**American Bacillaria. Pt. III. Echinellea and Lacernata / by J.W. Bailey.**

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# AMERICAN BACILLARIA:

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## PART III. ECHINELLEA AND LACERNATA.

# AMERICAN BACILLARIA.

## Part III.

The animalcules which form the subject of this part of my sketch of American Bacillaria, belong to the sections Echinellea and Lacernata.

The section Echinellea contains those Bacillaria which are *fixed*, that is, attached either by their extremities, or by a pedicel, to other bodies. They are all siliceous.

The section Lacernata includes those which have a double covering. They consist of groups of siliceous individuals, surrounded by a common gelatinous mass, or enveloped by a membranous tube.

As many species of each of these sections are often found spontaneously or accidentally separated from their pedicels or tubes, there is great chance of mistaking them for species of Naviculacea.

## Sect. III. ECHINELLEA.

### Isthmia.

*Fixed by one end, carapace or lorica siliceous, simple, broader than long, catenate by imperfect spontaneous division, individuals making various angles with each other, and connected by a narrow isthmus or neck-like process.*

Two species of this genus have been detected, viz. *I. enervis*, and *I. obliquata*. Neither of these have, to my knowledge, yet been detected in the United States; but as the latter is a pelagic species which has been found in places so different and distant from each other as Iceland, England, the Canary Islands, Cape of Good Hope, &c. there can be little doubt that it will yet be found growing on some of our marine Algæ. The first specimen which I ever saw, I detected on a dry specimen of Odonthalia dentata from Iceland. I have since received fine English specimens from E. J. Quekett, Esq. of London. Few microscopic objects exceed in beauty these little gems of the ocean. I have proved that their carapace is siliceous by the proper chemical

tests. A good idea of the general form of this genus may be got from Plate 4, fig. 153, of Pritchard's Infusoria.

### Synedra.

*Carapace simple, siliceous, fixed when young by one extremity, when older often free, longer than broad, foot either wanting or rudimentary, form elongated or prismatic.*

*Synedra* ——— ? (Pl. 3, fig. 1.)* Frustules long, slender, linear, adhering laterally into plates which are supported by a short fleshy pedicel, and terminated by a fleshy mass.

The species whose usual appearance is shown in Pl. 3, fig. 1, occurs in vast quantities on various Algæ in the Hudson River at West Point. It usually completely envelopes the plants to which it is attached, giving them a covering of bristling crystal-like particles, through which it is often difficult to see any portion of the supporting plant. When the Algæ on which it grows are dried, they often have a greenish gray hue, from the presence of this parasite.

It presents considerable resemblance to S. Gailloni, Ehr. (Diatoma crystallinum, Ag.) and has, like that, minute striæ on the edges, but I have seen no allusion made in the descriptions of that species to the fleshy projection which is so conspicuous in our species.

A person who sees how abundant this species is in the recent state, will no longer wonder that in the lapse of years masses of infusorial shells should accumulate so as to form extensive strata.

*Synedra* ——— ? (Pl. 3, fig. 2.) Frustules linear, strait, striate, truncate on the lateral side, ventral sides with a neck-like contraction near each end, ends rounded.

This species is very abundant in fresh water near West Point, often covering aquatic plants with a glittering envelope of crystal-like frustules. The individuals are perfectly linear with truncate ends. When seen laterally, they show near their extremities a slight contraction, which forms a neck supporting the round or knob-like terminations. Minute striæ may be seen as represented in the figure.

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* Plate III, which accompanies this part of Prof. Bailey's article, is also marked V in the series of plates contained in the present volume of this Journal. Plate III is marked at the bottom and plate V at the top of the plate.—Eds.

This species presents many points of resemblance both to Synedra ulna and Fragillaria rhabdosoma of Ehrenberg, but I cannot identify it positively with either.

PODOSPHENIA.

*Carapace simple, siliceous, cuneiform, fixed when young by one end, afterwards often free, longer than broad, pedicel small, hemispherical, or wanting.*

In Pl. 3, fig. 3, is represented a species which agrees with the above generic characters, and which I therefore place here, although it is a fluviatile production, while all of Ehrenberg's species are marine. It invests stones, &c. in small streams near West Point with a yellowish green covering, which appears like a mere stain, but which when scraped off with a knife, is seen to be composed of excessively minute frustules resembling those of Gomphonema, but which have no perceptible pedicel.

GOMPHONEMA.

*Carapace simple, siliceous, cuneiform, fixed upon a distinct filiform branching pedicel, dichotomous by spontaneous division.*

1. *Gomphonema minutissimum.* (Pl. 3, fig. 4.) Smooth? corpuscles cuneiform, curved, clavate, $\frac{1}{144}$ to $\frac{1}{72}$ line.

A minute species agreeing closely with Kutzing's figure of G. minutissimum, (see Linnea, 1833, fig. 43,) occurs abundantly on various aquatic plants in the Hudson River at West Point. It varies much in size; fig. 4, *a*, shows the largest individuals, and fig. 4, *b*, the smaller ones.

2. *Gomphonema* ———. (Pl. 3, fig. 5, *a*, *b*.) This large and beautiful species appears to be related to G. dichotomum and to G. geminatum, but I am unable to satisfy myself of its identity with either. I found it in vast quantities at the Island of Mackinaw, Straits of Michillimackinac, on a large cedar tree which was sunk in water ten or fifteen feet deep, and which was literally covered with large waving bunches of a yellowish white color, composed of the dichotomous filaments of this species, glittering with crystal-like particles.

The individuals are striate, with one side cuneate, and showing at the broad end two interior arcuate folds; the other side is elongated, obovate or clavate, with a central circular spot and longitudinal smooth portion. The pedicel is repeatedly dichotomous.

3. *Gomphonema acuminatum?* (Pl. 3, fig. 6.) Striate, corpuscles elongated, wedgeform, end swollen and pointed, contracted on the side.

The small species (fig. 6) agrees pretty well with the above characters. It is common in ponds near West Point. I have also seen it in several American specimens of fossil infusoria.

4. *Gomphonema* ———. (Pl. 3, fig. 7.) Frustules smooth, geminate or in fan-shaped groups, one side elongated, wedge-shaped, truncate; the other side obovate; pedicel repeatedly dichotomous. Marine.

I have examined this species only in a dry state, having first noticed it on a glass slide on which I had preserved some specimens of Echinella flabellata from Stonington, Conn.

The figure is drawn from the dry specimens.

### Echinella, *Ehr.*

*Carapace simple, siliceous, fixed at one extremity to a pedicel, wedgeform, longer than broad, fan-shaped or verticillate by spontaneous division.*

1. *Echinella flabellata.* (Pl. 3, fig. 8.) Smooth, corpuscles linear, cuneiform, truncate, slightly three-toothed, striæ longitudinal, $\frac{1}{10}$ line without the pedicel. *Licmophora flabellata, Ag.* Greville in Hooker's English Flora, V, p. 408.

This beautiful marine production presents in its fan-shaped groups of crystal-like corpuscles, an exceedingly elegant appearance. The fans are supported by long flexible clavate pedicels, which are grouped together in large bunches covering filamentous marine Algæ and zoophytes.

I found it quite abundant at Stonington, Conn. in July. It is said to occur also at Scotland, Venice, and at the Cape of Good Hope.

2. *Echinella* ———. (Pl. 3, fig. 9.) Corpuscles smooth? lanceolate, truncate; pedicel short, broadly clavate, often nearly circular, supporting the radiating closely aggregated corpuscles.

I detected this very elegant species about a year since in the Hudson River near West Point, where it grows upon Potamogeton, Enteromorpha, &c. It agrees in many respects with E. fulgens, Grev., but that is described as being striate, a character which I have not perceived on our species.

### Cocconema.

*Carapace simple, bivalve or multivalve, siliceous, fixed by one end, pediculate, longer than broad, pedicel in the direction of the axis of the body.* (*Pedicellate Naviculæ.*)

When separated from their footstalks, there is no good character to distinguish them from Navicula, but the unsymmetrical

boat-shaped frustules of Cocconema will *generally* serve to identify them.

1. *Cocconema* ———. (Pl. 3, fig. 10.) Carapace lanceolate, ends obtuse, pedicels repeatedly dichotomous, secondary branches articulated to the primary ones. Striæ were not perceived.

Abundant in the Hudson River at West Point. It appears to be allied to C. lanceolatum of Agardh.

2. *Cocconema* ———. (Pl. 3, fig. 11, *a*, *b*.) These figures represent two positions of a species of Cocconema which is very common in the living state near West Point, and which also abounds as a fossil. In the living state I have but rarely seen it attached to a pedicel. It is generally free, and moves about spontaneously like a Navicula.

I once, on a cold day in October, noticed vast collections of this species which were enveloped in a mucous covering, and which formed large cloud-like masses several inches in extent, investing aquatic plants, stones, &c. Each of these masses was crowded with millions of the siliceous shells of this species.

Ehrenberg mentions C. asperum as a new species detected by him among the fossils from West Point. I am ignorant of its distinguishing features.

### Achnanthes.

*Carapace simple, bivalve, or multivalve, siliceous, prismatic, longer than broad, fixed by one end, pedicellate, pedicel oblique, ventral, always simple, opening in the middle of the body. Groups, resulting from increase by spontaneous longitudinal division, resembling chains, little banners, plates or ribbons.*

*Achnanthes brevipes.* (Pl. 3, fig. 12.) Corpuscles striate, curved in the middle, ends rounded on the dorsal and ventral sides; pedicel thick, shorter than the body.

I first noticed this species on filaments of Conferva fracta from Providence Cove, R. I., and have since found it abundant on marine Algæ from Stonington, Conn. Small specimens, differing I believe in no essential character, are also very abundant on aquatic plants in the Hudson River at West Point.

The Achnanthes longipes of authors may be a distinct species, but the distinction "pedicel longer than the body," appears to me to be founded on a character liable to much variation. I saw specimens at Stonington having pedicels much longer than the body, yet they appeared to me to agree with E. brevipes in every other respect.

### Striatella.

*Carapace simple, (siliceous,) fixed by one end, longer than broad, or nearly square, obliquely pediculate in form of little flags, corpuscles without openings in the middle, often forming zigzag chains by spontaneous divisions. (Stipitate Bacillariæ.)*

1. *Striatella arcuata.* (Pl. 3, fig. 13.) Carapace lamellar, nearly square, with three to seven longitudinal internal lines, transversely striate, polypidoms (flags) in form of ribbons, often curved, nine striæ in $\frac{1}{100}$ line. *Diatoma unipunctatum*, Agardh, Greville, &c.

This species occurs in vast quantities on filiform marine Algæ at Stonington, Conn. It covers the plants in such profusion as to make them glitter in the sunbeams as if covered with crystals. The recent frustules are not flat, but slightly convex, and are usually marked with an internal nearly circular spot, which in my specimens was yellow, not rose-colored as usually described. Considerable variation in the width of the frustules occurs even in the same ribbon. Each plate is transversely striate, the alternate lines not quite reaching to the edge. I saw numerous specimens supported by long pedicels.

## Sect. IV. LACERNATA.

### Frustulia, *Ehr.*

*Envelope double, carapace siliceous, mantle gelatinous, amorphous, corpuscles scattered or in groups.*

I have seen no American species of this genus.*

### Syncyclia.

*Envelope double, exterior mantle gelatinous, carapace siliceous, navicula-shaped, forming by spontaneous division, circular groups surrounded by gelatine.* See Pritchard's Infusoria, Plate 4, p. 206.

No American species has yet been detected.

### Naunema.

*Envelope double, carapace navicula-shaped, siliceous; mantle gelatinous, exterior, tubular; tubes filiform, separate, branching,*

* My opportunity to study the marine Bacillaria, has been very slight. I presume therefore, that many marine forms not noticed by me during the two days which I spent at Stonington will yet be detected, and among them will probably be species of Frustulia, Syncyclia and Schizonema.

*confervoid, resulting from perfect division of the carapace, and imperfect division of the mantle.*

In this genus, corpuscles which cannot be distinguished from those of Navicula are assembled together in vast numbers, in flexible membranous tubes, within which they may often be seen to move freely. They doubtless often leave these tubes, and then appear like species of Navicula.

I have noticed several American species, but I am unable to decide whether they are identical with any hitherto described, as I have had very little opportunity to study our species in a living state and have no foreign specimens or figures to compare them with. I shall therefore content myself with merely giving the forms of the frustules found in each species, and such additional particulars as seem most interesting.

1. *Naunema* ———. (Pl. 3, fig. 14.) The figure represents corpuscles from a branching species found on the shores of Staten Island, N. Y. The tubes are whitish, containing long rows of corpuscles, strung end to end, each of which contains two round globules looking like air-bubbles. No trace of striæ.

2. *Naunema* ———. (Pl. 3, fig. 15.) This figure shows the form of corpuscles which filled short robust unbranched filaments, which were exceedingly lubricous. Bunches of filaments about half an inch in length, were found in great abundance on Zostera, &c. at Stonington, Conn.

3. *Naunema* ———. (Pl. 3, fig. 16.) This figure shows the outline of dried corpuscles from a specimen obtained at Stonington, Conn., where it is very common. Its filaments are branched and form larger and longer bunches than the preceding, with which it occurs.

4. *Naunema* ———. (Pl. 3, fig. 17.) This is from specimens found in immense quantities in the Hudson River, at West Point. The masses have not the green color of the two preceding species, but present a rich brown color. The frustules are in all respects like those of Navicula, and I have often seen them move spontaneously in their tubes, some going one way and others another.

In Pl. 3, fig. 17, *a*, is shown the outline of much longer frustules, found in tubes similar to those just mentioned.

### Gloeonema.

*Envelope double, carapace siliceous, mantle tubular, tubes simple, often branched, corpuscles curved, resembling* Cocconema *in a tube.*

Mr. Berkely has recently published (Ann. and Mag. Nat. Hist. Vol. 7, p. 449) some interesting observations, by which he appears to have proved that the only species of this genus, the singular *G. paradoxum*, consists merely of rows of ova of some aquatic insect. He watched their development into larvæ. I have not seen American specimens.

SCHIZONEMA.

*Envelope double, carapace siliceous, mantle tubular, tubes united in bundles, split in some places so as to appear branched, corpuscles like those of* NAVICULA.

No American species has yet been detected by me.

*End of the Bacillaria.*

It was my intention when I commenced the above sketch, to give in connection with it, an account of all the American localities of fossil infusoria, but further reflection has convinced me that this labor is unnecessary. All our fluviatile deposits of fossil infusoria, contain nearly the same species, and all these species are now living. From the great range which the living species have been shown to have in our country, there is great probability that all of the siliceous ones may be detected, if carefully sought for in any of the specimens of fresh-water infusorial deposits. As for the localities at which these fossil infusoria occur, it does not appear that a particular enumeration is necessary. The living animals inhabit in great quantities almost every place where water remains several months in the year, their indestructible shells are therefore to be found in greater or less quantity in the sedimentary deposits of all our bogs, ponds and slow streams. These deposits are most remarkable beneath peat bogs, where they constitute strata many feet in thickness, and of great extent, often composed entirely of the siliceous carapaces of animals so minute that millions of them exist in a cubic inch. The "siliceous marl" which they form, is often so white and light as to be mistaken for magnesia, and Dr. Jackson states that it has actually been sold as such to apothecaries, who were much surprised when informed by him that not a particle of magnesia was present.

Among the vast number of fluviatile localities now known, I think it necessary to allude only to the following, viz. West Point, from which specimens have been examined by Ehrenberg,

whose list of the species is given in this Journal, Vol. xxxix, p. 193; Blue Hill Pond, and various other localities in Maine, discovered by Dr. Jackson; Manchester, Spencer, Wrentham, Bridgewater, Andover, &c. in Massachusetts, discovered by Prof. Hitchcock, and Smithfield and other places in Rhode Island, discovered by Owen Mason, Esq. The largest and most conspicuous species from all these localities are Navicula viridis, Pl. 2, fig. 16, Navicula ——? Pl. 2, fig. 23, Cocconema ——, Pl. 3, fig. 11, Eunotia arcus, Pl. 2, fig. 26. With these occur various smaller species, and numerous siliceous spiculæ of fresh-water sponge, Pl. 3, fig. 18, *a* to *d*, and other siliceous bodies of organic origin, such as the Amphidiscus rotula of Ehrenberg, Pl. 3, fig. 20, and others whose nature is unknown, but which I suspect to be of vegetable origin, perhaps prickles of aquatic grasses. See Pl. 3, figs. 21, 22 and 23.

The most interesting American deposit of fossil infusoria, is the "infusorial stratum" discovered by Prof. W. B. Rogers, of the University of Virginia. It is peculiarly interesting from its vast extent, the beauty of its species, and from its belonging to the marine tertiary formations. All other American fossil infusoria yet discovered are of fluviatile origin, and of the most recent date.

I have already pointed out the striking correspondence between the fossils of the infusorial stratum of Virginia with those of Oran in Africa. This is shown by the occurrence of vast quantities of various species of Coscinodiscus and Actinocyclus, with Gaillonella sulcata? &c. Believing that it will be of great interest to geologists both at home and abroad to trace out this correspondence of the fossils of regions so far distant, and of beds which are at present referred to different epochs,* I have added to my plate 3d, a number of figures of siliceous bodies not before described, found in the infusorial stratum of Virginia. The following is a brief account of these bodies.

In Pl. 3, fig. 24, *a*, *b*, *c*, are shown different views of small siliceous bodies, which are quite frequent in the infusorial deposits both of Richmond and Rappahannock cliffs. They consist of a concave rhomboidal body, formed of open work, or with large

* Ehrenberg refers the infusorial conglomerates of Oran, &c. to the *chalk* formation, but Rozet considered them as *tertiary* deposits, and Prof. Rogers states that the beds discovered by him separate the *miocene* from the *eocene* tertiary beds of Virginia.

perforations, and having at the extremities projecting spines. I suspect that these belong to the genus Dictyocha of Ehrenberg, several species of which occur at Oran, Caltasinetta, &c.*

Pl. 3, fig. 25, shows a siliceous ring with projecting spines; it is possibly a fragment of the preceding.

Pl. 3, fig. 26, shows a circular ring connected with a concentric hexagon by six rays proceeding from the angles of the hexagon. The spaces within the hexagon and below the rays are perforations. It is possibly another species of Dictyocha. It occurs occasionally among fossil infusoria from Richmond and Rappahannock cliffs.

Pl. 3, fig. 27, shows a curious fragment apparently siliceous, having a campanulate form with a projection at the apex, and pierced with large holes. Fig. 28 shows an ovoid body perforated by similar holes. Of the nature of these curious fossils, I am entirely ignorant. They occur with the preceding.

Pl. 3, fig. 29, shows a triangular binary siliceous body, resembling some of the fluviatile species of Euastrum. The surface is covered with minute dots, some of which form lines leading from the centre to the angles. Perhaps this belongs to Ehrenberg's genus Triceratium, of which species occur fossil at Oran, and living in Cuxhaven.

In Pl. 3, figs. 30 to 35 show siliceous bodies which are quite abundant with the preceding forms, and which I suspect are spiculæ of marine sponges. Many of them show a central perforation, like that in the spiculæ of Spongilla.†

Other interesting forms occur in the infusorial strata of Virginia, but the limits of this paper will not allow me to present any more of them at present. I have transmitted specimens from Richmond to Ehrenberg, and he will doubtless determine to what extent the African and American beds agree in their microscopic fossils. As the infusorial strata of Virginia belong decidedly to the tertiary epoch, and yet appear to agree remarkably with what Ehrenberg considers as chalk marl from Oran, a revision of the evidence upon which the siliceous infusorial conglomerates of Africa and the south of Europe were referred to the cretaceous

* Since the above was in type, I have seen Ehrenberg's figures of several species of Dictyocha in the Berlin Transactions, and find them to agree with the bodies above referred to.

† I have reason to believe that similar siliceous spiculæ occur in vast quantities in the external rays of some species of Actinia.

group, appears necessary. Should the true age of either the American or African deposits be determined by means of the fossil infusoria, it will be an additional instance of the importance of this branch of microscopic paleontology. It has been well remarked that the microscrope is now as important an instrument for the geologist as the hammer; and indeed the results obtained by microscopic observation of coal, fossil wood, teeth, polythalamia, and infusoria, prove the truth of this remark. The question *cui bono?* to what useful end are your pursuits? can now be triumphantly answered by the lover of microscopic research; but happily, to use the words of the Hon. W. H. Harvey,* the class who now ask this question to naturalists "is neither so numerous or respectable as it was thirty years ago; it is becoming every day less so, and will soon be confined to the ignorant and the sensual." In the language of another distinguished philosopher,† "the time is past when the utility or dignity of such pursuits can be affected by a sneer at the littleness of their objects, as they seem little in the eyes of the indifferent and the ignorant. Every thing is great or small only by comparison; the telescope teaches us that the world is but an atom, and none know better than microscopical observers that every atom is a world."

*Note.*—Portions of the above paper were read before the Association of American Geologists at their meeting in Philadelphia in April, 1841.

*Explanation of Plate* 3.—The figures of this plate were drawn by means of the camera lucida, and to the same scale as was used in Plates I and II.

Fig. 1. Synedra ——. One group of frustules, with part of another, parasitic on aquatic plants in the Hudson River. *a*, fleshy base; *b*, fleshy projection at the summit. Brackish water.

Fig. 2. Synedra ——, *a*, *b*, different positions. Fresh water, also fossil.

Fig. 3. Podosphenia? possibly a Gomphonema. Fresh water.

Fig. 4. Gomphonema minutissimum, *a*, largest size; *b*, smaller individuals. Hudson River near West Point.

Fig. 5. Gomphonema ——, *a*, *b*, different positions; 5 *c*, sketch of a group of individuals with the branching pedicels.

Fig. 6. Gomphonema acuminatum, *a*, *b*, different positions. Fresh water, also fossil.

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* Manual of British Algæ, by the Hon. William Henry Harvey.

† Richard Owen, Esq. Address before the Microscopic Society of London, 1841.

Fig. 7. Gomphonema ——, 7 *a*, another view of a frustule. Marine, Stonington, Conn.

Fig. 8. Echinella flabellata, a single group. Fig. 8, *b*, a sketch of several groups slightly magnified, drawn from the living specimen. Marine, Stonington, Conn.

Fig. 9. Echinella ——, a group parasitic on an aquatic plant. Fig. 9, *a*, *b*, different positions of a single frustule. Hudson River.

Fig. 10. Cocconema ——, group supported on the branching pedicel. Hudson River.

Fig. 11. Cocconema ——, *a*, *b*, two positions of an individual separated from its pedicel.

Fig. 12. Achnanthes brevipes, several groups parasitic on a Conferva; *b*, a larger pair; *c*, back view. Stonington, Conn., Hudson River, &c.

Fig. 13. Striatella arcuata. Marine, Stonington, Conn.

Fig. 14. Naunema ——, *a*, *b*, two positions of the frustule separated from its tube. Marine, Staten Island, N. Y.

Fig. 15. Naunema ——, *a*, frustule separate from its tube. Stonington, Conn.

Fig. 16. Naunema ——, *a*, *b*, two positions of a single frustule. Stonington, Conn.

Fig. 17. Naunema ——, group of frustules within their tube. West Point, N. Y.

Fig. 17, *a*. Naunema ——, single frustule. West Point.

Fig. 18, *a* to *d*. Spiculæ of Spongilla or fresh-water sponge.

Fig. 19, *a*, *b*. Probably spiculæ of another species of Spongilla. *b*, group of three individuals.

Fig. 20. Amphidiscus rotula of Ehrenberg, probably derived from a Spongilla. Fossil at West Point, near Boston, Wrentham, &c., also in South America.

Fig. 21 to 23. Siliceous bodies of organic origin, found with fossil fresh-water infusoria.

Fig. 24. Dictyocha fibula? Ehr., common among fossil marine infusoria in the infusorial stratum of Virginia at Richmond and Rappahannock cliffs.

Fig. 25. Fragment of the preceding.

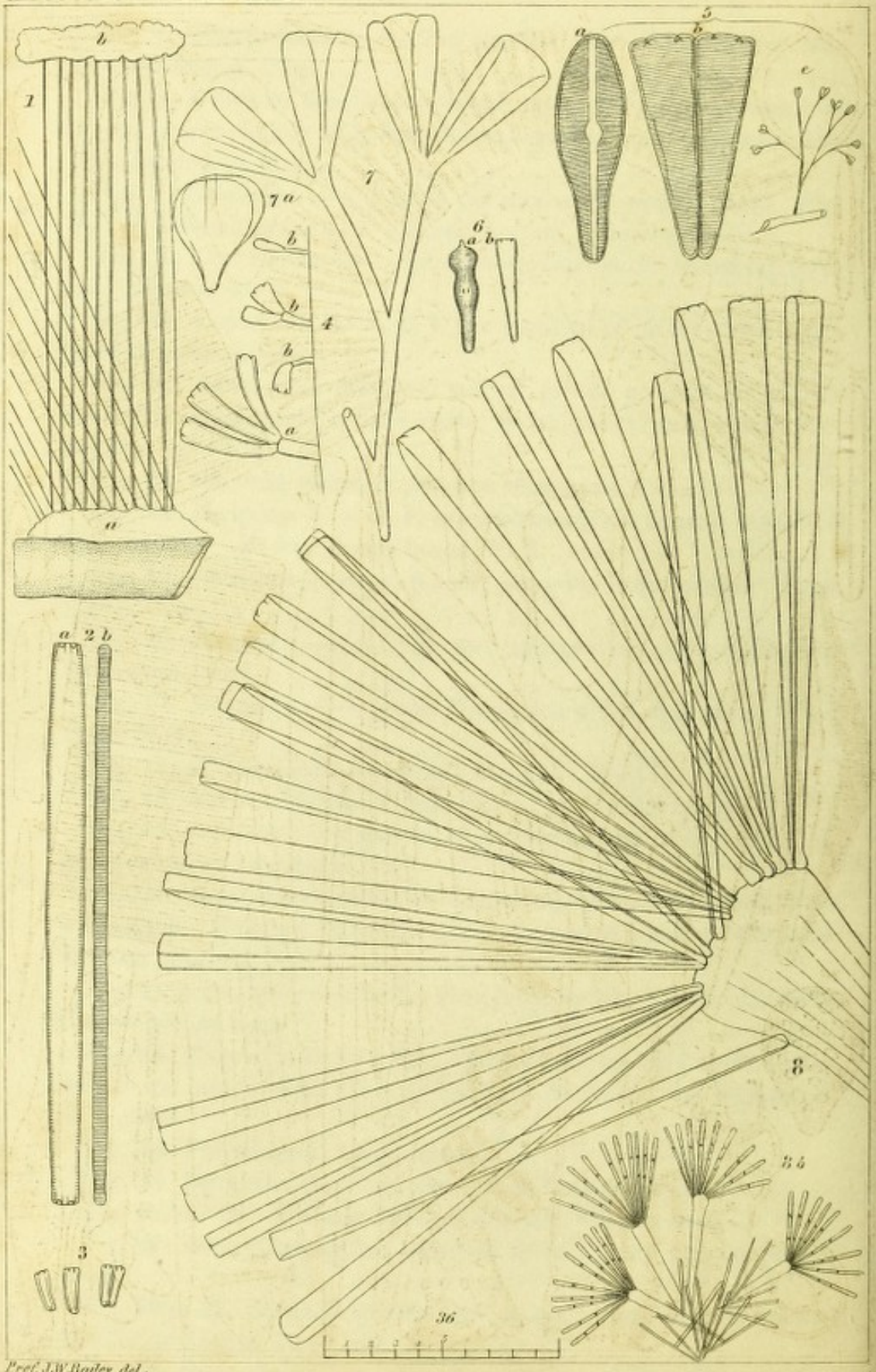
Fig. 26. Dictyocha speculum, Ehr., with the preceding.

Fig. 27 and 28. Siliceous bodies, found with the preceding.

Fig. 29. Binary, triangular, siliceous bodies, found with the preceding.

Fig. 30 to 35. Siliceous spiculæ, &c. probably derived from marine sponges or Actinia, found with the preceding.

Fig. 36. Scale showing $\frac{10}{100}$ths of a millimetre, magnified equally with the drawings.




Prof. J.W. Bailey del.

Plate Third, Part Third.

ILLUSTRATIONS TO PROF. J.W. BAILEY'S

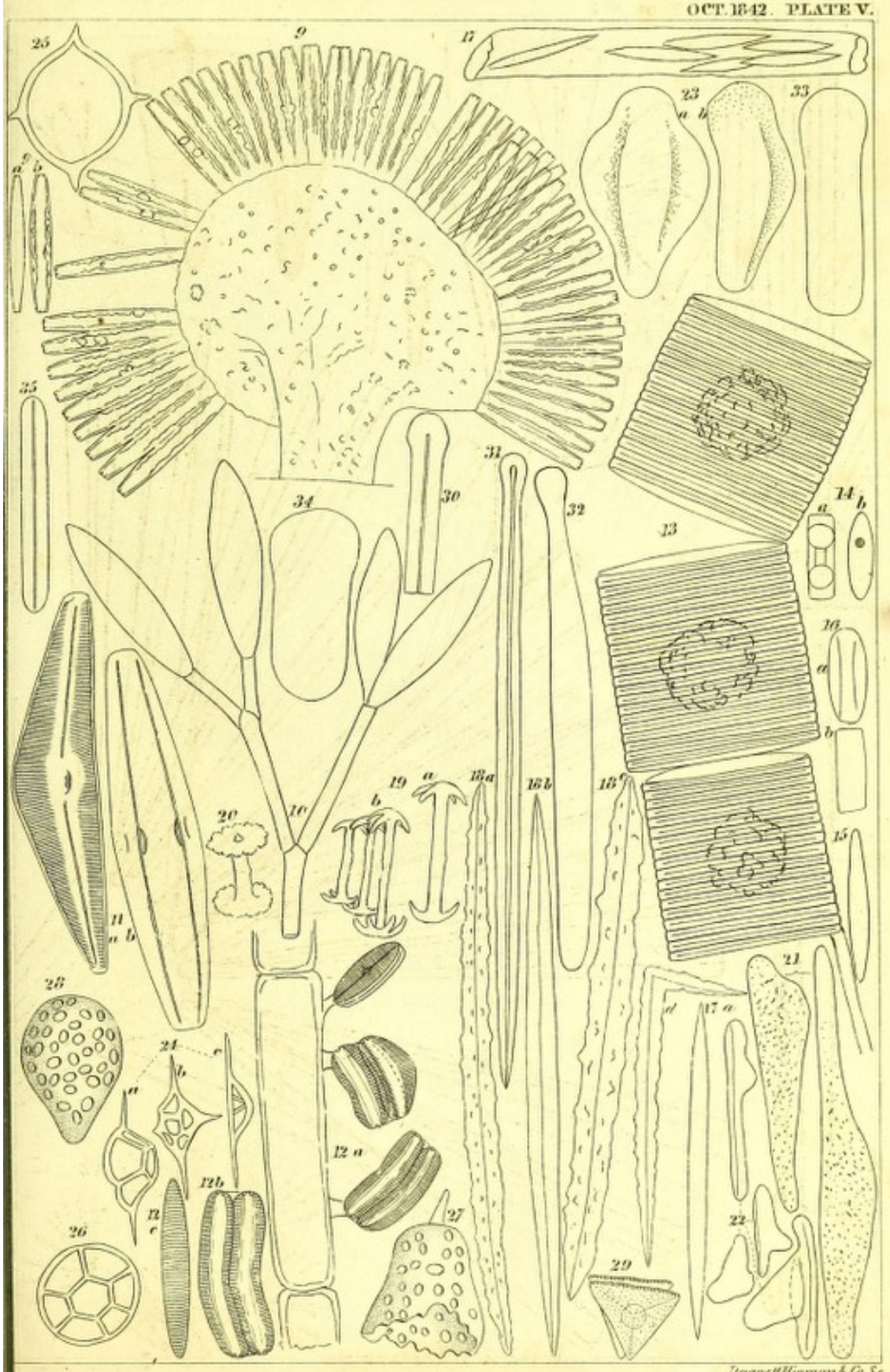



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Plate Third, Part Third

PAPER on AMERICAN BACILLARIA.