extension of the disk and the radial costae exclude it from *Actinocyclus*. It certainly is more unlike either of these than *Roperia* is unlike *Actinocyclus* or *Arachnoidiscus* unlike *Stictodiscus*. Its side view, here illustrated for the first time, will make this clear. The suggestion of Van Heurck, that it represents a separate genus, is therefore here adopted.

## STICTOCYCLUS VARICUS, new name

Plate 32, figs. 1-2

(Van Heurck, Synopsis, pl. 118, fig. 4, misnamed.)

General characters as in the genus. The valves are delicately thin and elastic. The radii adjacent to the pseudonodule on either side are slightly bowed around it.

Diameter to apparent rim, 0.130 to 0.199; width of flange, 0.035 to 0.053; width of sectors at apparent rim, 0.007 to 0.008; diameter of pseudonodule, 0.008 mm.

*Type*.—Cat. No. 43680, U.S.N.M.

Genus *STICTODESMIS* Greville*STICTODESMIS AUSTRALIS* Greville

(Greville, Diat., So. Pac., p. 34, pl. 1, figs. 1-4; Van Heurck, Treat., p. 237, fig. 34.)

The validity of both the generic and specific names of this diatom deserves discussion. First, as to this being a valid genus: It is claimed by several diatomists that the species of this genus are nothing more than certain diatoms belonging to other genera but which develop craticular plates ("dissepiments") within the frustule, one beneath each valve, similar to the craticular plates of such diatoms as *Navicula cuspidata* Kützing, the separated plates of which long went under the name of *Surirella craticula* Ehrenberg. Thus the present species, *S. australis*, is said to be the craticular state of *Navicula scopulorum* Brébisson (= *Pinnularia johnsonii* W. Smith) according to Van Heurck, Treatise, page 237, Peragallo's Diatomées de la France, plate 8, figure 28, Cleve's Naviculoid Diatoms, volume 1, page 152, etc. *S. australis* is quite abundant at Jolo Jolo, Sulu Islands, Philippine Islands, and has afforded material for a study of the complete frustules and of the valves and their internal dissepiments mounted separately. *Navicula scopulorum* is also abundantly supplied for comparison in H. L. Smith's Types, No. 286. The valves of the two are so similar as to make the claim of their being identical a strong one. But even the valves themselves show certain noteworthy differences, those of *S. australis* being much narrower and very often curved sideways, so as to take on a sickle shape. The rhaps too is more delicate and with terminations at the center and apices of the valve that remind one of the rhaps of *Frustulia rhomboides* (Ehrenberg) De Toni. But the important point is that the internal dissepiments are wholly unlike the occasional craticular plates found in other diatoms. They are not irregularly constructed plates, the ribs of which sometimes run transversely from side to side below the valves and sometimes anastomose into an irregular network; but they are the exact counterpart of the dissepiments of *Climacosphenia*, having cross ribs formed into a regular ladder, the opening between these rungs at the middle of the valve being always double that of the others; and at the center of each rung, as in *Climacosphenia*, is a knot where the two halves join. It is quite certain that if *Strictodesmis* is invalid, so also is *Climacosphenia*; if the former is a dimorphic phase of *Navicula*, *Climacosphenia*, is a dimorphic phase of *Licmophora*. Grunow's useful genus *Campyloneis* separates such forms as *C. grevillei* from the genus *Cocconeis* because of just such internal dissepiments as those here discussed, being identical with them in structure and position. So that if the present genus falls to the ground, *Campyloneis* must fall with it. Nor can *Mastogloia* be kept separate from *Navicula* by any definition that will not also jus-

tify the separateness of *Stictodesmis*; for *Mastogloia*'s sole distinction from *Navicula* lies in the constant dissepiments that form marginal chambered rows beneath each side of the valve, and not in the fact that they grow in gelatinous masses, which is equally true of some other genera, including some of the *Naviculae* proper.

It seems therefore that it is at least admissible to take the position of De Toni and hold this genus separate from *Navicula*. *Stictodesmis australis* occurs at Wake Island. All the diatoms from that locality are exceptionally poor in silica; and it is noteworthy that where individuals appear to lack the internal dissepiment a careful examination invariably shows it to be present as an almost invisible, unsilicified structure.

Confirmatory of the foregoing, Mereschkowsky (Ann. Mag. Nat. Hist., p. 415, 1901) proposes to restore the defunct genus, *Okedenia* Eulenstein, so as to accommodate this species; because he finds that its chromophores are totally unlike those of any known *Navicula*, and therefore he insists that *Navicula scopulorum* Brébisson is generically misplaced, believing that it and *Stictodesmis australis* are identical. But afterwards (Ann. Mag. Nat. Hist., p. 32, 1902) in reviewing Karsten's Diatoms of Kiel, he accepts the latter author's figures of the chromatophores of *Navicula scopulorum* and writes they reveal that *N. scopulorum* is valid, but nevertheless is a totally different diatom from his *Okedenia scopulorum*; in other words, from *Stictodesmis australis*. This, as above remarked, is confirmatory of the point now being discussed, namely, not the validity of *N. scopulorum* but the validity of *S. australis* Greville.

As to the correct name for this genus there is more question. *Stictodesmis* Greville and *Climaconeis* Grunow seem to be synonymous, the latter having been published a year before the former—1862 and 1863. If this is correct, Grunow's generic and specific names for this diatom, *Climaconeis lorenzii*, would replace Greville's. Although I think this view is probably right I am here retaining Greville's name because of the unaccountable absence of any rhaps in either Grunow's figure or description of *C. lorenzii* or of his other species, *C. frauenfeldii* the former from the eastern shore of the Adriatic, the latter from the Red Sea. Nor is there an observable rhaps in specimens I have found in the fossil Marine deposit at Jackson's Farm, Oamaru, New Zealand, which seem to be identical with *C. frauenfeldii* (Oest. Diat., Wien. Verh., 1862, p. 421, pl. 7, fig. 2, and pl. 8, fig. 7). How so experienced a diatomist as Grunow could leave out of both figure and description a factor of such importance as he knew the rhaps to be is beyond conjecture; and as I am unable to settle this point by a study of Grunow's original type, I am retaining the name given in Greville's publication, where the rhaps is clearly indicated.

Genus **STICTODISCUS** Greville**STICTODISCUS AFFINIS** Castracane

(Castracane, Chall. Exp., p. 119, pl. 1, figs. 4, 6.)

This seems to be a Philippine Islands form, its type having come from Zebu. It would be possible to classify it as a wide variety of the variable *S. californicus* Greville.

**STICTODISCUS ARGUS** A. Schmidt

(Schmidt, Atlas, pl. 74, fig. 12.)

**STICTODISCUS BICORONATUS** Castracane

See *Trigonium bicoronatum* (Castracane) Mann.

**STICTODISCUS CALIFORNICUS** Greville

Plate 33, fig. 1

(Micro. Journ., 1861, p. 79, pl. 10, fig. 1; Schmidt, Atlas, pl. 74, figs. 4-5.)

Recorded by De Toni only in fossil deposits, but it is rather frequent along the Pacific coast and the Hawaiian Islands. Very variable. The original type form and several varieties are common in the Philippine Islands. An interesting monstrosity which probably belongs to this species is here illustrated.

**STICTODISCUS EULENSTEINII** (Grunow) Castracane

See *Trigonium eulensteinii* (Grunow) Mann.

**STICTODISCUS JAPONICUS** Castracane

(Castracane, Chall. Exp., p. 119, pl. 1, figs. 2, 4.)

Like Castracane's *S. affinis*, it is too close to *S. californicus*.

**STICTODISCUS KITTONIANUS** Greville

(Micro. Journ., 1861, pl. 10, fig. 2; Schmidt, Atlas, pl. 74, figs. 16-18.)

**STICTODISCUS MULTIFURCATUS** Bergon, misnamed

(Le Diat., 1890, p. 3, pl. 2, fig. 1.)

This is *S. nankoorensis* Grunow in Reise *Fregatta* Novara, plate 1A, figure 23; but it is worth recording that the single specimen found by me duplicates exactly the figure given above, the locality of which is given only as "Soundings of the Challenger Expedition."

**STICTODISCUS MULTIPLEX** Janisch

See *Trigonium multiplex* (Janisch) Mann,

**STICTODISCUS NANKOORENSIS** Grunow

(Grunow, Reise F. Nov., pl. 1A, fig. 23.)

The figure in Schmidt's Atlas (pl. 74, fig. 2) shows the nearness of this to *S. californicus*, of which it is indeed generally made a variety. I follow De Toni in listing it separately solely as a convenience in identification.

**STICTODISCUS NITIDUS** Grove and Sturt

Plate 32, fig. 3

(Schmidt, Atlas, pl. 131, fig. 7; compare Grove and Sturt, Oam. Diat., pl. 5 fig. 7.)

The specimen found by me varies somewhat from the type, making this identification doubtful, especially as the species has not been found hitherto except in the fossil deposit at Oamaru, New Zealand.

If we consider it merely a wide variety of *S. californicus*, the view originally taken by Grove and Sturt, its presence in the Philippine Islands, where *S. californicus* is abundant, would be more easily understood. I have felt it to be worth while to illustrate here the Philippine Islands form which agrees with Schmidt's figure as to its peculiar border and the large, irregularly scattered beads, the latter, however, being more abundant in my specimen.

**STICTODISCUS PARALLELUS** (Greville) Grove and Sturt

(Schmidt, Atlas, pl. 75, fig. 13; pl. 76, figs. 15-16; pl. 131, fig. 9.)

The last reference above is the prevailing form in the Philippine Islands, called by Grove and Sturt variety *gibbosa*.

**STICTODISCUS RADFORDIANUS** Castracane

See *Trigonium radfordianum* (Castracane) Mann.

**STICTODISCUS RADIATUS** Castracane

(Castracane, Chall. Exp., pl. 1, fig. 1.)

Hardly separable from *S. californicus*. It seems to be peculiar to the Philippine Islands, the original type having been found there at Zebu.

**STICTODISCUS SIMPLEX** A. Schmidt

(Schmidt, Atlas, pl. 74, fig. 11.)

Found originally in San Francisco Bay, Calif. The single small but evident bead at the center of the valve appears in the specimens found by me and seems to be constant.

**STICTODISCUS VARIANS** Castracane

(Castracane, Chall. Exp., p. 120, pl. 17, fig. 7.)

A review of the comments made under the different species of *Stictodiscus* here listed makes it evident that, although the genus itself is well defined, its species are usually inconstant, a large part of them seeming to be only variations of *S. californicus*, a species which unquestionably shows extreme variability.

**Genus STOSCHIA** Janisch (invalid)**STOSCHIA ADMIRABILIS** Janisch

See *Coscinodiscus reniformis* Castracane.

Genus **SURIRELLA** Turpin**SURIRELLA BERTILLONII**, new species

Plate 33, fig. 2

Valve reniform by lateral expansion, not by an incurving of one side, the two polar ends being joined by the narrower axis, one end at the middle of the convex margin the other in the sinus of the concave margin; border massive, its outer edge strongly crossbarred; within this is a row of wedge-shaped elevations, touching each other at the outer wide ends, from the inner and pointed ends of which proceed single or double curved rows of beads to the pear-shaped central area of the valve; this area extends across the middle of the valve, its narrower end being at the polar point or center on the convex side and its wider end at the other polar point or center on the concave side of the valve; it is bounded by a fringe of closely set, short, radiating lines, like the cilia around certain Infusoria, and its surface is marked with dim scattered beads or blotches.

Longer (lateral) diameter, 0.087–0.097; shorter (polar) diameter, 0.046–0.050 mm.

Like *Surirella reniformis* Grunow and *Coscinodiscus reniformis* Castracane (= *Stoschia admirabilis* Janisch), this kidney-shaped diatom at first seems to be only an odd monstrosity. But on fuller acquaintance it displays a uniformity of shape that entitles it to specific rank. *C. reniformis* Castracane proves to be abundant in many widely separated localities and is everywhere true to its curious shape. So also is *S. reniformis* Grunow. Both are abundant in the Philippine Islands and all the specimens keep close to the type form. This species, *S. bertillonii*, was found in three quite dissimilar dredgings and exhibits practically no variation, either in outline or in plan of sculpture.

The specific name here given refers to the very curious resemblance of its markings to the thumb prints used in the Bertillon system of criminology.

*Type*.—Cat. No. 43681, U.S.N.M.

**SURIRELLA CASTRACANEI** De Toni

(De Toni, Syl. Alg., p. 588. See Castracane, Challenger Exp., p. 61, pl. 10, fig. 6.)

Castracane's name, *S. multicosmata*, being preempted by Leuduger-Fortmorel (Diat., Ceyl., pl. 3, fig. 40), De Toni renames it as above. Schmidt subsequently named the same diatom *S. sumbawana* (Schmidt, Atlas, pl. 205, figs. 1–2).

**SURIRELLA CEYLANENSIS** Leuduger-Fortmorel

(Leuduger-Fortmorel, Diat., Ceyl., pl. 3, fig. 38; Schmidt, Atlas, pl. 309, figs. 4–5.)

The Philippine Islands form is the trivial variation from type that Hustedt calls var. *oblongistriata* in the above reference in Schmidt's Atlas.

## SURIRELLA COMIS A. Schmidt

(Schmidt, Atlas, pl. 4, figs. 3-7; pl. 20, fig. 3.)

## SURIRELLA CONCENTRICA, new species

Plate 34, fig. 1

Valve broadly oval, its outer band or rim narrow but stout, cross-barred with closely set lines and bisected by a fine wavy median line, the outer half of the rim being further ornamented with widely separated, evenly spaced, shadowy rings or dots; within the rim narrow ribs or costae proceed radially toward the center, making a band about one-quarter the width of the valve in diameter and leaving a hyaline central area about one-half the valve's diameter in size, in which there is no median line; each costa begins at the outer band with a hardly perceptible enlargement, but is bordered for a short distance near its middle part with a row of fine beads on either side; these double rows of beads taken together appear as a smaller concentric band passing across the middle of the costal bands; polar areas terminating the longer axis are well defined, and are each marked with a semicircular protuberance.

Long diameter, 0.157; short diameter, 0.114 mm.

*Type*.—Cat. No. 43682, U.S.N.M.

## SURIRELLA CONTIGUA, new species

Plate 34, fig. 2

Valve elongated ovate, one end much broader than the other; outer rim a narrow band; no alae; the costae begin at the outside margin, crossing the rim and approaching almost to the center of the valve, but leaving a pronounced tortuous hyaline central area, extending the length of the valve; the costae in the middle portion of the valve are transverse, but near each end become rapidly more radial and outwardly curved; between the costae are fine, closely set parallel lines of minute beading, three to six between each pair of costae.

Long diameter 0.073-0.126; short diameter 0.038-0.071; 17.5 fine lines in 0.01 mm.

This species bears an interestingly close resemblance to the freshwater diatom *S. gemma* Ehrenberg, the similarity being referred to in the specific name here selected. Its intercostal lines are somewhat coarser and its strongly ovate shape and broad central area sharply differentiate them. A very similar but much larger species occurs at Panama and is here figured for comparison; see plate 34, figure 3. I have named it *S. foliata*, new species. It will be described in a forthcoming paper on the Diatoms of Panama.

*Type*.—Cat. No. 43683, U.S.N.M.



**SURIRELLA CONTINUATA, new species**

Plate 33, fig. 3

Valve a broad oval, the outer rim narrow, stout, finely crossbarred and beset with a row of minute processes near the outer edge; no alae; the costae or ribs begin at the rim in a row of lozenge-shaped enlargements elevated above the rim and draw to a point at their outer angle; from there inward they are very narrow, without beading, but showing two undulations, a strong sharp one a little less than half the distance to the middle of the valve, thereby producing the effect of an inner oval parallel with the outer one, and a second less pronounced undulation appearing as a still smaller oval within the other; the costae extend clear to the median line, those from one side generally, but not invariably, continuous with those from the other side; polar areas on the margin evident.

Long diameter, 0.162; short diameter, 0.097 mm.

The nearest known species to this is *S. tridens* A. Schmidt (Atlas, pl. 206, fig. 177) from the not distant Sumbawa.

*Type*.—Cat. No. 43684, U.S.N.M.

**SURIRELLA CUNEATA A. Schmidt**

(Schmidt, Atlas, pl. 4, figs. 1-2.)

Possibly a variety of *S. fastuosa* Ehrenberg.

**SURIRELLA CUNEATELLA, new species**

Plate 33, fig. 4

Valve narrow ovate, small but robust; rim narrow but heavy, strongly and closely crossbarred; ribs or costae beginning at the margin in very large pear-shaped plates elevated above the rim, striped lengthwise with strong moniliform lines and bearing one to three minute teeth on the broad outer end; short and very thin costa connect the small internal ends of the plates with a narrow median area, which is bounded by a closely set row of transverse lines; polar areas of the long diameter obscure.

Long diameter, 0.065-0.071; short diameter, 0.034-0.035 mm.

This belongs to the loosely defined *S. fastuosa* Ehrenberg group. It is rather abundant in Philippine Islands material, is uniformly minute but robust and heavy and strongly ovate. In shape it resembles Schmidt's *S. cuneata* (Schmidt, Atlas, pl. 4, fig. 2), which is, however, much larger, relatively less massive, and has a different border. It is perhaps nearest to the unnamed figure in Schmidt's Atlas (pl. 4, fig. 23) from the relatively near-by Surabaya, Java.

*Type*.—Cat. No. 43685, U.S.N.M.

**SURIRELLA CURVIFACIES Brun**

(Brun, Lac. Mar., ou Foss. Diat., pl. 15, figs. 36-37; Schmidt, Atlas, pl. 283, fig. 12.)

The dates of publication of the above two identical diatoms are Brun's name 1895, and the Atlas *S. trauensteinii* Hustedt, 1912.

**SURIRELLA DEFLEXA A. Schmidt**

(Janisch, Gaz. Exp., pl. 19, fig. 5; Schmidt, Atlas, pl. 20, fig. 2; pl. 205, figs. 5-6.)

Schmidt's objections to the suggestion of Brun that *S. incurvata* (pl. 205, figs. 5-6) is a variety of *S. ceylanensis* Leuduger-Fortmorel and to the suggestion of Grove that it is an abnormality of *S. macraeana* Greville are both correct. But Janisch rightly takes it to be a narrow variety of *S. deflexa*. Note the perfect identity of the border and the ribs. These, taken with the curious deflexion of the middle area, make any other view untenable.

**SURIRELLA FACILIS, new species**

Plate 35, fig. 2

Valve panduriform, the middle constriction gradual and shallow, the ends semicircular; border narrow, transversely lined, and having superimposed upon it minute beads, one to each rib, and alternating with, not opposite, their ends; ribs distinct but very narrow and hyaline, those at the middle part of the valve without enlargement, those toward the ends of the valve very slightly enlarged, thence running to and touching a well-defined central area, the middle ribs being strictly transverse, the end ribs radial; the central area is bordered on either side by a strong row of closely set dashes, the two rows approaching at their middle portion and flaring at their ends, the ends being open; faint dashes mark the two wide outer parts of this central area.

Length, 0.184; width, 0.092 mm.

This diatom is well figured by Janisch (Gaz. Exp., pl. 16, fig. 13), but not named. By comparing it with figure 3 of the same plate its slight similarity to *S. macraeana* Greville will be seen. It also has some likeness to figure 10 on the same plate, *S. studeri*, particularly in the width of its border and the narrowness of its ribs.

*Type*.—Cat. No. 43686, U.S.N.M.

**SURIRELLA FASTUOSA Ehrenberg**

(Schmidt, Atlas, pl. 4, figs. 7-15; pl. 19, figs. 1, 8, 13; Micro. Journ., 1862, pl. 3, fig. 1.)

A cosmopolitan marine species, with many striking variations. Those figured in Schmidt's Atlas, plate 5, figures 7-9, 11, 14, are peculiar to both Campeche Bay and the Philippine Islands.

**SURIRELLA FAUSTA** A. Schmidt

Plate 35, fig 3

(Schmidt, Atlas, pl. 4, fig. 20.)

The deep pits in the ribs of this species are well seen in the specimens found, illustrations of which are here given, Schmidt's type figure being rather poor.

**SURIRELLA FLUMINENSIS** Grunow

(Schmidt, Atlas, pl. 5, fig. 6; Peragallo, Diat. France, pl. 60, fig. 1.)

**SURIRELLA GRANDIUSCULA** Castracane

(Castracane, Challenger Exp., pl. 10, fig. 5.)

**SURIRELLA GRAVIS**, new species

Plate 33, fig. 5

Valve a perfect oval; the rim is heavy, strongly crossbarred and faintly indented, the indentations corresponding with the ends of the ribs or costae; these begin in small but massive knobs elevated above the rim and having a heavy, blunt, process on the outer side; the ribs or costae extend inward from these knobs to the middle and are transverse, except toward the two ends; they are very thin, but deep, and thereby sharply defined; they are widely separated and have between the knobs faintly ribbed scallops next to the rim; a minute angle in each costa near its middle produces a shadowy internal oval, parallel to the margin; the number of costae on each side is the same and they generally are continuous across the valve; there is no median area; the two polar areas of the long diameter are well defined.

Long diameter 0.079–0.113; short diameter 0.048–0.066 mm.

The sculpturing of this species is similar to that of the unnamed figure in Schmidt's Atlas, plate 56, figure 6, and less so to *S. apiae* Witt (Mus. Godef., p. 114, pl. 15, fig. 4). It is the most massively built *Surirella* I have seen.

*Type*.—Cat. No. 43687, U.S.N.M.

**SURIRELLA HYBRIDA** Grunow

(Van Heurck, Synopsis, pl. 73, fig. 17; Peragallo, Diat., France, pl. 64, figs. 1–6.)

A solitary specimen of this diatom was found by E. Leonard, Liverpool, England, in material supplied by me. Van Heurck in the text of his Synopsis (p. 188) puts this under *S. fastuosa* Ehrenberg. It is better to hold it separate, as is done by Peragallo.

**SURIRELLA IMITANS**, new species

Plate 34, fig. 4

Valve circular, rim broad and massive, marked with strong, closely set crosslines and bisected by a median line; costae beginning with small pentagonal plates elevated above the rim and having four to

six spines on the outer edge, the two side spines being largest; the costae running inward from these plates are narrow but deep and therefore sharply defined, radial, each with a slight angular bend at its middle; no central area; polar areas large.

Diameter, 0.061 mm.

There are a number of circular *Surirellae*, simulating the genus *Campylodiscus*, but without the double bend of that genus; none resemble the present species closely.

*Type*.—Cat. No. 43688, U.S.N.M.

**SURIRELLA INCURVATA** A. Schmidt

See *S. deflexa* A. Schmidt.

**SURIRELLA INTERCEDENS** Grunow

(Schmidt, Atlas, pl. 19, figs. 5-6.)

**SURIRELLA LATA** W. Smith

(Smith, Brit. Diat., pl. 9, fig. 61; Schmidt, Atlas, pl. 5, fig. 1; Schmidt Nordsee, pl. 3, fig. 9.)

De Toni's union of this with *S. fastuosa* is not warranted. The ribs of the latter are longitudinally striped; of the former marked with a cluster of closely set beads at the inner end of each rib, which is very short and broad.

**SURIRELLA LAXA** Janisch

(Janisch, Gaz. Exp., pl. 21, figs. 25-27; Schmidt, Atlas, pl. 56, figs. 3-4.)

The finely beaded margins of the short, heavy ribs is finely brought out in Schmidt's figures.

**SURIRELLA MACRAEANA** Greville

Plate 34, figs. 5-7; plate 35, fig. 1

(Micro. Journ., 1862, pl. 2, fig. 1; Janisch, Gaz. Exp., pl. 16, figs. 2-4; pl. 19, fig. 1.)

The great variability of this species has induced me to give four figures, that of the girdle view being specially needed in diatom literature.

**SURIRELLA MOLLIS** A. Schmidt

See *S. schleinitzii*.

**SURIRELLA ORIENTALIS**, new species

Plate 36, fig. 1

Valve elliptical, slightly constricted at the middle; that is, imperfectly panduriform; rim broad, heavy, coarsely crossbarred; alae obscure or wanting; costae beginning with lozenge-shaped pointed plates elevated above the rim, thence extending transversely to the middle, except at the ends of the valve, where they become oblique;

very narrow except close to the row of outer plates where there is a short thickening obscurely marked with a double row of beads; no median area; polar areas evident.

Long diameter, 0.117–0.194; short diameter, 0.066–0.112 mm.

*S. lata* W. Smith (Smith, Brit. Diat., pl. 9, fig. 61), *S. macraeana* Greville (Micro. Journ., 1862, pl. 2, fig. 1) and the somewhat unrelated figure in Peragallo's Diatomées de la France, plate 61, figure 6, called *S. lata*, var. *macraeana*; also *S. mexicana* A. Schmidt (Atlas, pl. 4, figs. 10–12), *S. japonica* A. Schmidt (Atlas, pl. 4, fig. 15), *S. pacifica* A. Schmidt (Atlas, pl. 4, fig. 19), together with the above, form a group of related species that show a more or less close similarity. The present species is practically without alae, there is no trace of central area, the marginal plates from which the costae arise are lozenge-shaped and sharply pointed at their outer ends. It is therefore unsatisfactory to call it a variety of any of the foregoing. It is rather plentiful in several of the Philippine Islands dredgings.

*Type*.—Cat. No. 43689, U.S.N.M.

#### SURIRELLA PATENS A. Schmidt

(Schmidt, Atlas, pl. 4, figs. 16–17; pl. 56, figs. 10–11; Janisch, Gaz. Exp., pl. 21, figs. 28–29.)

This is rather close to *S. ceylanensis* Leuduger-Fortmorel.

#### SURIRELLA RECEDENS A. Schmidt

(Schmidt, Atlas, pl. 19, figs. 2–4; pl. 24, fig. 28.)

#### SURIRELLA RENIFORMIS Grunow

(Schmidt, Atlas, pl. 309, fig. 9; Grunow, Diat. Hond., pl. 194, figs. 8–9a–b.)

Grunow first named this *Plagiodiscus martensianus* (fig. 8 above) and *P. nervatus* (fig. 9a–b) in his Honduras Diatoms (Micro. Journ., 1877). It is common in the Philippine Islands and, curiously, was given the name *reniformis* by me before I discovered Grunow's identification. It occurs also in the Hawaiian Islands at Hilo, at Laysan Island, etc.

#### SURIRELLA SCHLEINITZII Janisch

(Janisch, Gaz. Exp., pl. 19, fig. 7; Schmidt, Atlas, pl. 206, figs. 18–19.)

The report on the diatoms of the *Gazelle* Expedition was issued by C. Janisch in sixteen photographic plates, accompanied by a text naming only part of the figures. It was distributed to quite a number of diatomists in either 1888 or 1889. Grunow refers to Janisch's report on the *Gazelle* diatoms in the Botanisches Centralblatt of 1888, but Rattray in his Revision of *Coscinodiscus* states that it was "read June 17th, 1889." It is included in diatom bibliography by De Toni, Rattray, and others and is extensively referred to in diatom literature.

Its names therefore are to be reckoned with; and the above has priority over *S. mollis* A. Schmidt, in the second reference above, the date of which is 1897. The diatom is curiously unlike other Surirellae in having the ribs extremely short around the margin, with no trace of a separate median area or other markings; and it is practically identical with the so-called *Campylodiscus anceps* Castracane (Chall. Exp., p. 66, pl. 16, fig. 2, 1886) which Janisch later called *C. similis* (Gaz. Exp., pl. 19, fig. 8) because of the resemblance here noted. This latter differs from *S. schleinitzii* merely in being circular instead of figure 8 shaped, is perfectly flat instead of having the *Campylodiscus* double curvature and, it may be incidentally mentioned, is probably a constant and curious variety of this unique species. Both are rather frequent in the Philippine Islands.

**SURIRELLA SIGNIFICANS, new species**

Plate 36, fig. 2

Valve broadly elliptical; border double, that is, divided by a median line into an outer and an inner half; heavy, marked with coarse beaded crosslines; ribs or costae with broad, rectangular outer ends overlapping the border and having two teeth or spines next to the margin; proceeding inward from these ends the ribs are narrow for about one-third their length, where they swell into a small knot or joint and then continue as still narrower lines until they meet the ribs of the opposite side or reach a small circular area in the center of the valve; this last is exactly central, is bordered by a sharply defined line or ridge, and is so perfectly hyaline as to appear like a circular hole. Its size is in every case proportionate to the size of the valve, being about one-sixth its transverse diameter.

Length of valve, 0.066 to 0.103; width, 0.046 to 0.082 mm.

*Type*.—Cat. No. 43690, U.S.N.M.

**SURIRELLA STUDERI Janisch**

Plate 35, fig. 4

(Janisch, Gaz. Exp., pl. 16, fig. 10.)

My specimens exactly duplicate the type form figured in the above, which I believe is the only illustration of this fine and rare diatom, for which reason it is figured here.

Unfortunately no locality is given for the type.

**SURIRELLA SULUENSIS, new species**

Plate 36, fig. 3

Valve broadly elliptical, massive; border heavy, coarsely crosslined; outer ends of the costae superimposed on the border, lozenge-shaped; outer third of the costae made up of twin rows of fine transverse lines, the remaining two-thirds thin, unmarked, narrowing down until

they totally disappear before they reach the middle of the valve; this latter indefinite in contour, because not bounded by any investing line, hyaline, except for a few scattered watery dashes; polar areas evident.

Length, 0.200; width, 0.153 mm.

In general shape this resembles the one shown in Schmidt's Atlas, plate 5, figure 8, which, however, as there stated, is a variety of *S. fastuosa* Ehrenberg. This differs from that species in three respects: it has no well-defined central area; the outer ends of the costae are not wedge shaped with one to three teeth on the marginal side; the broad part of the costae is not marked with longitudinal but with transverse lines. Found only at Jolo Jolo Harbor; there frequent.

*Type*—Cat. No. 43691, U.S.N.M.

**SURIRELLA TAHITIANA** Castracane

(Castracane, Chall. Exp., p. 61, pl. 19, fig. 3.)

**SYDENDRIUM DIADEMA** Ehrenberg

See *Chaetoceros diadema* (Ehrenberg) Gran.

**Genus SYNEDRA** Ehrenberg

**SYNEDRA CRYSTALLINA** (Agardh) Kützing

(Van Heurck, Synopsis, pl. 42, fig. 10; Peragallo, Diat., France, pl. 79, figs. 1-4.)

The removal of this and a few other species into a new genus, *Ardissonia*, on the basis of the division of the transverse rows of beading by longitudinal lines, is not to be commended.

**SYNEDRA CUNEATA** (Grunow) Peragallo

(Peragallo, Diat. France, pl. 78, figs. 1-2.)

See *Sceptroneis cuneata* Grunow.

**SYNEDRA FULGENS** W. Smith

(Smith, Brit. Diat., pl. 12, fig. 103; Van Heurck, Synopsis, pl. 43, figs. 1-4; Peragallo, Diat., France, pl. 79, figs. 5-6.)

**SYNEDRA PULCHERRIMA** Hantzsch

Plate 37, fig. 1

(Hantzsch, Diat., Ostind. Arch., p. 19, pl. 5, fig. 2.)

This apparently rare species is not uncommon in the Philippine Islands. The type was found in the near-by East India Archipelago, described in 1863 and never recorded since. My specimens are all larger than that of the type as given by Hantzsch, but only slightly wider, namely—length, 0.615; width, 0.031; width of ends, 0.038; 8.5 to 9 lines in 0.01 mm., the type being length 0.24 to 0.36, width 0.017 to 0.029 mm.

As there is only one figure of this species published, and in a paper not easily obtained, I give a photograph here. To those who see an advantage in Grunow's creation of the genus *Ardissonia*, for these robust Synedra forms with hyaline side lines, this species would be so classified.

**SYNEDRA ROBUSTA** Ralfs

(Van Heurck, Synopsis, pl. 42, figs. 6-7; Pritchard, Inf., pl. 8, fig. 3; Peragallo, Diat., France, pl. 78, figs. 3-5.)

This is not easily separable from *S. formosa* Hantzsch.

**SYNEDRA UNDULATA** (Bailey) W. Smith

(Gregory, Diat., Clyde, pl. 14, fig. 107; Van Heurck, Synopsis, pl. 42, fig. 2; Peragallo, Diat., France, pl. 78, fig. 7.)

**Genus SYRINGIDIUM** Ehrenberg

**SYRINGIDIUM DAEMON** Greville

(Micro. Journ., 1866, p. 83, pl. 9, figs. 22-28.)

This species and *S. americanum* L. W. Bailey (Van Heurck, Synopsis, pl. 106, fig. 2) are closely alike; the latter was named in 1861 (Bost. Journ. Nat. Hist., pl. 2, figs. 62-64).

**Genus TERPSINOE** Ehrenberg

**TERPSINOE INTERMEDIA** Grunow

(Schmidt, Atlas, pl. 199, figs. 1-8.)

**TERPSINOE MUSICA** Ehrenberg

(Schmidt, Atlas, pl. 199, figs. 9-13.)

**Genus THALASSIOTHRIX** Cleve and Grunow

**THALASSIOTHRIX FRAUENFELDII** Grunow

(Van Heurck, Synopsis, pl. 37, figs. 12-15; Gran, Nord. Plankt., p. 117, fig. 159.)

This strictly plankton diatom was only accidentally met with in these dredgings.

**TRIBRACHIA**, new genus

Diatoms growing in chains, each member joined to the next by means of three long, spirally twisted arms; in side (girdle) view each frustule is seen to be a cylinder, its length about three times its width, the ends (valves) being convex; from the margin of each valve there arise vertically three massive, hyaline arms, sharply bowed inward at the middle, so that they interlace, and also having a slightly spiral twist; at their extremities they are joined to the three corresponding arms of the next frustule, not end to end but by lateral contact; their length is somewhat above one-half that of the cylindrical frustule, so that each cylinder in the chain is widely separated from



those on either side of it; no markings except a very obscure rugosity spread over the entire surface of the frustule, exclusive of the arms; the valve view discloses no fact of structure except that the frustules are strictly cylindrical.

This remarkable genus bears only a slight resemblance to other chain-forming genera, like *Skeletonema*, *Corethron*, *Stephanopyxis*, and Greville's grotesque genus, *Thaumatonema*. The arms are so strong and their ends so firmly welded with those of the next frustule that any break in the chain invariably occurs across the cylinder, rather than in the arms.

**TRIBRACHIA PELLUCIDA, new species**

Plate 37, fig. 2

General characters those of the genus. The perfectly hyaline arms and the merely slight rugosity of the cylinders give to this diatom a remarkably crystalline clearness like finely molded glass. It is infrequent, even in the few dredgings where it occurs; for although several specimens were secured, they are rarely met with, those secured probably representing all that were present, as their robust resistance to breakage and their striking appearance would insure their being found.

Length of cylinder, 0.061–0.071; width, 0.015–0.025; length of cylinder with arms, 0.153–0.166 mm.

*Type*.—Cat. No. 43692, U.S.N.M.

**Genus TRIGONIUM Cleve**

**TRIGONIUM ARCTICUM (Brightwell) Cleve**

This is Cleve's type species of the present genus. For a discussion of the necessity of this genus to accommodate forms once included in the impossible genus *Triceratium* and not assignable to other genera, see under *Trigonium* in Mann's *Diatoms of the Albatross Voyages*, page 289. In the present species is included Brun's *T. cyclamen* (Schmidt, *Atlas*, pl. 165, fig. 5) probably also the following species.

**TRIGONIUM BALAENA (Ehrenberg) Cleve**

(Peragallo, *Diat.*, France, pl. 105, figs. 1–3; *Micro. Journ.*, 1859, pl. 9, fig. 15.)

This is possibly a two-angled form of *T. arcticum*. Bailey gives a good figure of it in his *New Species and Localities of Microscopical Organisms*, plate 1, figure 29, with the name *Zygoceros radiatus*. Brightwell in the second reference above puts it in *Biddulphia*.

**TRIGONIUM BICORONATUM (Castracane) Mann**

Plate 37, fig. 4, and plate 38, figs. 1–3

For a discussion of this see under *Trigonium eulensteinii* (Grunow) Mann.

## TRIGONIUM CAELATUM (Janisch) Mann

(Schmidt, Atlas, pl. 81, fig. 19.)

De Toni rightly rejects Grove and Sturt's, including this diatom under their *T. plenum* (*T. weissflogii*), to which it has only the most superficial resemblance. (Syl. Alg., p. 949; Grove and Sturt, Oam. Diat., p. 328, pl. 11, fig. 22.)

## TRIGONIUM CINNAMOMEUM (Greville) Mann

(Micro. Journ., 1863, pl. 9, fig. 12; Van Huerck, Synopsis, pl. 126, fig. 1.)

Grunow's assignment of this to *Cestodiscus*, indorsed by Van Huerck, as well as his suggestion that it be put in a new genus, *Pseudotriceratium*, favorably mentioned by Van Huerck, are both unsatisfactory. It seems better to accept Greville's original view, as De Toni does, but to change the wholly untenable name *Triceratium* into its true correlative, *Trigonium*, the generic title proposed by Cleve for just such members of *Triceratium* as this one is. For a full treatment of this question see my Diatoms of the Albatross Voyages, page 292.

## TRIGONIUM CONTUMAX, new species

Plate 39, fig. 6

Valve ridgedly triangular, with straight sides and acute angles; central portion slightly depressed below the sides and the even more elevated apices; markings a marginal row of coarse, roundish or square blotches extending into the apices, arranged in well-separated rows that are almost perpendicular to the side, but more truly continuous with radii drawn from the center of the valve; these radii are represented by shining watery lines, running from each row of beads to the center, at which there is a small rosette of similar round or roundish beads; in side (girdle) view the slight depression of the central portion of the valve and the very slight elevation of the angles above the sides are clearly seen; the line of demarcation between the girdle and the downward curve of each valve is marked by a narrow sinus or groove running around the frustule; the girdle is almost hyaline, except for a single row of widely separated beads on its upper and its under edge.

Diameter, 0.0486–0.0873; lines of beads at margin, 3 in 0.01 mm.

This diatom has some resemblance to a number of species, particularly to *T. margaritifera* Cleve (New and Little-known Diat., p. 26, pl. 6, fig. 76), which, however, has concave sides, blunt apices, and no radiating lines. Cleve found it in the Galapagos Islands. It also somewhat resembles the misnamed figures in Truan and Witt's Diatoms of Hayti, plate 5, figure 9, and plate 6, figure 16, there called *Stictodiscus johnsonianus* Greville. There is indeed a specious resemblance here to the genus *Stictodiscus*, (1) because of the watery lines

so common in that genus, and even more so, (2) because of an apparent rim or border around the edge of the valve. This latter, however, is an illusion, due to the appearance of the rows of beading when seen on the curving edge of the valve; for the side (girdle) view shows that no such border or rim exists. It also shows the above-mentioned sinus where the valve joins the girdle, a construction never found in *Stictodiscus*. This is therefore an illustration of the desirability of obtaining both face and girdle views of such diatoms. Both valves are alike in their shape, a fact which would also exclude this from *Stictodiscus* if we accept the generally expressed statement that the two valves of *Stictodiscus* differ in their convexity. (See Van Heurck's *Treat. Diat.*, p. 506.) This, however, is not to be relied upon. *St. californicus* Greville, for example, rarely has its two valves of different convexity. This new species is well distributed and fairly abundant at the Philippine Islands.

*Type*.—Cat. No. 43693, U.S.N.M.

**TRIGONIUM DIAPHANUM, new species**

Plate 37, fig. 3

Valve only slightly convex, but near the margin turning rapidly downward to form a deep vertical flange or rim that joins the girdle of the frustule; three to five angled, the sides between the angles convex, except occasionally in triangular specimens, where they are practically straight; surface of the valve covered with small beads in radiating rows, gradually enlarging from the center to the sides, where they sometimes become imperfectly square or hexagonal from pressure, the separate beads having each a minute central dot (prickle?), the larger polygonal ones a more or less rugose appearance; the beading of the three to five produced and rounded angles is finer and more closely set than that of the rest of the valve; at the center is a conspicuous cluster of small spines grouped into an imperfect rosette or sometimes a ring. Under moderate magnification this diatom has a delicate, lacy appearance.

Diameter (apex of angle to middle of opposite side) 0.135–0.231 mm.

This species is the unnamed figure in Janisch's Report of the Gazelle Expedition, plate 9, figure 1. From the fact that his photograph was made from a broken specimen we may infer that it was rare in his material. It is remarkably abundant in some of the Philippine Islands dredgings, the three, four, or five angled forms being often found together in the same strewing. The four-angled forms generally predominate. Although this species is thin and gossamer-like it is very conspicuous in a dry strewing, not only because of its

considerable size, but because it arrests attention by its fine prismatic coloring, the main portion of the valve being a bluish-green and the more finely beaded angles a soft buff or straw color.

It is much like the figure in Schmidt's Atlas (pl. 79, fig. 1) but not quite identical. Schmidt incorrectly calls this *Amphitetras graeffeiana* Witt. It may be well to state here that the true *A. graeffeiana* Witt is a very coarse diatom, with well separated rectangular beads (figured and described in Journ. Mus. Godeff., 1873, p. 69, pl. 8, figs. 2a-b). Witt says of it "Erinnert in der Form an *Tri. formosum* var., Bright (Micro. Journ., vol. 4, p. 274, pl. 17, fig. 8). Kann aber nicht mit demselben vereint werden da die zellige Struktur von *Tri. formosum* (1) viel feiner, (2) nicht so deutlich radiirend ist." Perhaps the Schmidt figure represents a quadrate form of *T. formosum* Brightwell. All these belong to what we may call the *T. arcticum* Brightwell group, including *T. antarcticum* Janisch, and some diatomists would group them under that name. After a careful examination of *T. arcticum* *T. formosum* Brightwell and this new species, numberless specimens of all these being available in Philippine Islands material, I have come to the conclusion that there are three well defined types which it would be much better to hold as separate species. They are: (1) *T. diaphanum* Mann, as above, the markings of which are very delicate, composed of radiating rows of minute beads, and having at the center an evident cluster of small spines. (2) *T. formosum* Brightwell, more coarsely marked with a hexagonal radiating network, with no central spines but generally having a slightly depressed central area in which the markings are imperfectly formed beads or blotches; well illustrated under that name in Schmidt's Atlas, plate 79, figures 2-3. The network is much finer than that of the next, and is never or rarely filled with a secondary set of markings consisting of minute beads appearing as a ring within each of the areolations, as is always the case in the following: (3) *T. arcticum* Brightwell, much coarser, with secondary internal beading within or, as a matter of fact, beneath the areolation, the center of the valve generally having a minute hyaline space (Schmidt, Atlas, pl. 79, figs. 5-8, and pl. 81, figs. 3-4).

As the old genus *Triceratium* is a hopeless complex of disassociated forms, chiefly *Biddulphiae*, I see decided advantage in accepting Cleve's suggestion of placing in the genus *Trigonium* that residue of *Triceratium* which is *Biddulphoid*, but entirely destitute of the horns or other processes at the angles, a salient characteristic of the true *Biddulphia*. Most members of *Trigonium* are uniformly triangular; a few, like the above, show occasional specimens with four or more angles.

In this connection it is interesting to consider the statement of Castracane in the Report of the Challenger Expedition, page 113, that

"we can not believe that the same species can assume sometimes one form and sometimes another, or that from the same *Stictodiscus* sometimes discord and sometimes triangular or polygonal forms arise." The first half of this statement is not true; nor is the other half true, unless he means by "the same *Stictodiscus*" the same *individual*. In that case it evidently is true; for the usual method of diatom multiplication always results in the new individual having one old valve of the parent frustule and one new valve. Consequently no biangular, quadrate, or polygonal new valve could match up with a triangular old valve, and any deviation in the number of sides or angles would be impossible. But the same species with two, three, four, or more sides is so common that every diatomist is familiar with the fact. Thus in some of the Pacific Ocean dredgings examined for my paper on Diatoms of the Albatross Voyages the triangular and quadrate forms of *Biddulphia favus* (Ehrenberg) Van Heurck were both extremely abundant. It is easy to understand the change from a triangular to a quadrate or pentagonal form if we remember that in the auxosporial method of reproduction we have all the necessary conditions for this modification of contour without the loss of those other factors on which depend the species' true characteristics. It was the failure to take this into account that misled Ehrenberg into giving over one hundred specific names to the same species *Actinocyclus ehrenbergii* Ralfs, and that lured De Toni into the muddle of splitting up several clearly defined species and grouping them in two impossible genera, *Amphitetras* and *Amphipectas*, according as individual specimens happened to have four or five angles. (See De Toni, Syl. Alg., p. 911.) And as a triangular or other angled form of a species starting out from its auxosporial original would retain that form in all its subsequent multiplications by fission, we see the reason why some one of these is often abundant at a particular place in excess of, or even to the exclusion of, the others. Thus in the case here considered, the quadrangular phase shown in the illustrations is more frequent in the Philippine Islands than the triangular or pentagonal forms. The same is true in the case of *T. bicornatum* where, as already stated, the generally rare biangular form outnumbers the triangular.

*Type*.—Cat. No. 43694, U.S.N.M.

**TRIGONIUM DISSIMILE (Grunow) Mann**

(Schmidt, Atlas, pl. 81, fig. 5.)

See under *T. latum*.

**TRIGONIUM DULCE (Greville) Mann**

(Micro. Journ., 1866, p. 9, pl. 2, fig. 20.)

The type came from a fossil deposit at Barbados.

## TRIGONIUM EULENSTEINI (Grunow) Mann

Plate 37, fig. 4; plate 38, figs. 1, 2, 3.

(Schmidt, Atlas, pl. 75, figs. 6-7; pl. 81, fig. 13.)

*Triceratium eulensteinii* GRUNOW, Schmidt, Atlas, pl. 75, figs. 6-7.*Stictodiscus eulensteinii* (GRUNOW) CASTRACANE, Chall. Exp., p. 116.*Triceratium portuosum* JANISCH, Schmidt, Atlas, pl. 81, fig. 13; *T. eulensteinii*, var. *inornata* A. Schmidt.*Stictodiscus bicoronatus* CASTRACANE, Chall. Exp., p. 120, pl. 6, fig. 5; pl. 13, fig. 2.*Stictodiscus radfordianus* CASTRACANE, Chall. Exp., p. 118, pl. 17, fig. 10.*Stictodiscus anceps* CASTRACANE?, Chall. Exp., p. 116, pl. 1, fig. 5.\* *Triceratium multiplex* JANISCH, Schmidt, Atlas pl. 75, fig. 1; pl. 81, fig. 14.*Stictodiscus multiplex* (Janisch) CASTRACANE, Chall. Exp., p. 116.—TRUAN and WITT, Diat. Hayti, p. 21 pl. 5, fig. 7.*Triceratium (Biddulphia) heteroporum* GRUNOW, Van Heurck, Synopsis, pl. 112, fig. 2.*Triceratium galapagense* CLEVE, New and Little Know Diat., p. 25, pl. 6, fig. 72.

Through the good fortune of having a large number of gatherings from the Philippine Islands in which nearly all the above are more or less abundant I have been able to compare these apparently diverse forms. I find they are unquestionably only differently shaped phases of the same general type represented by *Triceratium eulensteinii* Grunow. It is very possible that *Stictodiscus anceps* Castracane and the second figure of *Stictodiscus bicoronatus* Castracane in the Report of the Challenger Expedition, plate 13, figure 2, may together represent a second closely allied group. I have not seen a sample of *T. heteroporum* Grunow, which comes from fossil St. Monica material; but judging from the illustration in Van Heurck's Synopsis, plate 112, figure 2, unfortunately without description, it is specifically identical with Castracane's *Stictodiscus bicoronatus*. The most aberrant example of this group is the biangular form here illustrated, which is rather abundant in the Philippine Islands. Such biangular forms of normally triangular diatoms are not at all uncommon; as for example, the biangular form of *Entogonia davyana* Greville, called "*Heibergia barbadosensis*" Greville, and the biangular form of *Trigonium arcticum* (Brightwell) Cleve, called *Biddulphia balaena* (Ehrenberg), var. *arctica*. All the diatoms named with the present species have certain peculiarities in common and which also distinguish them from other diatoms. They are marked with small but strong beads, rather loosely dispersed except near the margin of the valve, where they are more closely set and arranged in definite rows at right angles to the edge; at the angles of the valve, whether two or many, the beading is smaller, more compact, and is arranged somewhat fanwise. In the center of each of the larger beads is a minute dot or prickle, and where this is prominent the bead is elongated radially as to the center of the valve and the central prickle seems to divide it into twin halves.

This is usually observable in *T. multiplex*, *Stictodiscus radfordianus*, *Stictodiscus bicoronatus*, and the unnamed biangular form here figured, and is very evident in my photograph of the triangular *T. bicoronatum* (Castracane) Mann. It would seem to be evident also in *T. heteroporum* Grunow, judging from the Van Heurck figure. In addition to the beading, the surface of the valve is more or less covered with very fine puncta that give to it a dusty appearance, but which is absent in a little ring around each of the beads. This is very generally seen in *Stictodiscus bicoronatus* and is so noted and figured by Castracane; in *T. multiplex*, as represented in Schmidt's Atlas, plate 75, figure 1, and plate 81, figure 14, in my photograph of *Stictodiscus bicoronatus* and in *Triceratium heteroporum*, because of which the latter specific name was selected. Traces of this dusty spattering are also more or less observable in *T. eulensteinii* and *Stictodiscus radfordianus*. There are two other specific marks that are more inconstant; one is a single or double rosette of beads or lines at the center. It is generally prominent in *T. eulensteinii* (Schmidt, Atlas, pl. 75, figs. 6-7), but is sometimes lacking (pl. 81, fig. 13) a phase called for this reason var. *inornata*. In *T. multiplex* it is frequently obscure or absent, but is strongly marked in Schmidt's Atlas, plate 75, figure 1, and dimly so in Schmidt's Atlas, plate 81, figure 14. In the biangular form it is usually conspicuous, sometimes a single ring, sometimes a double one. It is very evident in *T. heteroporum* as a single ring, in *Stictodiscus bicoronatum* as a double ring, whence the name. It is lacking in *T. galapagense* Cleve. The other inconstant factor is the set of watery radiating lines, sometimes straight and sometimes anastomosing. They are usually quite strong in *T. eulensteinii*. This is the case in Schmidt's Atlas, plate 75, figure 6; but in plate 75, figure 7, they are more indistinct and even more so in plate 81, figure 13. In Castracane's type figure of *St. bicoronatus*, Challenger Expedition, plate 6, figure 5, they are evident; but in his second figure, plate 13, figure 12, they are wholly wanting. In Castracane's figure of *St. radfordianus*, Challenger Expedition, plate 17, figure 10, they are rather dim, but in my specimens of this form from the Philippine Islands they are very strong. They are also well marked in *T. galapagense* Cleve. I have never found more than mere traces of them in the biangular form here figured. No hint of them is given in Van Heurck's figure of *T. heteroporum* Grunow.

It will be seen from the forgoing that we have here a group of diatoms well defined from the species outside of the group, but with no constant mark of distinction between each other. Nevertheless, we find the name *eulensteinii* given to such specimens as have an undulate margin, *radfordianus* to such polygonal forms as have practically straight sides and slightly protruded angles, *multiplex* to those with straight sides but not protruded angles, *bicoronatus* to triangular

forms with double central rosette, *heteroporum* to triangular forms with single central rosette, *galapagense* to triangular forms with no rosette, and finally the unnamed biangular form here illustrated, showing all the characteristics of the others except the radiating watery lines that are generally but not always present in some of them. As to whether or not these so-called species should be retained for the greater convenience of future identifications depends wholly on what one considers a diatom species to be. I have decided to leave these specific names in my list of Philippine diatoms, as offering better facilities for references to illustrations in other works, but with the above-expressed opinion that they are in reality only varied phases of *T. eulensteinii* Grunow.

As to the confusion caused by some authors assigning these forms to *Trigonium* (that is to say, the old *Triceratium*) and others to *Stictodiscus*, a study and comparison of a liberal number of specimens, examined in both valve and girdle aspect, will convince anyone that Grunow, Van Heurck, Janisch, Cleve, and Schmidt are correct in their original assignments to *Triceratium*, rather than to *Stictodiscus*. It is probable that the watery radiating lines running from the margin toward the center of the valve in some of the foregoing specimens are responsible for their being classified under *Stictodiscus*, that genus being characteristically marked with such lines. But *Stictodiscus* always has a distinct border or rim, well defined and differently marked from the rest of the valve, corresponding to the rim of *Arachnoidiscus*, the genus with which *Stictodiscus* is most closely affiliated. No such rim exists in any of the forms here under consideration. It is true that something like a rim appears in some of the illustrations here referred to; but in every case it is an illusion due to the appearance of the beading at the edge of the valve, where it bends downward toward the girdle, and a slight change of focus of the microscope will quickly dissipate this false impression. A girdle view even more clearly shows there is no trace of a rim; and the whole structure of the diatom seen in that aspect is so utterly unlike *Stictodiscus* that no doubt remains. Such a view of a typical triangular "*Stictodiscus bicoronatus*" Castracane, plate 37, figure 4, of this report, will make clear the true structure.

It may be added that the attempt to avoid the unsatisfactory classification of *T. eulensteinii* as a *Stictodiscus* by referring it and some of these other forms to *Pseudo-Stictodiscus* is most unfortunate; so also Van Heurck's suggestion of its being a *Biddulphia* (Treatise, pp. 466, 468). The type species of the former is *Pseudo-Stictodiscus angulatus* Grunow (Schmidt, Atlas, pl. 74, figs. 24-30), a diatom that has no relationship with the present forms. H. H. Chase, (New and Little-known Diat., p. 6) remarks upon the transfer of *T. eulensteinii* into *Pseudo-Stictodiscus*. "This splitting of well-established



genera to accommodate one or two species that happen to vary slightly in size, locality, or outline is to be seriously deprecated; and can but result in confusing students and in bringing certain discredit upon those who make it their business to create new genera and species from insufficient material."

**TRIGONIUM FORMOSUM (Brightwell) Cleve**

(Schmidt, Atlas, pl. 79, fig. 4; Micro. Journ., 1856, pl. 17, fig. 8.)

For a discussion of the validity of this species and its separation from *T. arcticum* Cleve see under *T. diaphanum*.

**TRIGONIUM FRAUENFELDII (Grunow) Mann**

(Schmidt, Atlas, pl. 94, fig. 13; Van Huerck, Synopsis, pl. 110, fig. 10.)

There is doubt if this can be held as anything more than a variety of *T. latum* Greville. My specimen agrees exactly with Schmidt's figure, somewhat less with that of the type figure in Van Heurck's Synopsis.

**TRIGONIUM GEMINUM (A. Schmidt) Mann**

(Schmidt, Atlas, pl. 80, fig. 16.)

This has rather disturbing affinities with that group of diatoms figured on plate 80 of Schmidt's Atlas, with *T. gibbosum* as its type, and for the accommodation of which Bailey himself proposed the genus *Lampriscus*. Bearing on the suggestion, not universally accepted by diatomists, see De Toni (Syl. Alg., p. 1136). The present species is not manifestly a member of this group and a discussion of the necessity for *Lampriscus* is therefore not attempted.

**TRIGONIUM HETEROPORUM (Grunow) Mann**

(Van Heurck, Synopsis, pl. 112, fig. 2.)

See under *Trigonium bicoronatum* (Castracane) Mann for a discussion of these species.

**TRIGONIUM INELEGANS (Greville) Mann**

(Schmidt, Atlas, pl. 128, fig. 3.)

The specimen found agrees exactly with Schmidt's figure, to which Grunow gives the varietal name *micropora*, but is rather wide from Greville's type illustration (Micro. Journ., 1866, pl. 2, fig. 21). Neither of these should be confused with *T. punctatum* Brightwell, which they superficially resemble.

**TRIGONIUM INGLORIUM (Greville) Mann**

(Micro. Journ., 1865, pl. 9, fig. 18.)

This seems to be a strictly Philippine Islands diatom, the type having come from Manila.

**TRIGONIUM LATUM (Greville) Mann**

(Micro. Journ., 1865, pl. 9, fig. 20; Schmidt, Atlas, pl. 77, figs. 38-39.)

This species is quite variable. An unimportant variety, despite its assertive name, is Grunow's *T. dissimile* in Schmidt, Atlas, plate 81, figure 5. So also another form found at the Philippine Islands and named *T. zonulatum* Greville in Schmidt's Atlas, plate 77, figure 33. It may be added that varieties of these two do approach closely.

**TRIGONIUM MEMBRANACEUM (Cleve) Mann**

(Cleve, W. I. Diat., p. 20, pl. 5, fig. 33; Peragallo, Diat., France, pl. 105, figs. 4-5.)

This species could be classified as a small and very delicate variety of *Trigonium balaena* (Ehrenberg) Cleve, which see. But in addition to its much more fragile structure, the minute beading of its valves is made up of closely set circular beads, so spaced as to produce a quincunx pattern; while those of *T. balaena* are set in more widely spaced rows and are oval. De Toni and others unite this with *B. titania* Grunow, the type figure of which is given in Van Heurck's Synopsis, plate 95bis, figures 6-9, from which it differs in the character of its girdle and in the absence of the remarkable curved row of prominent beads marking the valve at either end of the oval of *B. titania*. These curious markings favor the idea of placing *B. titania* in the genus *Janischia*. My Philippine specimens are unique in being three-angled instead of two-angled.

**TRIGONIUM MULTIPLEX (Janisch) Mann**

(Schmidt, Atlas, pl. 75, fig. 1.)

For a discussion of the essential unity of this and *T. eulensteini* (Grunow) Mann, see the latter.

**TRIGONIUM PARDUS (A. Schmidt) Mann**

(Schmidt, Atlas, pl. 79, fig. 15.)

Rather close to *T. punctatum*. Schmidt's type came from N. Celebes.

**TRIGONIUM PUNCTATUM (Brightwell) Mann**

(Micro. Journ., 1856, pl. 17, fig. 18; Schmidt, Atlas, pl. 76, figs. 19-20; pl. 81, figs. 6-7.)

That this is only a variety of the earlier named *T. sculptum* Shad-bolt is discussed in my Diatoms of the Albatross Voyages, page 295. It is rather common in the Philippine Islands dredgings and is named separately merely for convenience of reference, a plan here adopted in other similar cases.

**TRIGONIUM QUINQUELOBATUM (Greville) Cleve**

(Micro. Journ., 1866, p. 83, pl. 9, fig. 21; Schmidt, Atlas, pl. 79, fig. 8.)

Although I am disposed to agree with Grunow, quoted in the above reference to Schmidt's Atlas, that this is a pentagonal form of *T. arcticum* Cleve, and have so recorded in my Diatoms of the Albatross Voyages, page 291, the arrangement is open to objection. It is worth while to note here that typical specimens of *T. arcticum* are common in Philippine Islands material and all show the characteristic cluster of small beads within each hexagon of the network, but no trace of a central papilla in the hexagons, or at most a bright spot in the center due to the absence of beads at that point. In contrast to this, *T. quinquelobatum*, less common but not scarce, has a strong papilla in the middle of each hexagon with no trace of the underlying beading so evident in *T. arcticum*. There is an unmistakable contrast between the two, both with low magnification and under immersion objectives.

**TRIGONIUM RADFORDIANUM (Castracane) Mann**

(Castracane, Chall. Exp., pl. 17, fig. 10.)

For a discussion of the essential unity of this and *T. eulensteinii*, see under the latter.

**TRIGONIUM (TRICERATIUM) RADIOLATUM Janisch**

See under *Cestodiscus radiolatus*.

**TRIGONIUM SCULPTUM Shadbolt**

(Micro. Journ., 1854, p. 15, pl. 1, fig. 4; Schmidt, Atlas, pl. 76, figs. 9-10.)

As stated above, under *T. punctatum*, that diatom is a variety of this one. De Toni (Syl. Alg., p. 944) unites them, but under Brightwell's later name (1856), and then confuses the two with *T. reticulum* Brightwell (1853), following Cleve's mistake in his Diatoms from the West Indian Archipelago, page 16. Van Heurck (Synopsis, pl. 109, figs. 7-8) names it *T. sculptum*, but figures Brightwell's varietal form *T. punctatum*, which lacks the three rings on which Shadbolt's name was based and which are well shown in the above references. He further implies that the species is really a *Biddulphia*, from which I dissent, there being no processes at the angles.

**TRIGONIUM ZONULATUM (Greville) Mann**

(Schmidt, Atlas, pl. 77, fig. 33.)

There is a doubt of the Philippine Islands form belonging to this species. It is exactly figured as above, but it might perhaps better be considered to be a small triangular example of *T. latum* Greville. The statement made under the latter, that the two are often approximately alike, may be here repeated.

Genus *TRINACRIA* Heiberg

The species classified under this name are generally recognized to be merely triangular phases of the genus *Hemiaulus* (Ehrenberg) Grunow. They are principally found in fossil deposits, notably those at Mors, Denmark, and Simbirsk, Russia. A coarse, blotchy style of marking and stiff, straight processes tipped with stout spines that rise vertically from the angles of the valves are equally characteristic of both, the processes being two on the biangular *Hemiaulus* and three on the triangular *Trinacria*. Van Heurck makes this essential unity clear by figures in Van Heurck's Treatise, page 456. He there also adds to *Hemiaulus* a quadrate phase for which Heiberg created the genus *Solium* and an unsymmetrical biangular phase for which Heiberg created the genus *Corinna*. How that diatomist could separate generically such evident examples of *Hemiaulus* as the last is a mystery.

But *Trinacria* has at least one quality that is favorable to its retention as a convenient division of diatom taxonomy—the fact that these triangular forms are very rarely or never anything but triangular; that is to say, do not vary into the typical biangular *Hemiaulus* phase, and can therefore never be confused with strict *Hemiaulus* species. In the superficially similar genus, *Trigonium*, and especially in the old conglomerate *Triceratium*, two, three, four, five, or more angled modifications of the type form are common. But the persistent triangular shape maintained by the 30 or more species of *Trinacria* makes their retention in a group a material help in identification. I therefore retain this generic name, subject to the foregoing statement of agreement with H. L. Smith, Grunow, Van Heurck, and other diatomists, who have carefully considered this subject.

*TRINACRIA LIMPIDA*, new species

Plate 39, fig. 1

This species resembles rather closely two examples of *T. wittii* A. Schmidt figured in Schmidt's Atlas, plate 96, figure 1, and plate 97, figure 2, and the phase of the same thing accepted as such by Schmidt and figured in Witt's Diatoms of Simbirsk, plate 11, figure 1. But the Philippine specimens have undulating sides, delicate lines radiating from a central rosette, on which are strung widely separated beads, as on threads; a strongly contrasting single row of large, oval beads along the margin, and with decidedly rounded apices marked with minute, closely set beading arranged fanwise; in all of which it contrasts with *T. wittii*, especially with the latter's produced and apiculate apices. In fact, there is less doubt of the separateness of these two than the wisdom of calling either of them anything more than wide varieties of *T. regina* Heiberg.

Diameter of valve, from apex to middle of opposite side, 0.107 mm.

*Type*.—Cat. No. 43695, U.S.N.M.

## TRINACRIA TRIPEDALIS, new species

Plate 39, figs. 2-3

Valve triangular, with blunt, rounded apices, the verticle legs at the three angles appearing in this view as three oval or subtriangular disks, each showing a shadowy internal ring, but otherwise hyaline; exclusive of these, the valve is ornamented with small widely separated beads, set in four concentric circles, with large, elongated, equidistant beads or bars along the three sides of the valve; in side (girdle) view the beading of the valve is seen to extend downward toward the girdle only one or two rows, being followed by a hyaline space, with a single row of beading on its edge where it joins the girdle; the latter is beaded with closely set transverse lines; the vertical legs are short, stout, rounded, and marked with scattered beading, their terminal awns three parted.

Height of valve measured from apex to middle of opposite side, 0.037-0.047; width of frustule, 0.039 mm. (average).

There is marked similarity between this and some figures of so-called *Triceratium*, as *T. pauperculum* Greville (Trans. Micro. Soc., 1865, pl. 6, fig. 26) and *T. dulce* Greville (Trans. Micro. Soc., 1866, pl. 2, fig. 20), but as only a side (girdle) view can indicate their true generic position, a union of this merely similar form with them would be unwise.

*Type*.—Cat. No. 43696, U.S.N.M.

## Genus TROPIDONEIS Cleve

The diatoms included in this genus were weeded out of *Amphiprora* by Cleve. I believe they form a valid genus and relieve *Amphiprora* of some species resembling true *Amphiproras* in only a general way. Cleve defines and gives reasons for this genus in his *Naviculoid Diatoms*, part 1, page 22. Van Huerck in his treatise, page 263, accepts the genus and its three subdivisions *Orthotropis*, *Plagiotropis*, and *Amphoropsis*.

## TROPIDONEIS APPROXIMATA Cleve

(Cleve, Nav. Diat., vol. 1, p. 26, pl. 3, figs. 20-21.)

## TROPIDONEIS FRAGILIS (Tempère and Brun) Mann

(Brun, Diat. Jap., pl. 9, fig. 14.)

This is rather close to *Amphiprora membranacea* (Cleve, Diat. Java, pl. 2, fig. 18), renamed *Tropidoneis membranacea* by Cleve, in his *Naviculoid Diatoms* (vol. 1, p. 24).

## TROPIDONEIS JAVANICA (Cleve) Mann

(Cleve, Nav. Diat., vol. 1, p. 21, pl. 2, fig. 22.)

Cleve puts this in the genus *Auricula*. After carefully examining several specimens I can find no justification for this. The geographical proximity of the type location, Java, to the Philippine Islands is to be noted.

**TROPIDONEIS LATA** Cleve

(Cleve, Nav. Diat., vol. 1, p. 28, pl. 3, figs. 3-4.)

**TROPIDONEIS LEPIDOPTERA** (Gregory) Cleve

(Micro. Journ., 1857, pl. 1, fig. 39; Gregory, Diat., Clyde, pl. 12, fig. 59.)

**TROPIDONEIS MAXIMA** (Gregory) Cleve

(Gregory, Diat., Clyde, pl. 12, fig. 61.)

**TROPIDONEIS MEMBRANACEA** Cleve

(Cleve, Diat., Java, pl. 2, fig. 18; Cleve, Nav. Diat., vol. 1, p. 24.)

Note the resemblance to this mentioned under *T. fragilis*.

**TROPIDONEIS OBLONGA** (Greville) Cleve

(Micro. Journ., 1863, pl. 1, fig. 15.)

Cleve says (Nav. Diat., vol. 1, p. 26) that this "seems to be akin to *T. maxima*." If this means they are specifically the same, the specimens I have do not uphold that supposition. There is enough difference between them to justify both names.

**TROPIDONEIS PHANTASMA**, new species

Plate 39, fig. 4

Valve extremely convex and laterally compressed, so that the view obtained is always that of the side (girdle), the rhapshe occupying the sharp curved ridge of the dorsal side; the two halves on either side of the rhapshe are of unequal width, so that, seen from the side, one overlaps the other, the edge of the wider appearing to be convex and that of the narrower slightly concave; the rhapshe is strong, the central nodule (in middle of the dorsal ridge) somewhat depressed; the two terminal nodules are located at the extreme tips of the pointed apices; markings of transverse lines of very fine closely set beading, frequently interrupted by hyaline spaces, giving to the valve a decidedly mottled appearance. This species is rare.

Length of valve, 0.148; depth of valve, 0.056; lines 17.2 in 0.01 mm.

*Type*.—Cat. No. 43697, U.S.N.M.

**TROPIDONEIS VAGA**, new species

Plate 39, fig. 5

Valve lanceolate, at its middle barely constricted laterally but deeply depressed transversely with tapering, somewhat cuneiform ends and rounded apices; an elevated longitudinal median area, one-third the width of the valve, extending from the center to the two apices; rhapshe strong, straight, its halves terminating at both ends in beads, the central ends well separated; the markings are of closely set, coarse, transverse, beaded lines; there is a small hyaline space at the central nodule, and a slight separation of the lines on either side

of this, giving a suggestion of a stauros; in girdle view the two convex halves are seen to be separated by the deep median sinus.

Length 0.143; width 0.019; lines 10 in 0.01 mm.

This diatom because of its median ridge and its coarse beading resembles *Navicula carinifera* Grunow, except for its linear shape, median constrictions, and tapering ends. It has some likeness to *T. lepidoptera* (Gregory) Cleve, but its very coarse beading in proportion to its size and its *Achnanthes*-like constrictions at the middle sufficiently separate them. In this last-respect it reminds one of "*Achnanthes pennaeformis*" Greville (Diat. So. Hemi., pl. 6, figs. 11-13). The specific name here given refers to the confusing qualities, which seem to link it to *Navicula*, to *Tropidoneis*, and to *Achnanthes*. It is rare.

*Type*.—Cat. No. 43698, N. U.M.S.

#### Genus WILLEMOESIA Castracane

This genus, created by Castracane in his Report of the Challenger Expedition, page 165, is not clearly described, although the first of his three figures in plate 8 make sufficiently plain the nature of the single species so far known. Rattray (Rev. Cosc., p. 452) rejects this genus and names the diatom *Coscinodiscus humilis* Rattray. It is a serious stretch of the boundary of *Coscinodiscus* to include this form, and the finding of three specimens in three separate dredgings from the Philippine Islands shows we have to do with a persistent and well-marked diatom. Van Heurck in his treatise, page 537, accepts this genus.

#### WILLEMOESIA ELONGATA (Grunow) Mann

(Castracane, Chall. Exp., pl. 8, fig. 8; not 8a-8b; Van Heurck, Synopsis, pl. 125, figs. 14-17; Van Heurck, Treat., p. 537, fig. 284.)

The two figures of Castracane's excluded above are suspiciously like nondiatom plates frequently met with, one of which is well illustrated in the same work, plate 10, figure 10. In no other figures nor in the specimens I found are the borders hyaline, as they are in these plates. They are also perfectly flat, not convex like the present species. Rattray's specific name, *humilis*, should be rejected in favor of the earlier *Coscinodiscus elongatus* of Grunow (1880), which is unquestionably the same diatom. As to the figures in Van Heurck's Synopsis, which with some question he places in *Actinocyclus*, it is *a priori* evident these unique specimens are suspiciously alike; and as for the "pseudonodule" because of which Van Heurck with doubt assigns them to *Actinocyclus*, I am of the opinion that the dot seen by Van Heurck is not a true pseudonodule, one of my specimens having *three* such dots on one valve and *none* on the other valve of the same frustule. I shall therefore assume, for the present, that we are here dealing with a single species.

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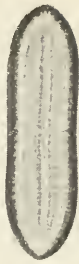
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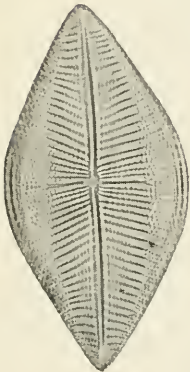
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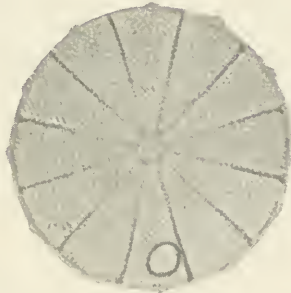
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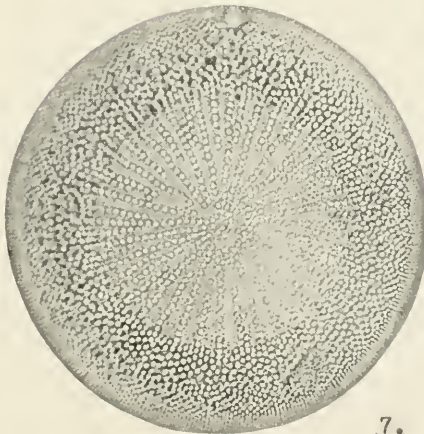
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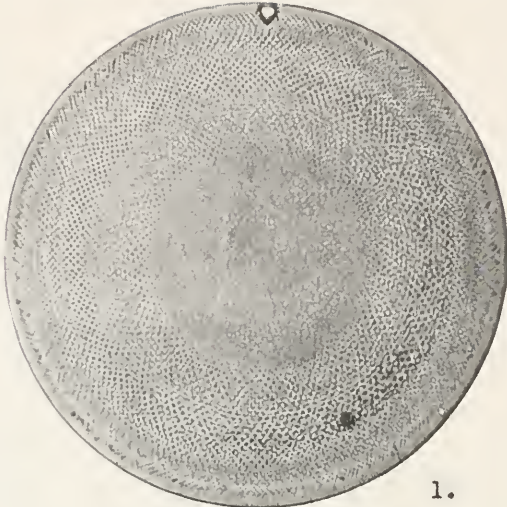
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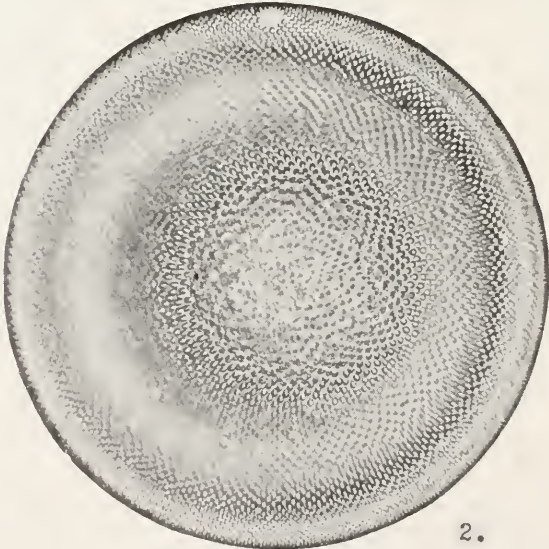
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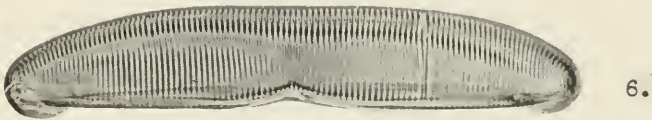
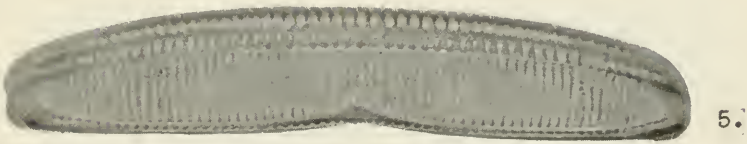
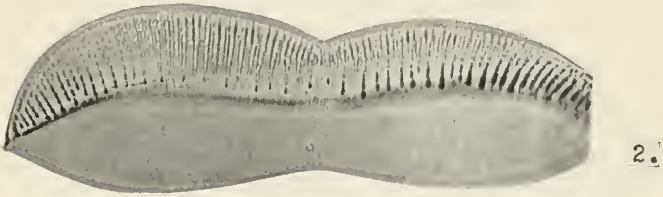
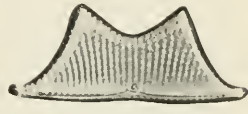


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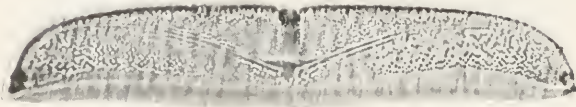


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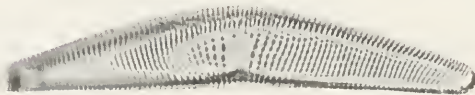
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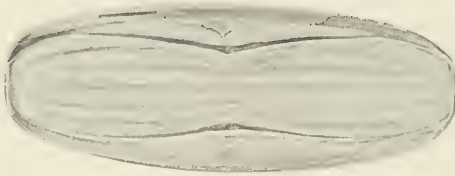
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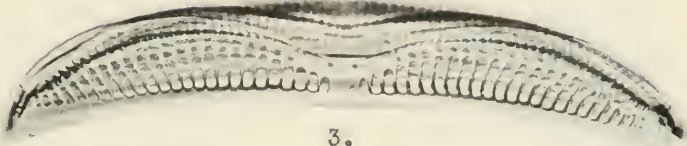
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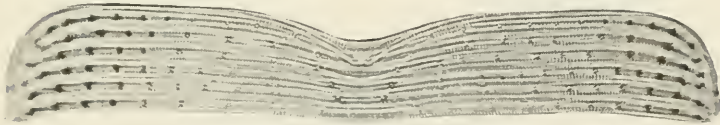
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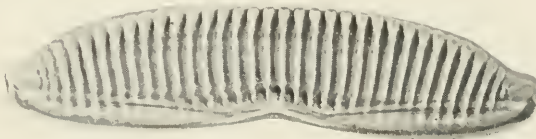
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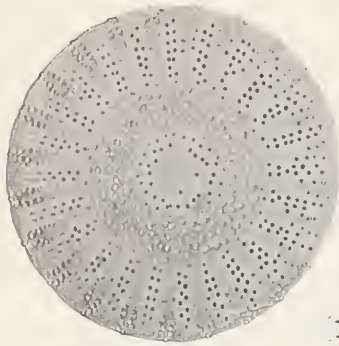
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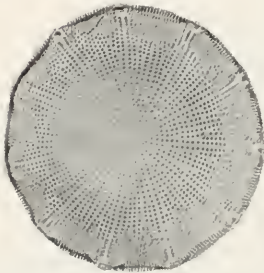
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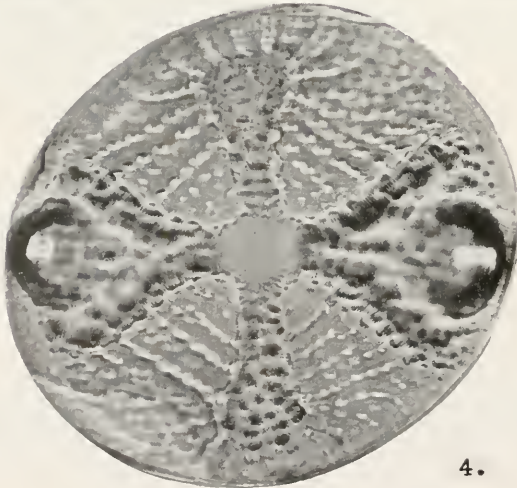
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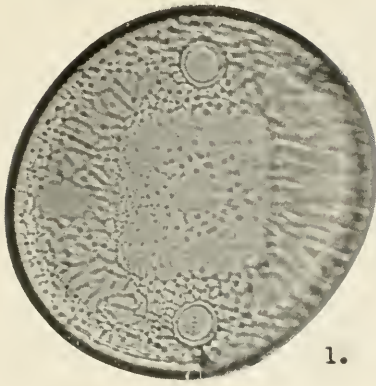
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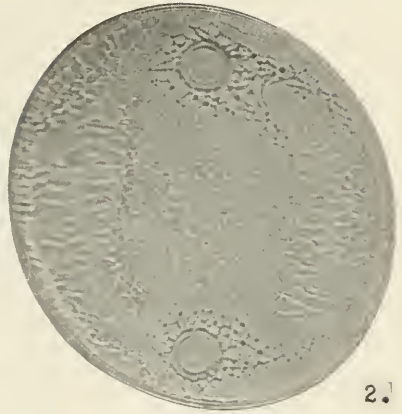
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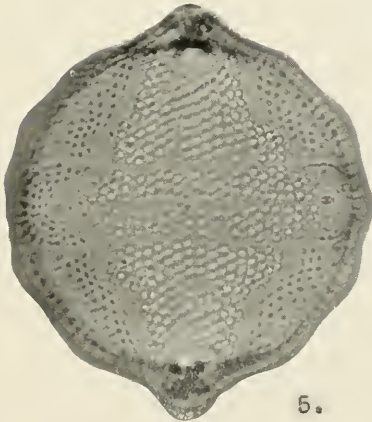
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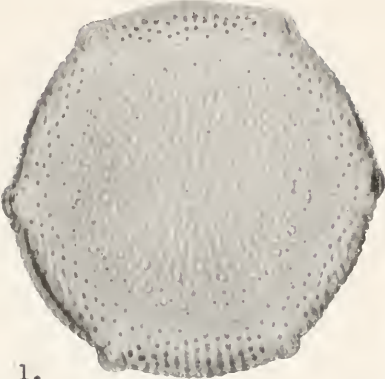
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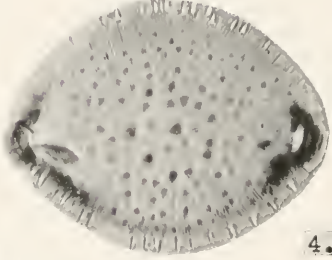
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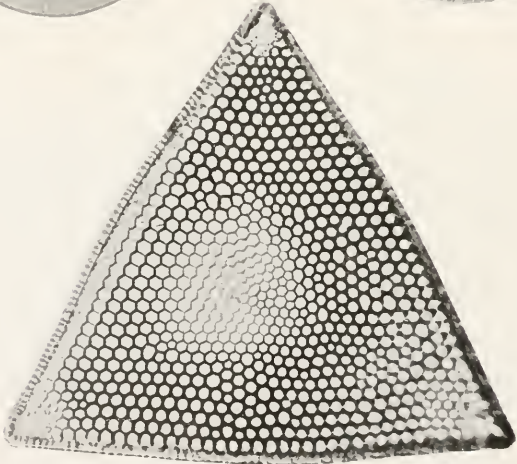
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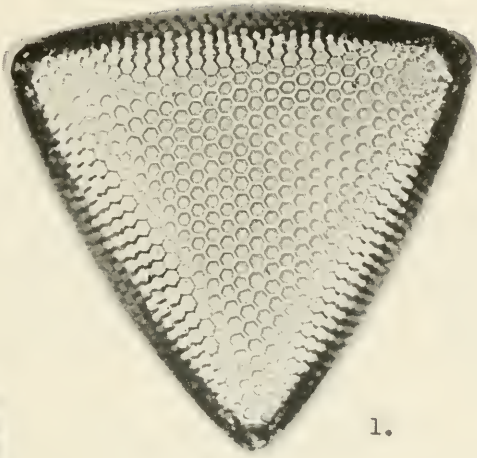
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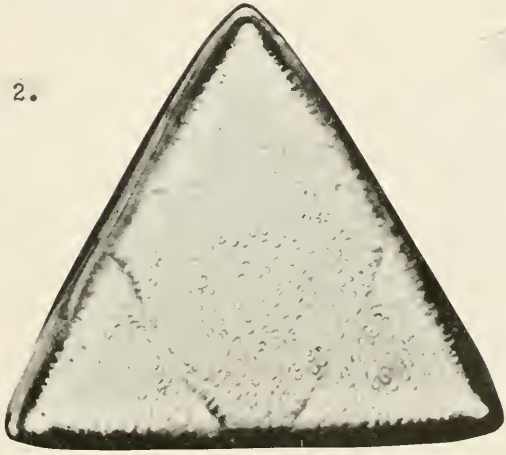
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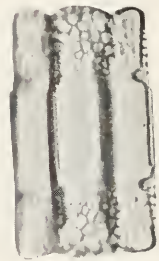
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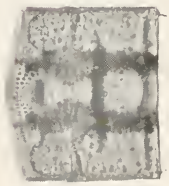
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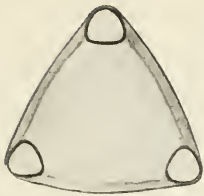


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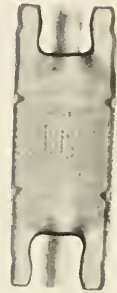




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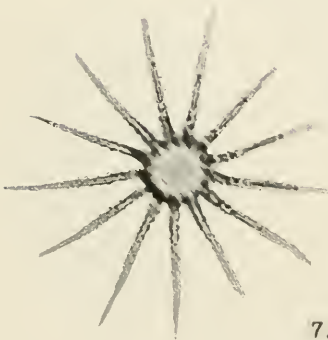
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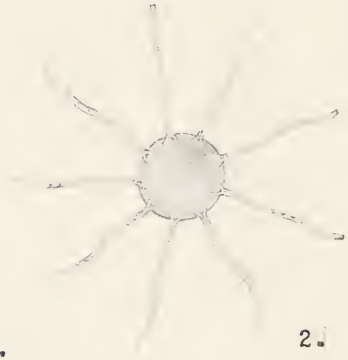
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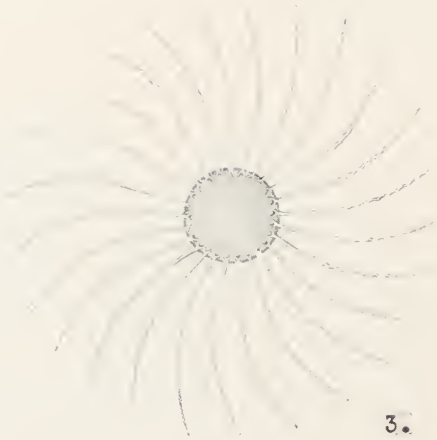
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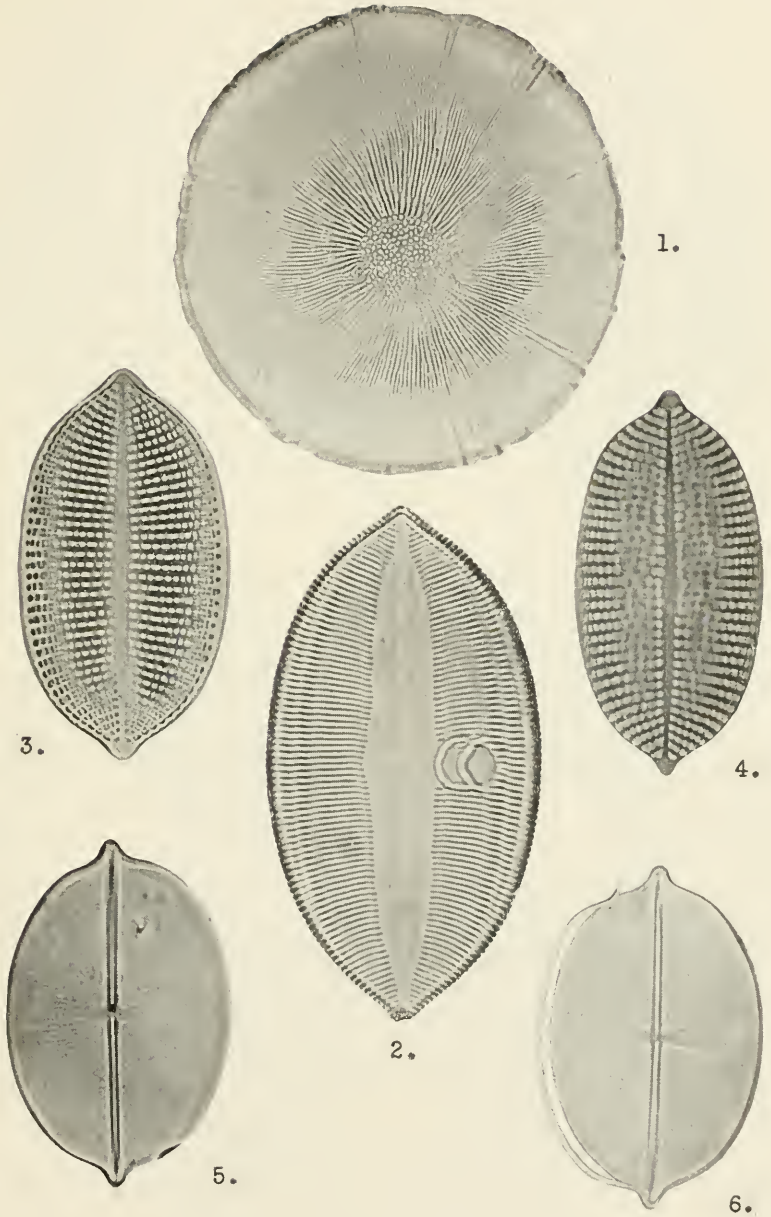
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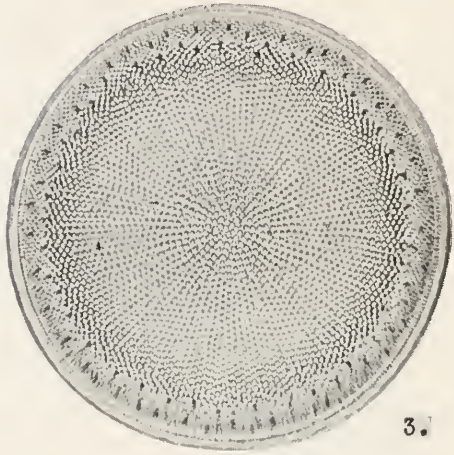


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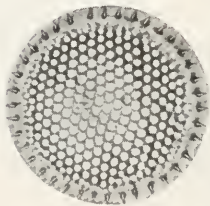
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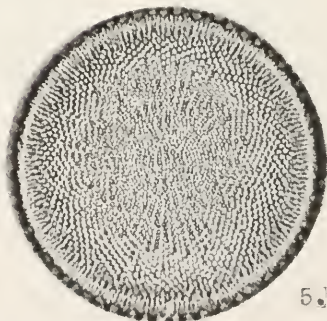
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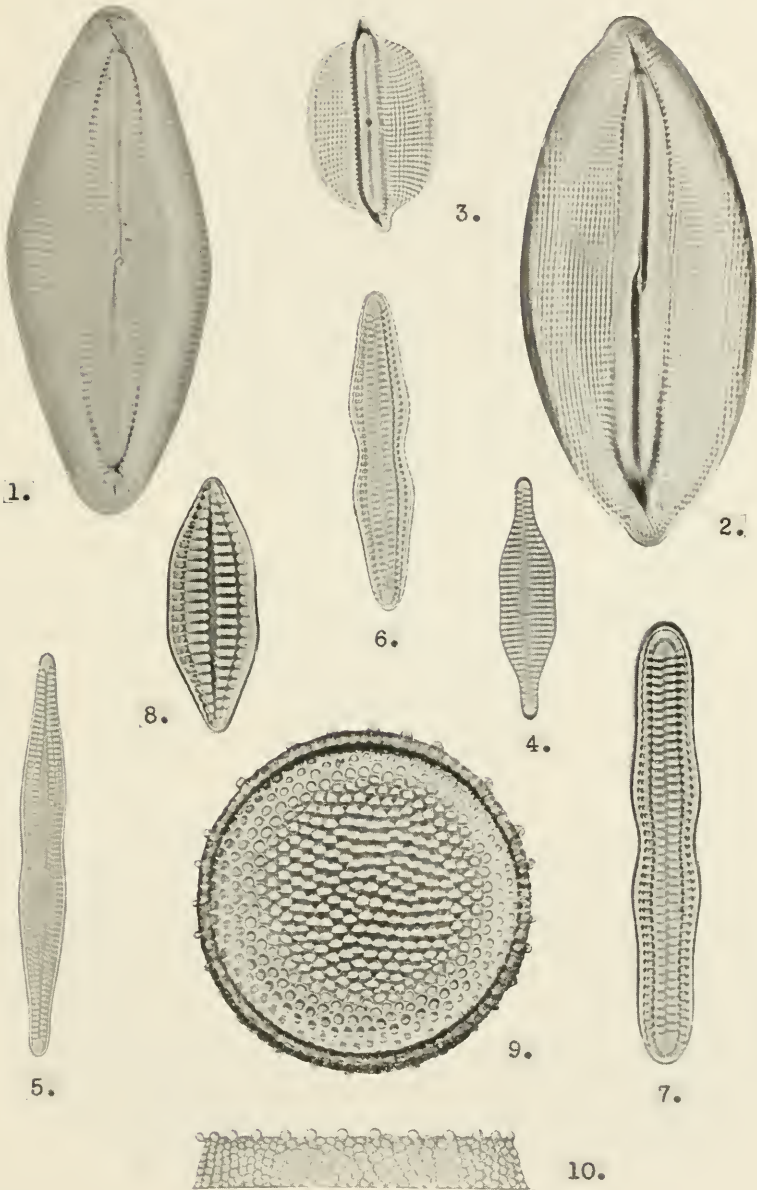
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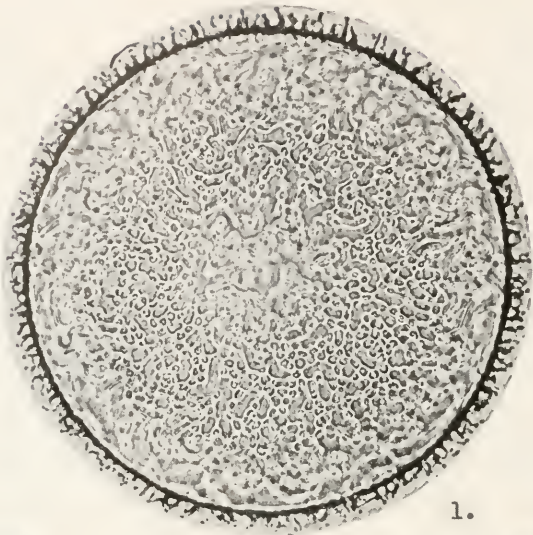
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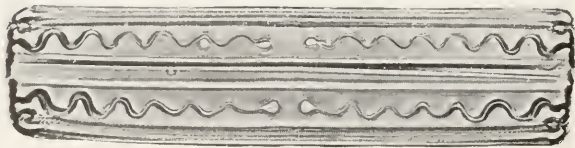
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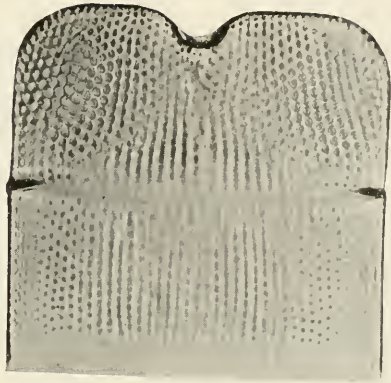
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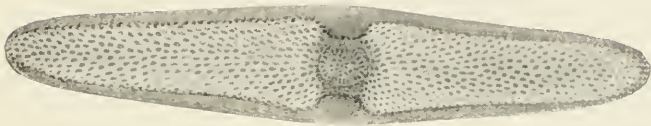
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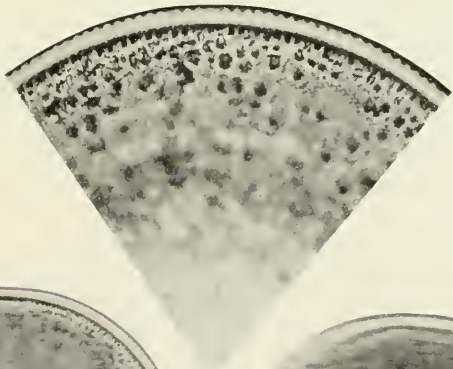
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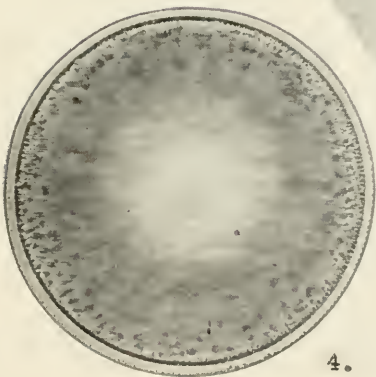
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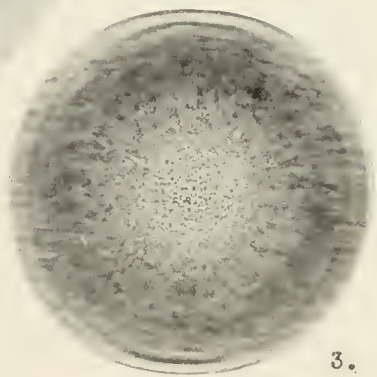
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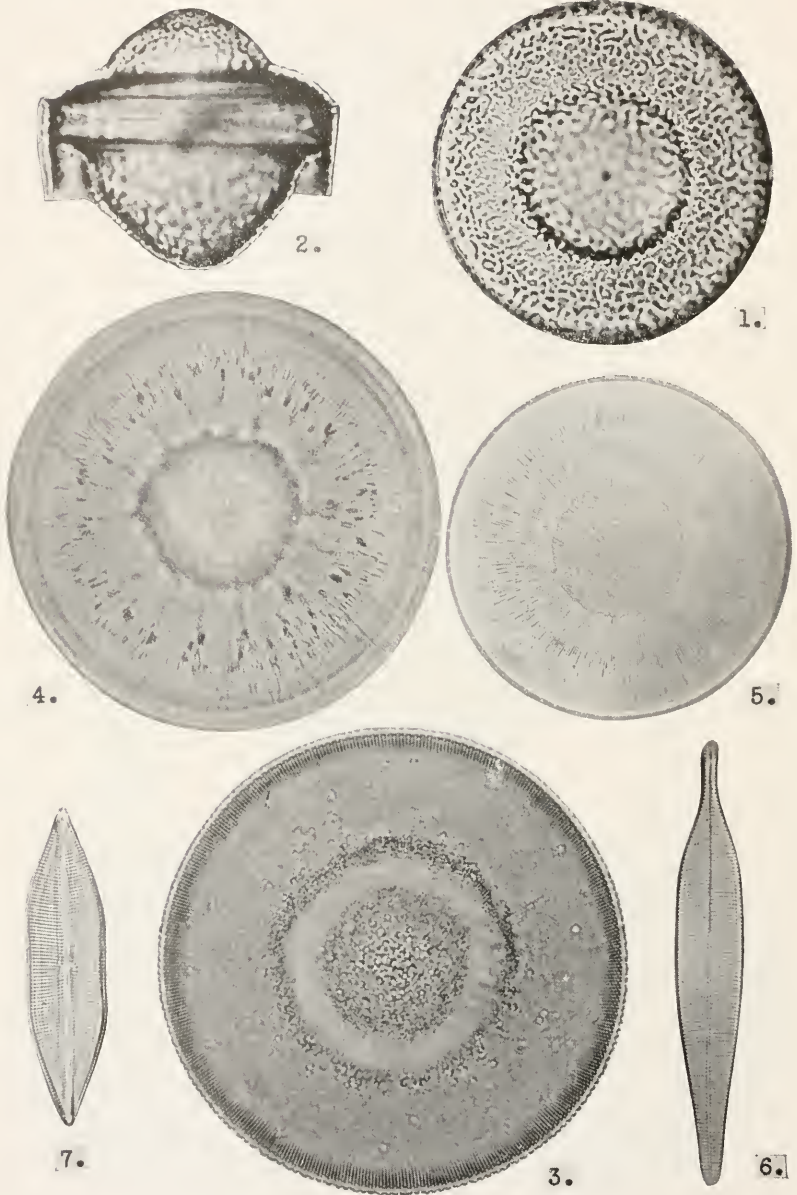
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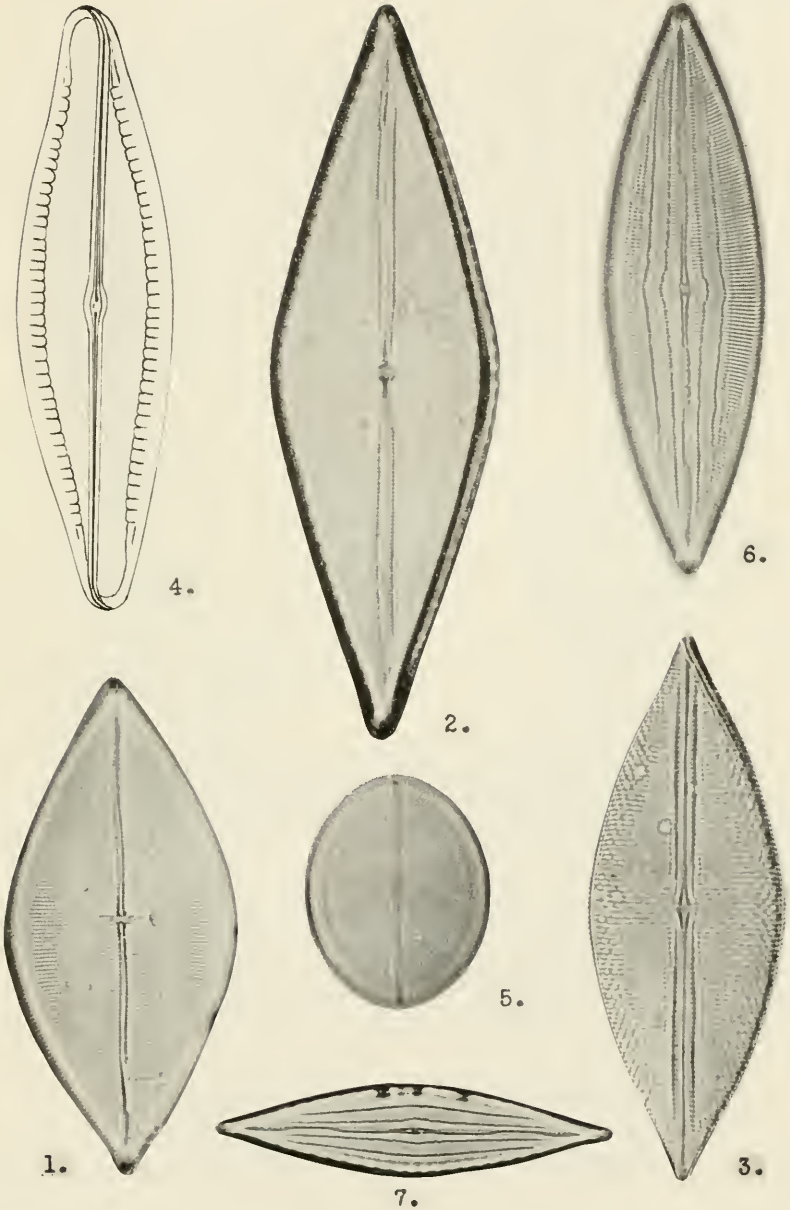
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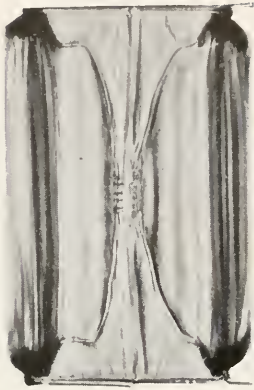
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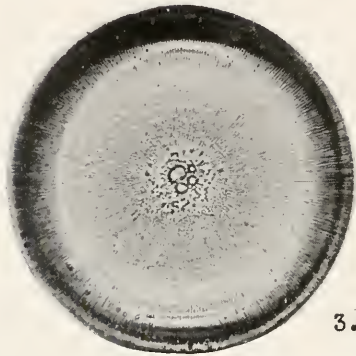


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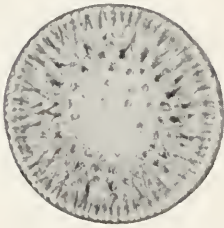
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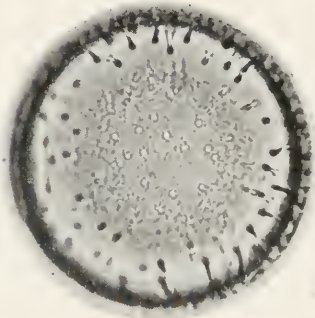
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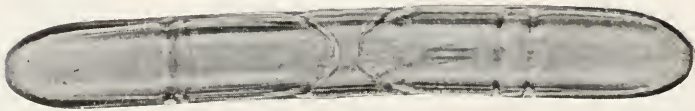
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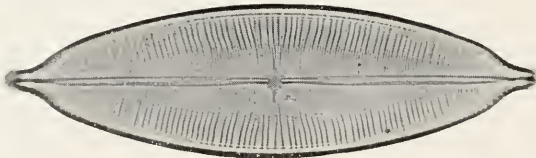
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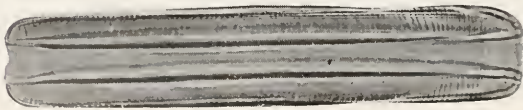
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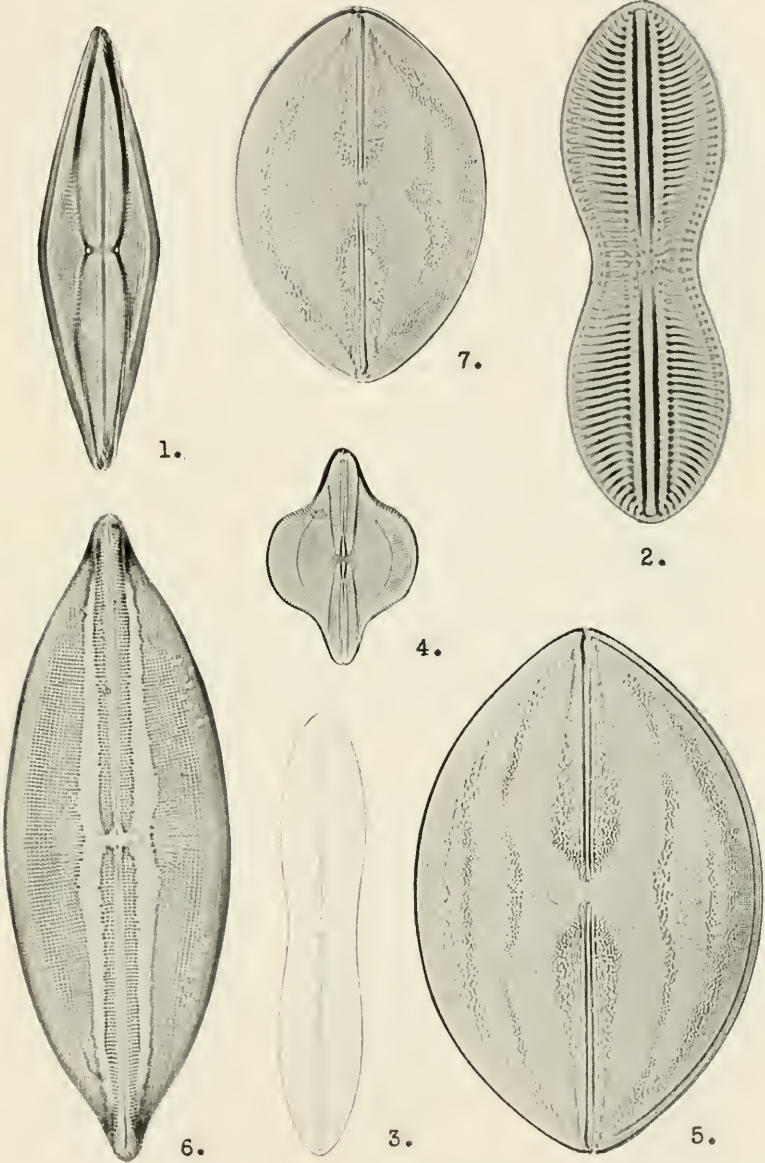
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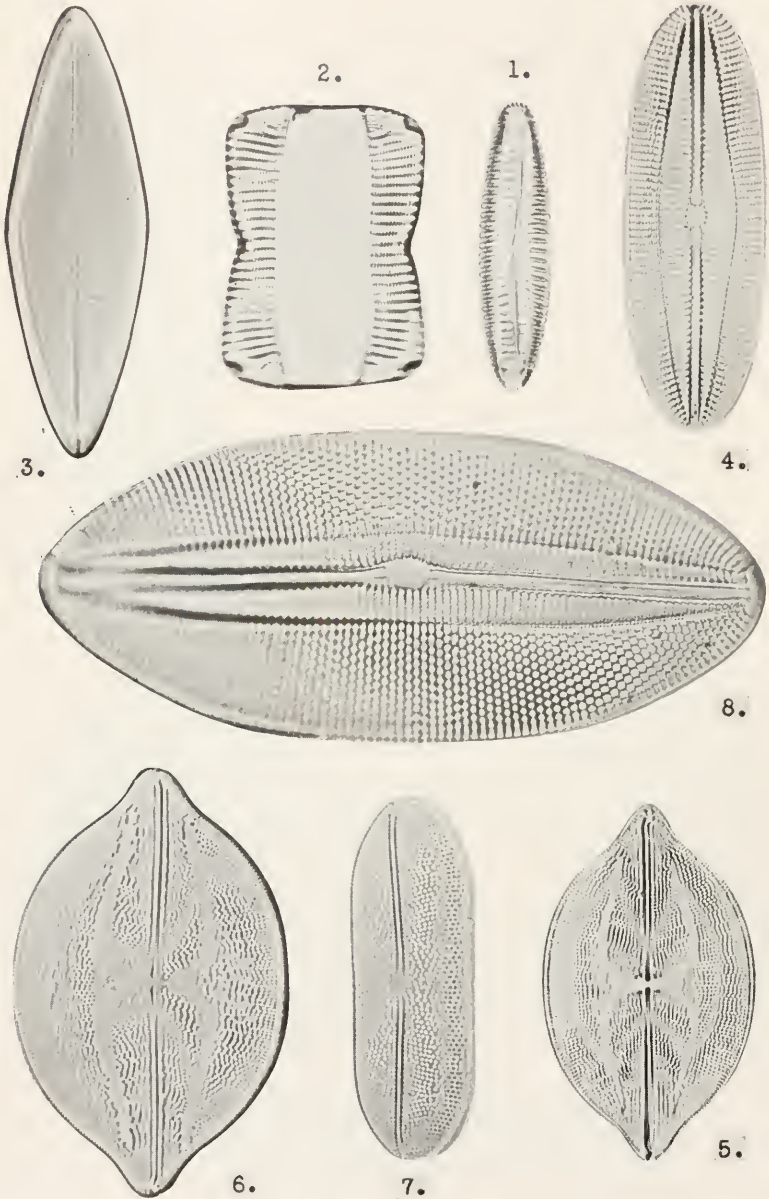
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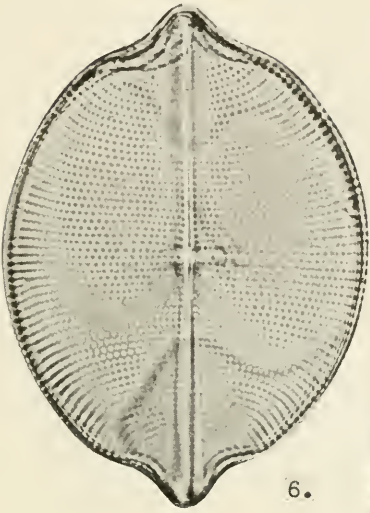
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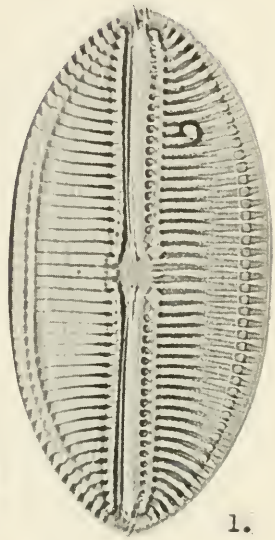


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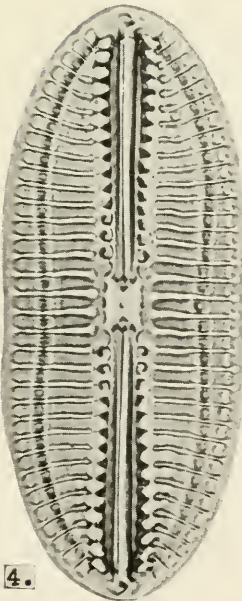
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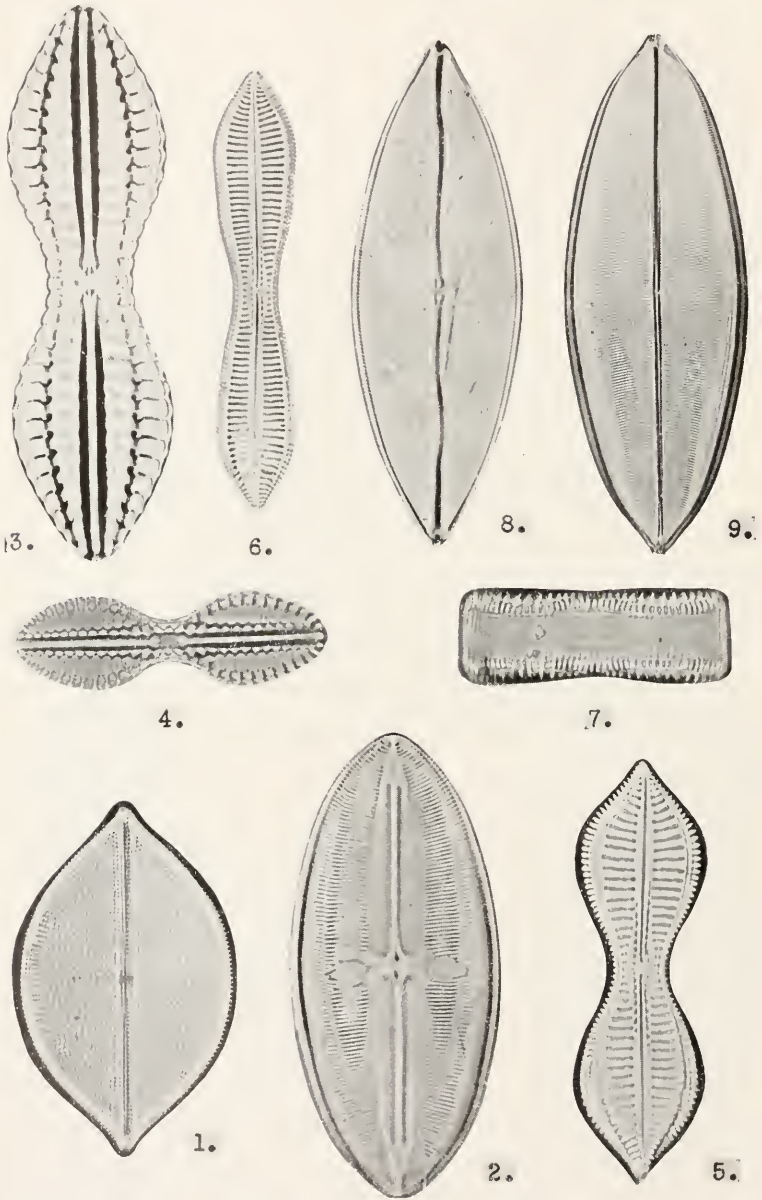
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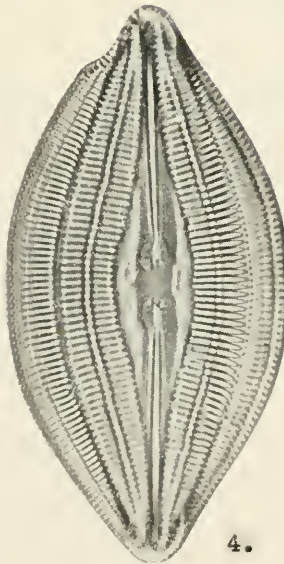
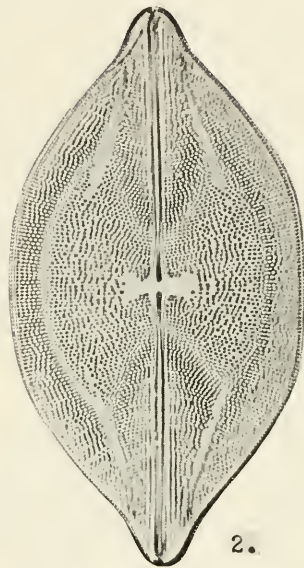
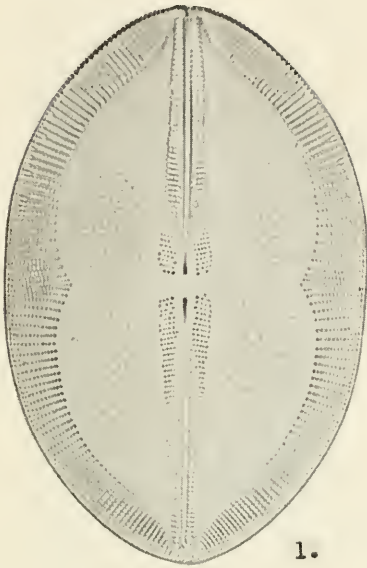
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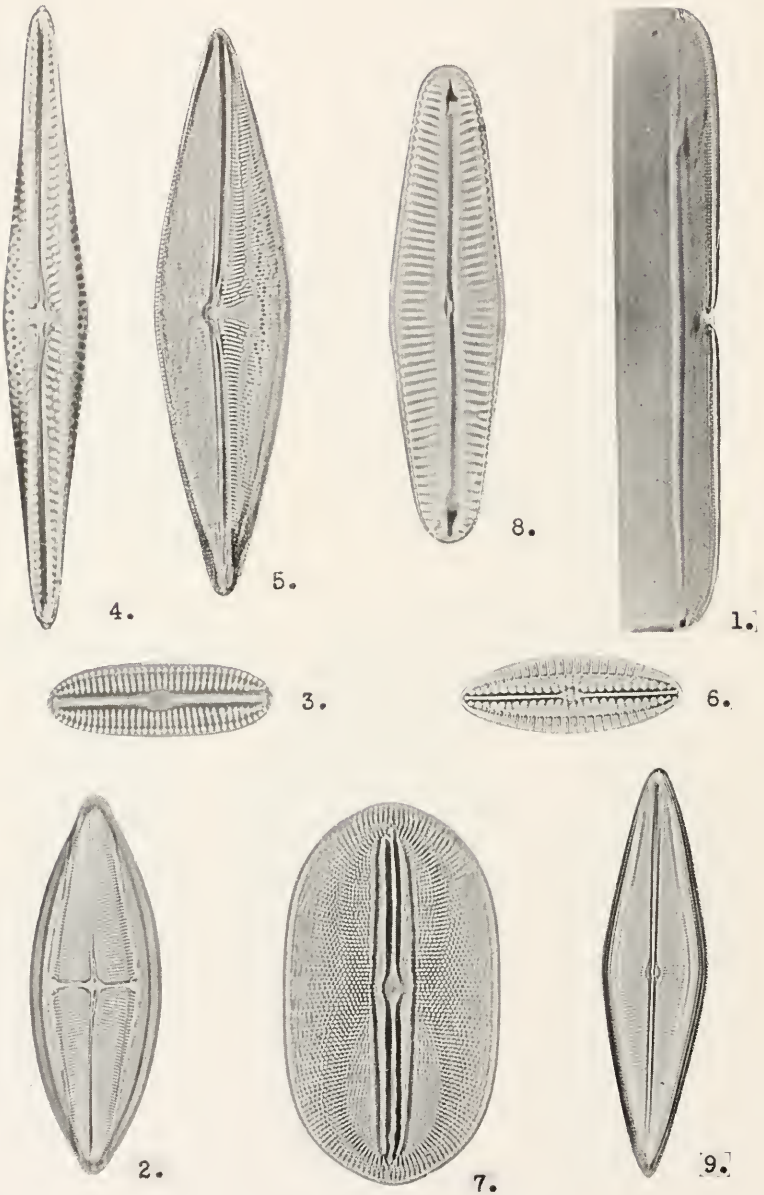
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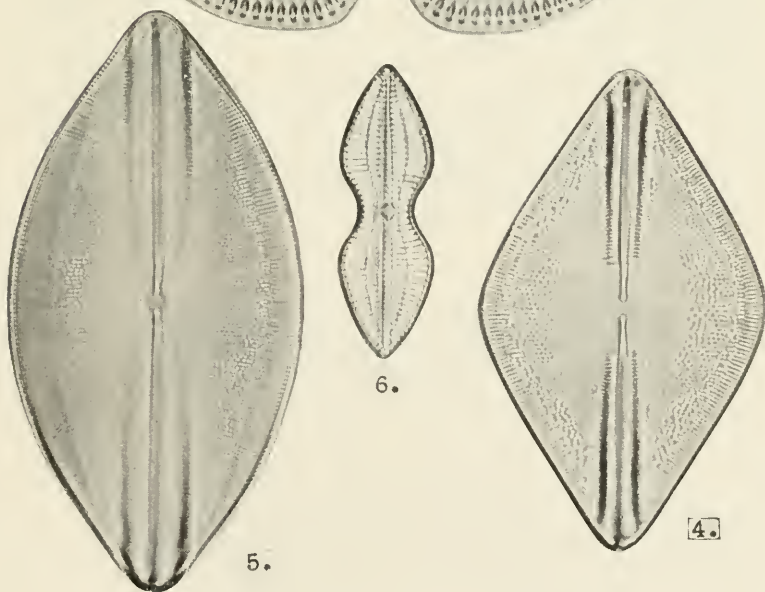
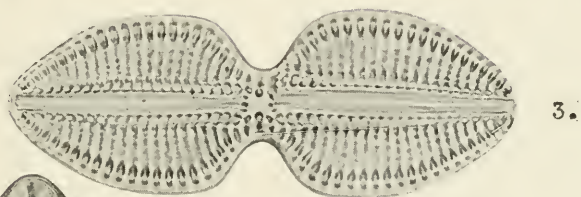
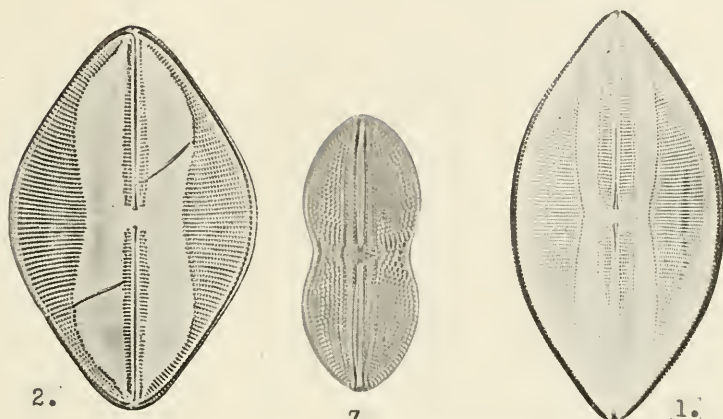
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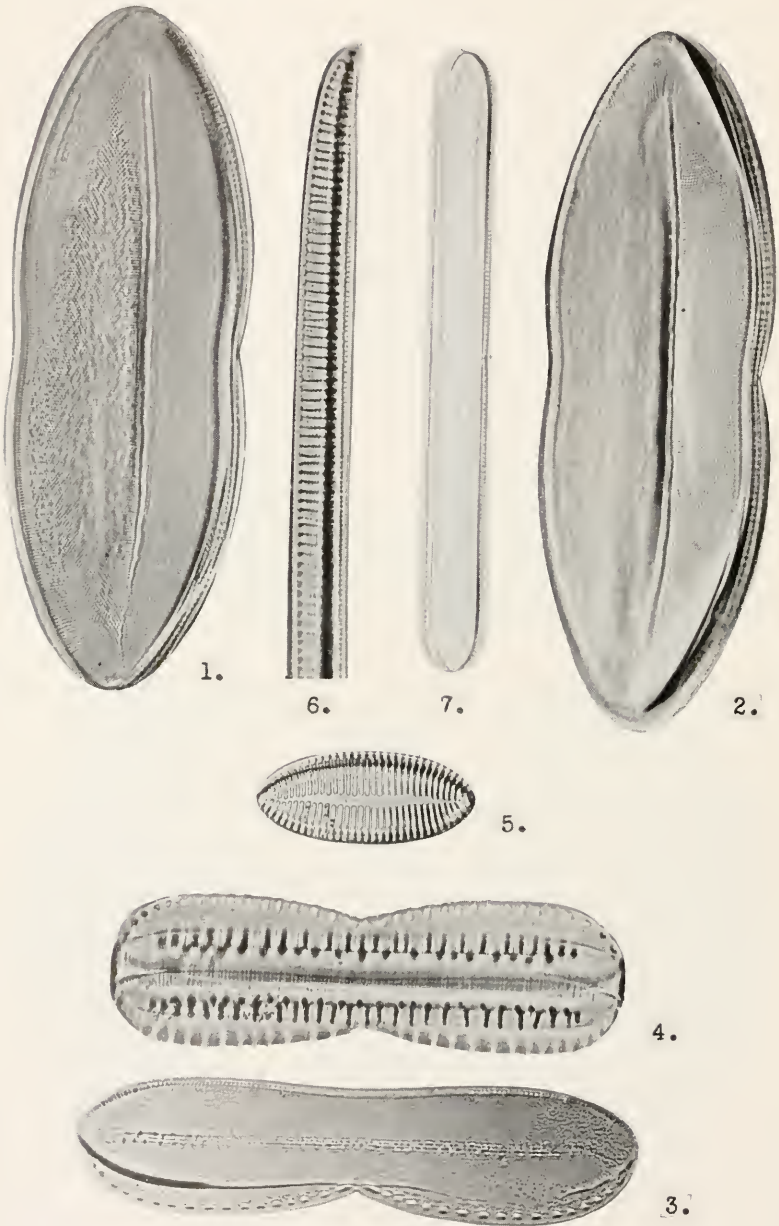
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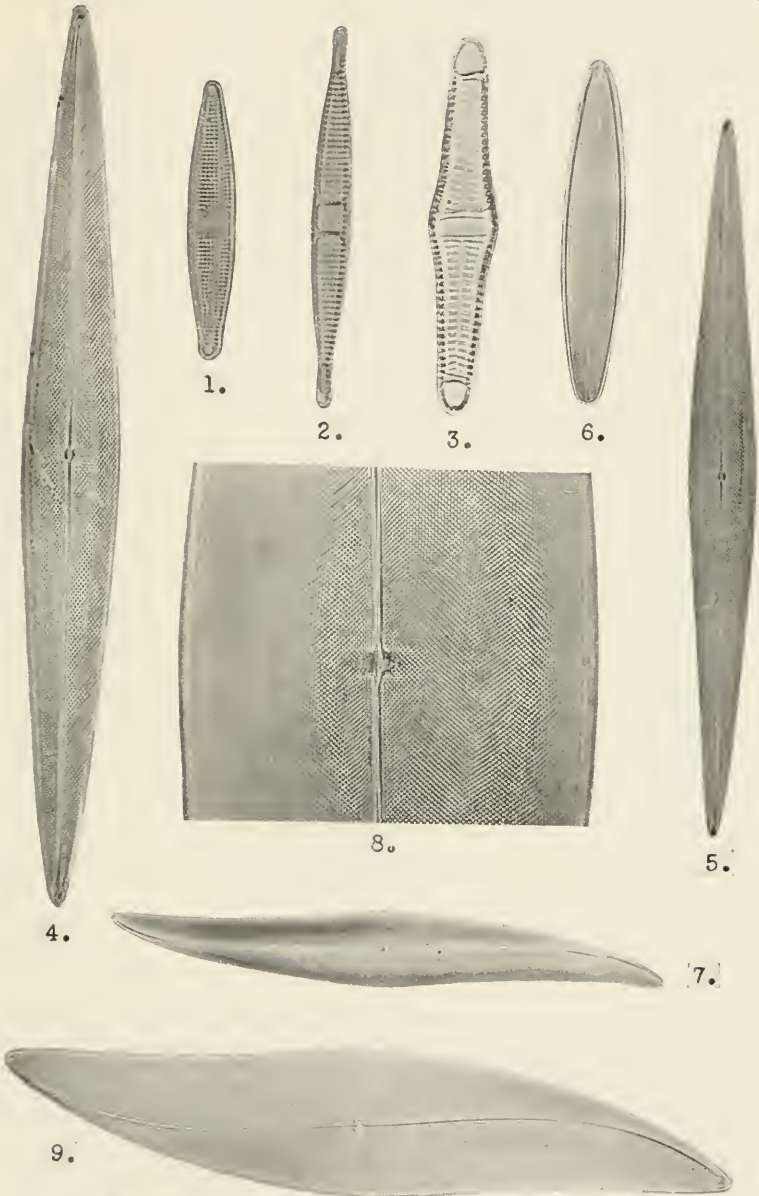
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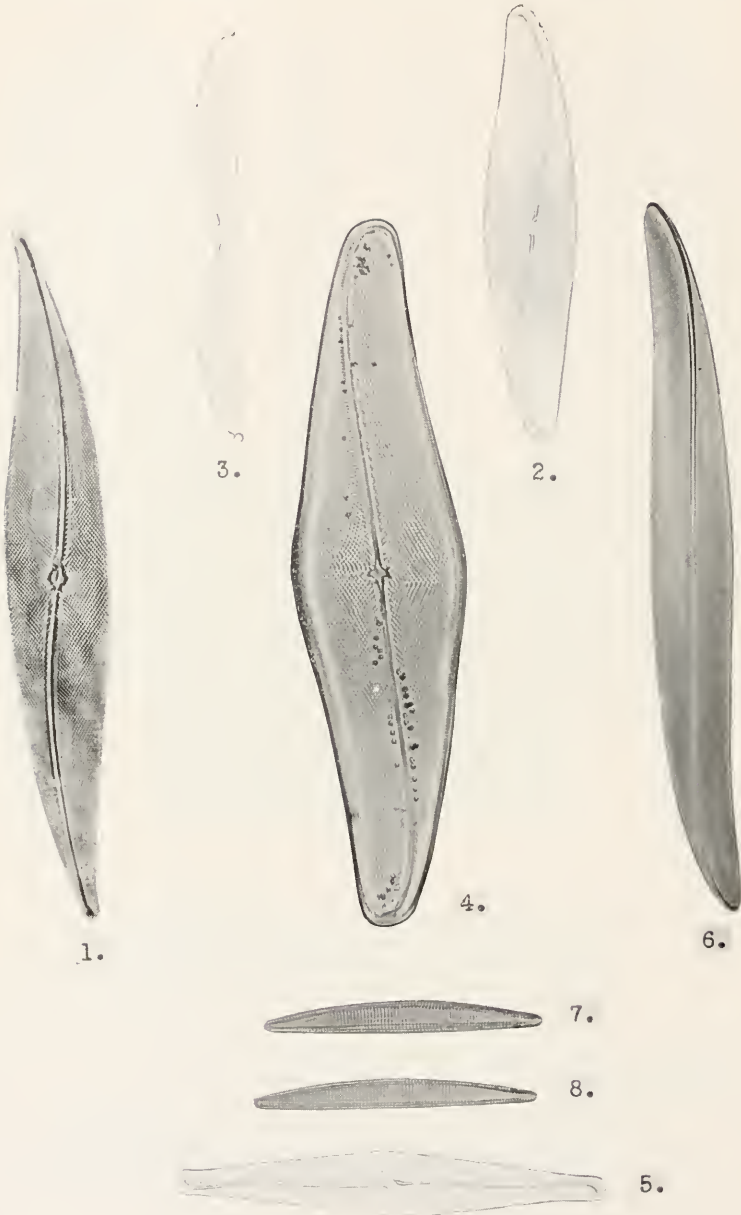
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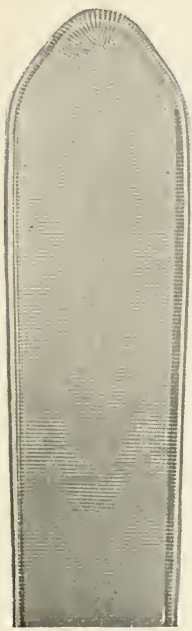
DIATOMS OF THE PHILIPPINE ISLANDS

FOR EXPLANATION OF PLATE SEE PAGE 181



DIATOMS OF THE PHILIPPINE ISLANDS

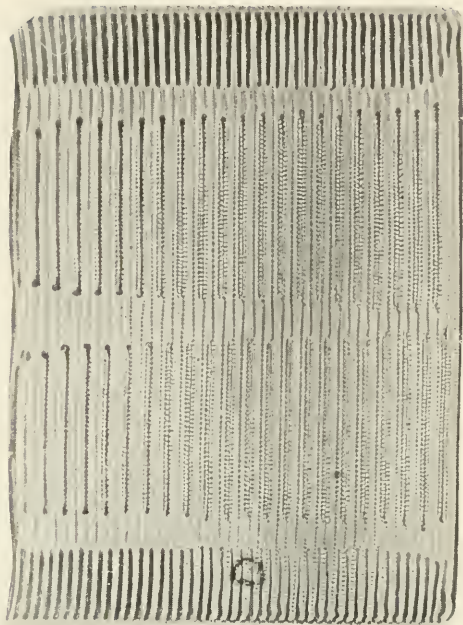
FOR EXPLANATION OF PLATE SEE PAGE 181



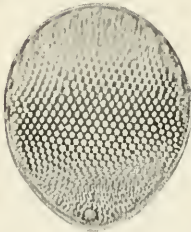
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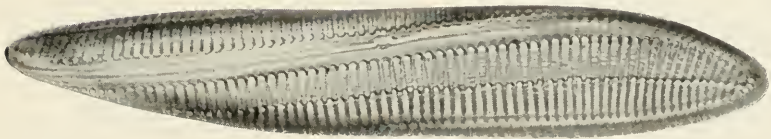
2.



1.



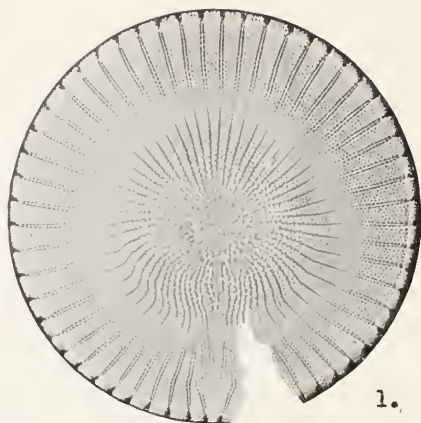
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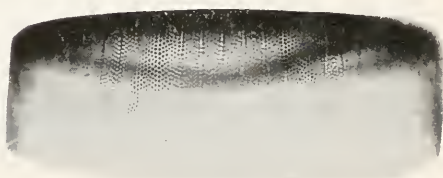
5.

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1.



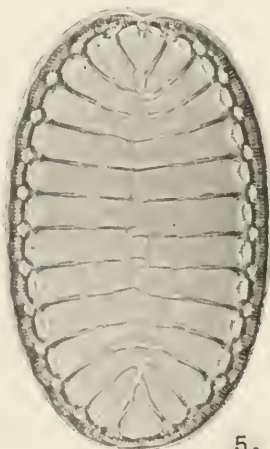
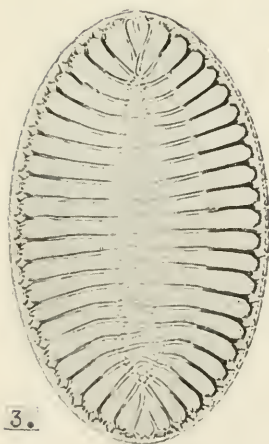
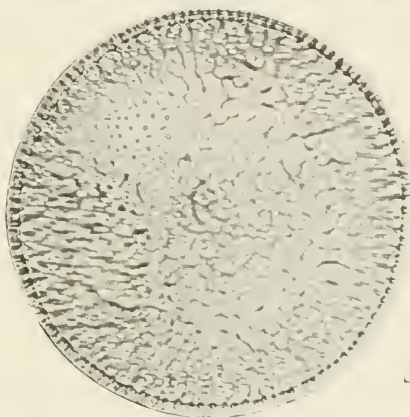
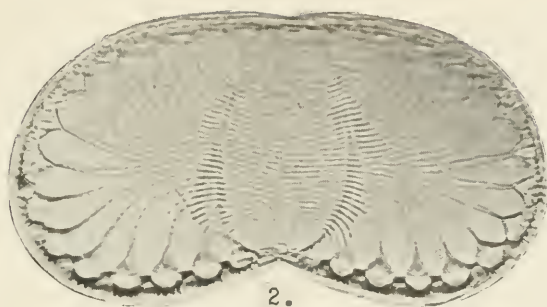
2.



3.

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FOR EXPLANATION OF PLATE SEE PAGE 181

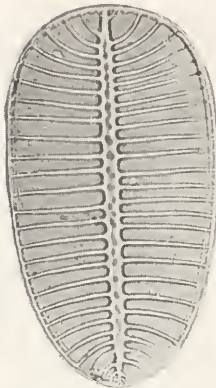


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1.



2.



3.



4.

7.

6.



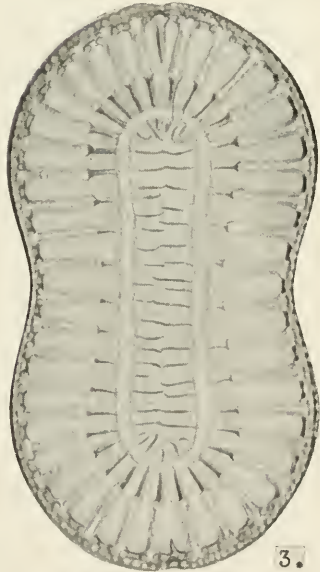
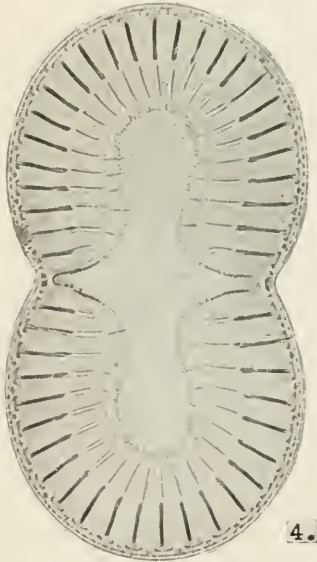
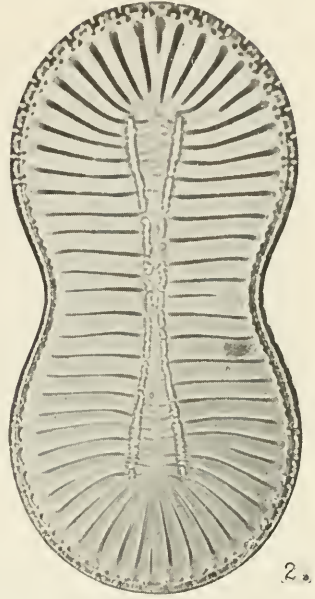
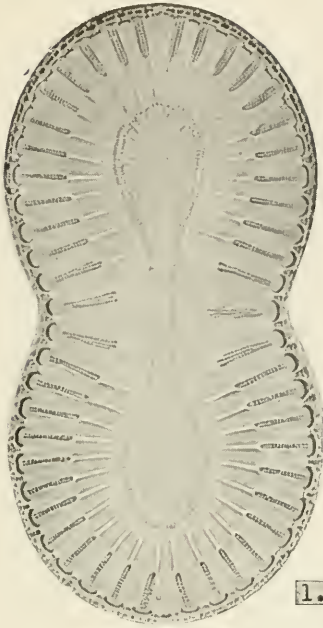
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DIATOMS OF THE PHILIPPINE ISLANDS

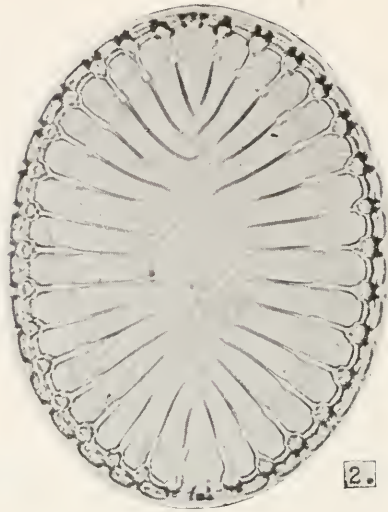
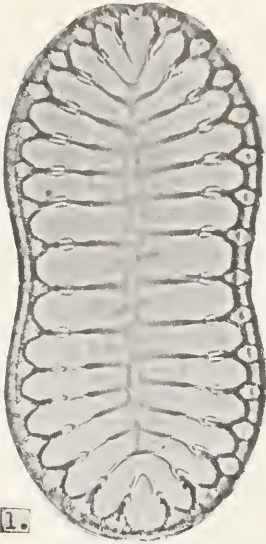
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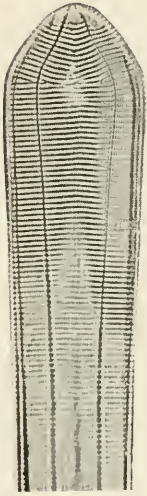
DIATOMS OF THE PHILIPPINE ISLANDS

FOR EXPLANATION OF PLATE SEE PAGE 182

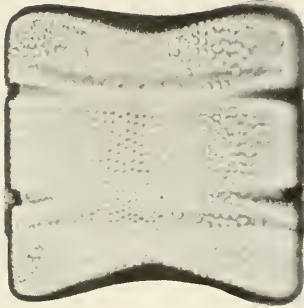


DIATOMS OF THE PHILIPPINE ISLANDS

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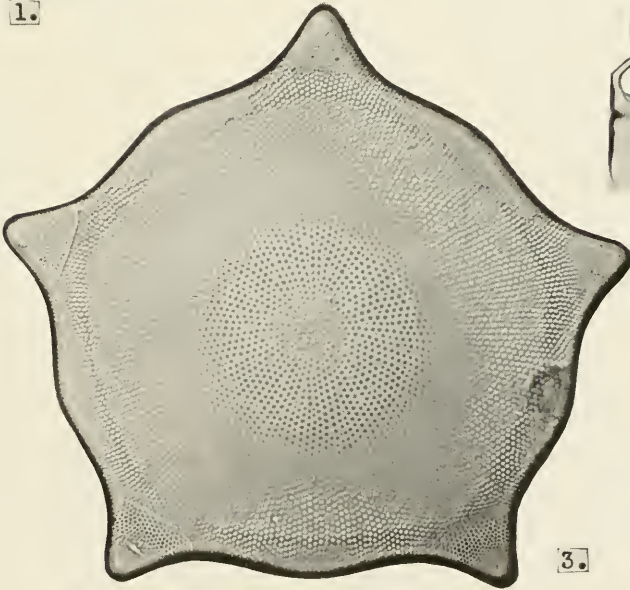
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4.



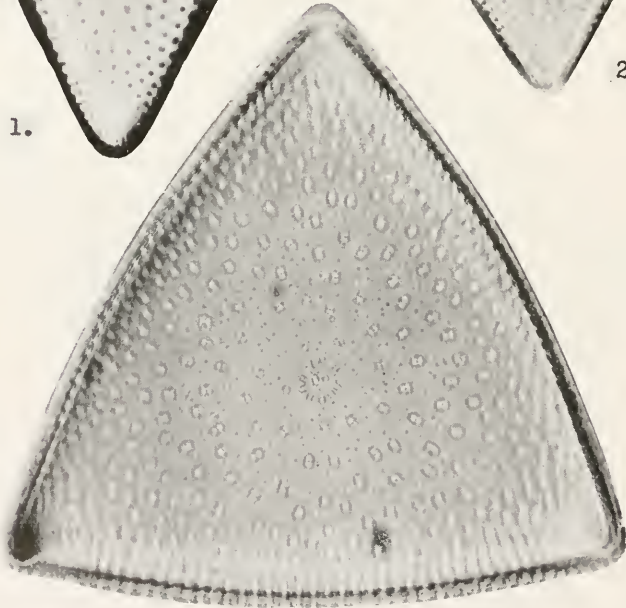
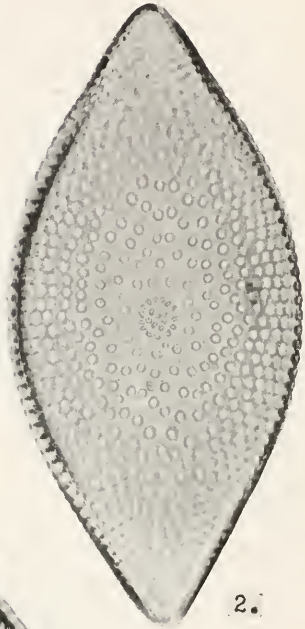
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3.

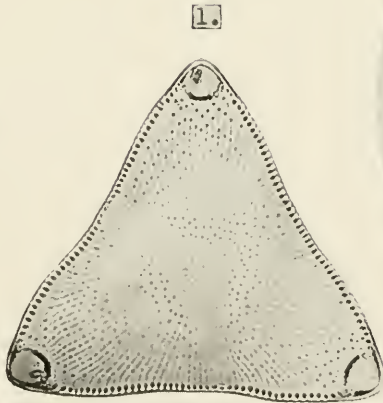
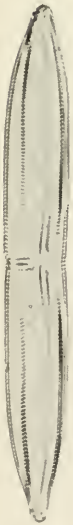
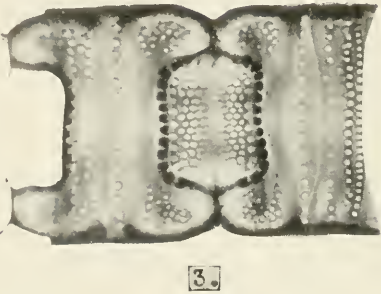
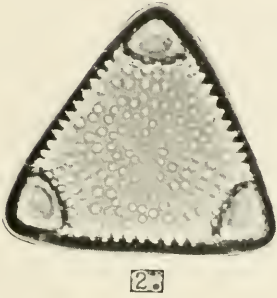
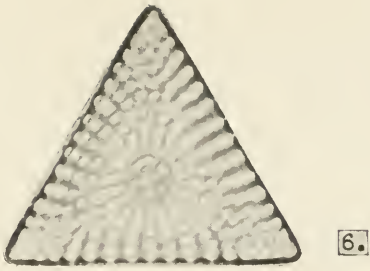
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FOR EXPLANATION OF PLATE SEE PAGE 182



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