

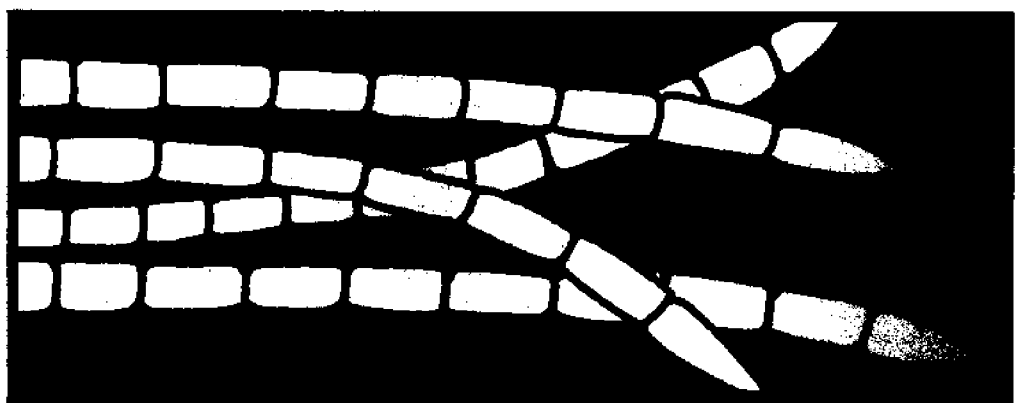
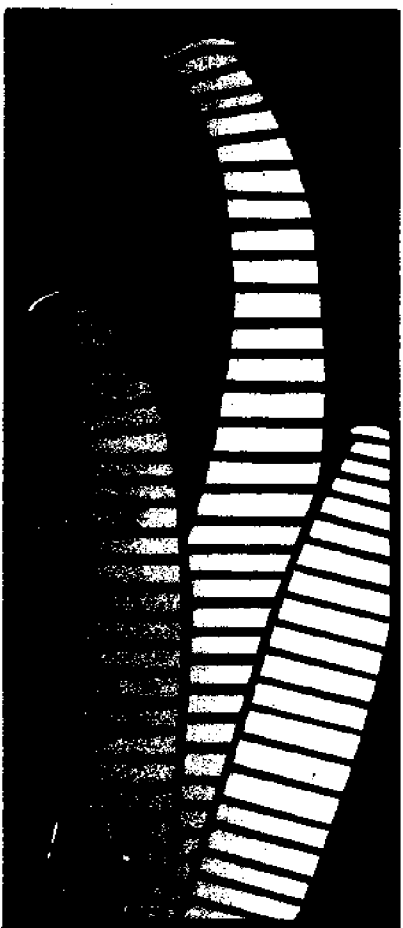
# Blue-Green Algae of the Shores and Marshes of Southern Delaware

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by R.D. Ralph

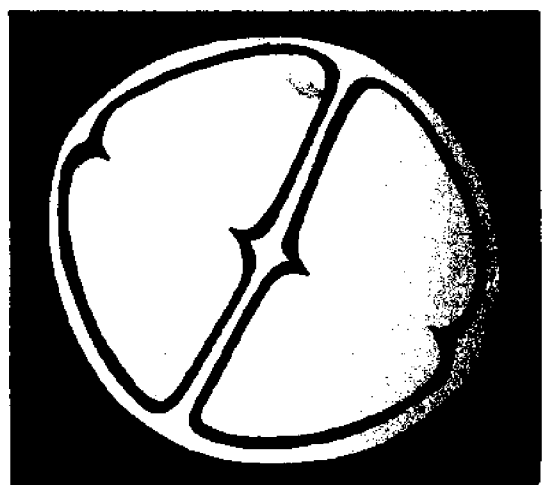
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## INTRODUCTION

### Classification

The blue-green algae are prokaryotic photosynthetic organisms which have existed relatively unchanged since the Archaeozoic era. They are closely related to the true bacteria but have been segregated into the distinct Division Cyanophyta of the Kingdom Prokaryota. The division contains only one class, the Myxophyceae (Cyanophyceae), to which all extant forms belong. The classification and nomenclature of the subordinate taxa within the class remain controversial.

A number of schemes for the classification of the Myxophyceae based on widely divergent interpretations of aspects of the morphology and physiology of the species have been proposed (Nägeli, 1849; Thuret, 1875; Bornet and Flahault, 1886-1888; Gomont, 1892; Lemmerman, 1907; Frémy, 1929 and 1934; Tilden, 1935; Elenkin, 1936; Fritsch, 1942, 1944 and 1945; Geitler, 1942; Drouet, 1951, 1968 and 1973; Drouet and Daily, 1956; Baker and Bold, 1970; Stanier et al., 1971; and, Kenyon et al., 1972). In this author's opinion, Drouet and Daily (1956) and Drouet (1968, 1973) have consistently taken the most rational approach to the taxonomy of the coccoid and certain filamentous forms. Consequently, these works have been chosen as the bases for the treatment of the taxonomy of the Chroococcaceae, Chamaesiphonaceae, Oscillatoriaceae, and the Nostocaceae with cylindrical trichomes used in this work.

The treatment of the Nostocaceae with trichomes constricted at the cross walls is derived, in lieu of a shortly forthcoming revision of this group on which Dr. Drouet is currently working, from the treatment of the Tribe Nostoceae in Bornet and Flahault (1886-1888). If a more classical approach to the taxonomy of the blue-green algae is preferred, consult the floras compiled by Tilden (1910), Fritsch (1917), Prescott (1951), Zaneveld (1966), Cocke (1967) and Webber (1967).



## Morphology and Cytochemistry

The basic morphology of the typical blue-green algal cell is quite simple. The protoplast is tenuously differentiated into two major compartments. The centropiasm or nucleoplasm, the supposed seat of the genetic apparatus, occupies the center of the protoplast. This is surrounded by and interdigitates with the highly colored peripheral chromatoplasm, the seat of the photosynthetic apparatus. The protoplasm, which otherwise appears homogeneous, may often contain a variety of inclusions. The most commonly observed of these are the bead-like, hyaline cyanophycin granules. The entire protoplast is contained within a thin, elastic cell wall.

Blue-green algal cells may range in size from a few tenths of a micron up to one-hundred micra or more in diameter. They may be free, invested within gelatinous sheaths, or variously disposed within an amorphous mucous matrix. They may occur singly, doubly, in eucapsoid series, colonies or masses, or in uni- or multiseriate branched or unbranched filaments of indeterminate length. In some species vegetative cells may become differentiated into reproductive structures called spores or akinetes or into supposed nitrogen-fixing structures called heterocysts.

The centropiasm of the blue-green algal cell stains readily with Schiff's reagent or dilute Giemsa solution which indicates the presence of nuclear material (Fuhs in Carr and Whitton, 1973). Otherwise, these staining procedures reveal little internal structure within the centropiasm. Occasionally large polyphosphate granules, formerly called volutin or metachromatin, may be observed within the centropiasm of cells from old cultures or heavily polluted water (Fogg *et al.*, 1973).

The chromatoplasm, in contrast to the centropiasm, has considerable internal structure. Electron photomicrographs from many sources (see Fogg *et al.*, 1973) clearly show that it consists of concentrically arranged photosynthetic lamellae called the thylakoids. The primary photosynthetic and accessory pigments are closely associated with these membranes.

The chromatoplasm may contain a number of inclusions, the most conspicuous and often encountered of which are the hyaline, bead-like cyanophycin granules. When present these are usually evident but may be better visualized though not selectively stained by application of dilute methylene blue or Gram's iodine. They are reported to stain selectively on short exposure to Schneider's acetocarmine or on prolonged



exposure to very dilute Janus green (Fuhs in Carr and Whitton, 1973). They are thought to consist of condensed storage proteins.

The presence or absence and the manner of distribution of cyanophycin granules along the cell walls of certain of the filamentous forms are very characteristic and have been used by Drouet (1968) and others as prime criteria for taxonomic distinctions among the Oscillatoriaceae. It has been shown by a number of investigators (Fogg et al., 1973) that the presence or absence and relative abundance of the granules within blue-green algal cells is closely correlated with their physiological condition. These may therefore be tenuous criteria for distinguishing between species with otherwise similar morphology.

Some blue-green algal cells may also contain gas vacuoles, or so-called pseudovacuaoles, within the chromatoplasm. These often appear greenish-black in the light microscope. They may be distinguished from other inclusions in that they collapse after pressure is applied to the algae and disintegrate when the algae are treated with Gram's iodine, chlor-zinc-iodide or strong detergent solutions.

The presence or absence of gas vacuoles has been used by Drouet and Daily (1956) and others as a criterion for segregating species of coccoid Myxophyceae. As it is now thought, however, that the gas vacuoles arise in response to changes in various environmental parameters (Fogg et al., 1973) their use as a taxonomic character should be abandoned.

The cell walls of blue-green algal cells consist of muco- and lipopolysaccharides similar to bacterial cell wall constituents. The cell walls are often difficult to perceive with conviction in the light microscope and may be better visualized by staining with general basic dyes. Cross walls are usually quite evident when present especially if subtended by granules.

The cell walls are extremely resistant to chemical attack and may persist, along with any adhering sheath material, long after the dead protoplasts have dissipated. Such "ghosts" may become difficult to distinguish from living cells in collections from macroscopic algal masses particularly if they have been invaded by fungal hyphae or bacteria.

In many filamentous species the form of the outer wall of the mature terminal cell is very characteristic.

It has been used as a taxonomic criterion by a number of authors including Drouet (1968, 1973) in his recent revisions of the Oscillatoriaceae and Nostocaceae with cylindrical trichomes.

Nearly all blue-green algae excrete large amounts of acidic mucopolysaccharides which may contribute to the formation of discrete sheaths around the cells. Under the influence of the immediate environment the sheath may vary in extent, texture, form, and color.

In the classical treatments of the taxonomy of the blue-green algae the presence or absence, extent, texture, form and color of the sheath have all been considered characters of prime importance in defining the species. However, only the relative amount and biochemical composition of the secreted sheath material is under the direct genetic control of the algal cell. The eventual form the sheath material assumes once outside the cell, therefore, is presumably largely under the control of the immediate environment (Drouet, 1968). Those taxonomic distinctions based on the form of the sheath alone should, therefore, be abandoned as has been done in the revisions of Drouet and Daily (1956) and Drouet (1968, 1973). The extent and form of the sheath, however, must not be disregarded altogether in making observations on the blue-green algae as these may provide important information on their physiological status and environmental setting.

When indistinct the sheath may be better visualized by application of either of the basic dyes, ruthenium red or alcian blue, both of which indicate acidic polysaccharides. Under certain conditions the sheath may stain blue in chlor-zinc-iodide reagent which is thought to indicate the presence of cellulose (Gomont, 1892). The presence or absence of a positive reaction with chlor-zinc-iodide has been used by some authors to justify the segregation of species, but there is no chemical evidence that new blue-green algal sheath material contains cellulose (Fogg *et al.*, 1973). Furthermore, as Drouet (1962, 1968) points out, the sheath material may become invested, after its elaboration by the blue-green alga, with saprophytes which, themselves, produce cellulose. The use of the chlor-zinc-iodide reaction as a taxonomic criterion should be abandoned.

The sheath may also be visualized by negative staining with india ink or by mixing the algae with a very small amount of an aqueous suspension of lamp black. In the former case the sheath will appear as a bright halo about the algal cells on a dark background. In the latter case the carbon particles will begin after some time to adhere to the sheath and define the margins.

In the Myxophyceae reproduction is by simple synchronous or asynchronous binary fission in from one to three planes perpendicular to one another. Sequential reduction or enlargement in cell size upon successive divisions commonly occurs. New cell walls are laid down between daughter cells in a centripetal fashion from the outer walls and may be accompanied by visible constrictions in the outer walls at the points of division particularly in the coccoid and certain filamentous Myxophyceae. In rapidly growing filamentous forms with terete trichomes the incompletely formed dissipiments may be clearly seen at regular intervals along the length. Daughter cells may remain attached for some time after division or separate at once. Differences in the exact mode of division within each group accounts in part for the great diversity of form among the mature plants in the Myxophyceae.

Some groups within the Myxophyceae produce special reproductive structures. Among the coccoid forms, species of Chamaesiphonaceae produce so-called endospores and exospores. Endospores arise via repeated internal division of the protoplasts of enlarged vegetative cells, the outer envelopes of which remain intact such that large, variously shaped sporangia containing from two to many endospores are produced within the thallus. Exospores arise via budding from the free ends of filaments or stalked basal cells of the thallus. Short catenate series of exospores may thus be produced at the free ends of the generative basal cells but usually soon break up. The Nostocaceae (sensu Drouet, 1973) and some Stigonemataceae also produce spores or so-called akinetes. These are commonly much larger than vegetative cells, contain dense, highly granular protoplasm and usually possess a relatively thick, sometimes much sculptured cell wall.

In most filamentous forms the vegetative trichome may break at intervals along its length either by destruction of intercalary cells or by separation at cross walls between adjacent cells. The resulting short fragments of several to many cells, called hormogones, are released and may grow into new vegetative trichomes. It is doubtful that the hormogone represents a specialized reproductive structure although it would seem to represent a definite life stage in nostocaceous development (Fogg et al., 1973; Lazaroff in Carr and Whitton, 1973). Production of hormogones would seem, otherwise, to be a natural consequence of the filamentous growth form.

Some species of Myxophyceae produce so-called heterocysts either terminally or intercalated within the trichome between vegetative cells or spores. The heterocysts may be distinguished from the vegetative and reproductive cells by their relatively thicker cell walls, homogeneous contents and the presence of a single large pore in each of the walls

contiguous to a vegetative cell or spore. The morphology of the heterocysts and their position within the trichomes with respect to the spores are criteria of primary taxonomic importance in the Nostocaceae with trichomes constricted at the cross walls (Bornet and Flahault, 1886-1888; Tilden, 1910).

Heterocysts are known to be responsible for nitrogen fixation in some species (Fogg *et al.*, 1973). In some nostocaceous species differentiation of heterocysts is markedly stimulated by nitrogen starvation (Fogg *et al.*, 1973) and there is also evidence indicating that development of heterocysts induces sporulation (Wolk, 1965) so it has been suggested that they may indirectly participate in reproduction by supplying fixed nitrogen to adjacent developing spores (Fay *in* Carr and Whitton, 1973).

The blue-green algae are remarkably variable with regard to coloration. Generally, however, macroscopic masses of blue-green algae on soil surfaces and solid substrates along shores and in the marshes range from dull olive green to deep greenish-black although occasional reddish or purplish efflorescences may also be encountered. The apparent coloration of the algae is dependent on the relative concentrations of the variously hued primary and accessory photosynthetic pigments within the chromatoplasm.

Of the primary pigments blue-green algae have been shown to possess only chlorophyll a. A wide variety of accessory pigments including carotenes, xanthophylls and phycobiliproteins may also be present. This complement of pigments makes the algae capable of considerable chromatic adaptation. Changes in light intensity and spectral composition, nutritional status and oxygen tension may all produce alterations in coloration through shifts in pigment composition (Fogg *et al.*, 1973). Coloration, therefore, is of no value whatever as a taxonomic criterion. Treatments which rely heavily upon differences in coloration to segregate closely related taxa should be avoided.

Most filamentous and some coccoid Myxophyceae are capable of some movement. Gliding, oscillating and rotating movements can often be observed together in one specimen, particularly in the Oscillatoriaceae. The extrusion of sheath material from the cells has most often been linked with locomotory ability in the past but recent investigations have shown that locomotion may be brought about by the alternate contraction and extension of microfibrils on the surface of the cells (Castenholz *in* Carr and Whitton, 1973). The motility of some Myxophyceae allows for a variety of tactic responses to different chemical and physical parameters.

## Ecology

Blue-green algae are ubiquitous on the shores and marshes of southern Delaware in the summer. They may produce obvious macroscopic masses just above the high water line wherever there is a suitable solid substrate (Zaneveld, 1966). Such masses often impart a greenish-black cast to solid objects in or near the water such as pilings, docks, jetties, and shell heaps along creek banks. Thin films may also be seen above the water line on the otherwise bare muds of creek banks. These commonly produce a characteristic olivaceous sheen over the mud and often have a curious greasy feel, as well. For more detailed information on the blue-green algae of the shores of southern Delaware, consult Zaneveld's papers (1966, 1972).

On the surface of the marshes macroscopic evidence of the presence of blue-green algae is rare except on the bases of grass culms, in pools and over the mud in bare areas. Pannes and pools around upland areas and along the break between the high and low marshes and bare areas along eroding marsh faces support, by far, the greatest bulk of blue-green algae on the marshes in the summer. In such locations the algae produce extensive, thick, leathery, coherent mats over the soil surface which may persist well into the fall (Ralph, 1975).

The myxophycean flora of the marshes of southern Delaware is dominated by the three oscillatoriaceous species (sensu Drouet, 1968), Microcoleus lyngbyaceus, Schizothrix arenaria and S. calcicola. Of consistent secondary importance in the flora are the three oscillatoriaceous species (sensu Drouet, 1968, 1969), Arthrospira neapolitana, Porphyrosiphon Notarisii and Spirulina subsalsa, the two nostocaceous species, Anabaena torulosa and Calothrix crustacea (sensu Drouet, 1973), and the two coccoid forms (sensu Drouet and Daily, 1956), Anacystis montana f. montana and A. dimidiata. All other species reported here occupy ephemeral positions within the flora except where freshwater influx onto the marshes is great (Ralph, 1975).

Although this basic floral association is common to all marsh angiosperm zones, the greatest diversity occurs in the Spartina patens - Distichlis spicata zone by incorporation of many minor species into the flora. Peak populations occur in all zones of the marsh in the late summer. The Myxophyceae are virtually absent from the marshes in the winter. Significant relict populations survive in sheltered areas, notably on the dead, lodged culms of the grasses of the previous season and in surface mats of macroscopic filamentous

green algae in the dwarf Spartina alterniflora and S. patens - Distichlis spicata zones (Ralph, 1975).

In general, marshes fringing upland areas support the best developed blue-green algal floras. The flora of the open broad marshes is depauperate by comparison. Those areas which afford the best opportunities for collecting blue-green algae, then, are along shores, along eroding marsh faces and in pannes and pools along the break between high and low marshes adjacent to uplands. For more detailed information on the ecology of the Myxophyceae of the marshes of southern Delaware, consult Ralph (1975) and Somers (1975).

### Collection and Preservation

The best method to use for collection of blue-green algae for herbarium specimens depends on the conditions under which they are found in the field. Consolidated specimens from soil crusts, floating mats or growing on larger plants are most easily collected by placing them in a sheet of ordinary newsprint folded into a packet. The collector must take care to gather enough of the algae to constitute a good specimen and should arrange to dry the collected algae as quickly as possible without excess heating. Detailed notes on the circumstances of each collection such as the habitat, exact location and date should be taken in a field notebook. A unique identification number for each collection should be written in pencil directly on the margin of the newsprint packet or on a separate slip of paper folded inside with the specimen.

Semi-consolidated masses such as from heavy planktonic blooms, floating scums or muddy soil may be placed on pieces of all rag herbarium paper or filter paper and allowed to dry somewhat before being placed in newsprint packets. Filter paper is less expensive than herbarium paper, but its porosity may render the removal of samples difficult.

Very wet, unconsolidated masses such as from the plankton, shallow water along shores or submerged substrates may be collected in any suitable containers. Care should be taken not to agitate the containers after collection and they should be kept cool. Penciled labels with collection numbers or notes may be attached to the outside of the containers or slipped inside with the specimens.

Once in the laboratory the specimens may be spread thinly on mica sheets inside circular wax pencil marks and allowed to dry at room temperature. When thoroughly dry they

may be placed in newsprint packets on which collection notes have been recorded. Mica is used because it is somewhat pliable when split thin enough, is less likely to break when stored than glass, and does not yellow or become cloudy or brittle with age as do some plastics. [The sheets may also be cut to any desired size with ordinary scissors.]

Where there is no macroscopic evidence of blue-green algae in the field but their presence is suspected, samples may be placed in containers partially filled with a suitable growth medium. For collection and culture of marsh Myxophyceae a modified Chu #10 medium (Chu, 1942) adjusted to an approximate salinity of 25 ‰ is most effective.

Specimens from the marsh such as mud, water or litter may be placed directly into appropriately labeled collecting bottles containing 50 - 100 ml. of medium. On return to the laboratory the caps should be loosened slightly to allow for gaseous exchange and the bottles placed on a sunny window-sill. If blue-green algae are present in the samples macroscopic masses will appear shortly. The cultured algae, properly labeled as such, and as to origin, may then become the bases for herbarium specimens.

For permanent storage, specimens are transferred from the newsprint packets into appropriately labeled packets made from any suitable all rag, heavy weight 8 x 11 inch bond paper. To make a permanent packet, position the paper as for writing, fold the bottom up three inches and the top down three inches. Fold both sides to the back, leaving a gap of at least one inch and crease sharply.

When typing or writing notes directly onto the permanent packets arrange it so that they are clearly visible on the top flap of the finished packet. Final notes should include the names of the algae with the authorities, the name[s] of the collector and, if different, the person making the determination, the date of collection, the exact location, including the nearest town, the county and the state, and any pertinent remarks on the habitat or the circumstances of the collection. If more than one species is present in the sample it is customary either to list those present in the order of their abundance or simply to list that species of the most interest.

To mount a packet a spot or line of tin paste or other suitable permanent cement is placed on the back midway between [but not near] the two flaps. The packet is then positioned on the herbarium sheet and held down with a paper weight until the cement is dry.

Packets should be positioned on the sheets at random in any of the corners or at the center so as to avoid stacking problems in storage. Sheets are stored by genus and species within folders in a dark, dry, pest-free place. Specimens containing more than one species are usually filed under the name of the most abundant or interesting form. Otherwise, the organization of the herbarium is a matter of personal preference.

Blue-green algae may be cultured on solid media made by adding one to two percent agar to the liquid medium and pouring into sterile plastic Petri dishes. The cooled plates may then be sterilized by exposing them to strong shortwave UV light for about 15 minutes and holding them in the dark for about one hour after treatment. The sterile plates should not be stored under the UV light since prolonged exposures cause the plastic to yellow and become brittle.

The isolation of the more common Myxophyceae from the marshes in unialgal culture is easily accomplished by standard microbiological techniques. Contamination by aquatic fungi and marine bacteria presents the most difficult problem since these often grow within the sheath material of the algae. For this reason standard techniques are often ineffective in isolating the algae in pure culture. Furthermore, once in the axenic condition many algal cultures lose vigor rapidly and die out even when supplied with a variety of organic growth factors. Unless the cultures are to be used for physiological work they should be left in the unialgal state with associated fungal and bacterial contaminants so long as these do not cause serious difficulties.

Generally, it is advisable to transfer unialgal cultures every few weeks even if they are held in the cold to avoid overgrowth by the contaminants. Most axenic cultures may be stored indefinitely in the cold at about 4°C. so long as they are packaged to prevent desiccation. For more detailed information on the culture of blue-green algae, consult the review by Fogg et al., 1973, for appropriate references.

#### Observation

The greatest pitfall in observing the blue-green algae is to single out a few individuals as the basis from which a determination is to be made. Because of the kinds of morphological distinctions on which the more recent revisions of the taxonomy of the algae are based, it is necessary to view many individuals within a given specimen in order to form an adequate total impression of the



morphology. Generally, careful ordinary light microscopic observations are sufficient to allow for most determinations.

Microscopic observations are best made on living algae but dried specimens are almost equally as good as they quickly reattain their former morphology when rehydrated, particularly if a dilute solution of detergent is used. Often it is advisable to rinse specimens from the marsh prior to mounting to remove debris and excess salts, especially if stains are to be applied later.

When taking a sample from a herbarium specimen for examination care should be taken to remove as little material as possible so as to conserve the specimen. Herbarium specimens on mica are generally mounted directly on the microscope after rehydration; thus the sheet acts as the slide. They should be allowed to dry thoroughly again before being returned to their packets.

After having observed any material from an herbarium specimen the student should annotate the herbarium sheet corresponding to the specimen to indicate whether or not he agrees with the determination. It is customary if one agrees with the determination to annotate the sheet near the packet or other label with an exclamation point (!) followed by one's name and the date. If one does not agree then it is customary to annotate the sheet with the proper determination, one's name and the date.

The motility of living algae is not much affected by methyl cellulose. Consequently, before making any photomicrographs it is generally best to kill the algae by applying a drop or two of a dilute solution of mercuric chloride to the preparation. This does not appreciably alter the morphology, although some minor swelling may occur after a time, but does drastically change the fresh color and may seriously interfere with subsequent staining procedures.

The specific properties and uses of some staining agents with regard to the blue-green algae have already been alluded to briefly. The most generally useful reagent is Gram's iodine. The reagent nonselectively stains the blue-green algae a characteristic amber color. This improves contrast and may help to clarify some dubious aspect of the morphology. The stain also indicates the presence of starch by the development of an intensely blue-black reaction which may be used to distinguish the blue-green algae, which lack starch, from other algae of similar external appearance which do store starch. For more detailed information on the staining properties of blue-green algae consult Geitler (1932, 1960), Fritsch (1945), Schussnig (1953) or Fuhs (1968, 1969).

## Taxonomic Key and Descriptions

The following compendium has been designed as an aid to the proper identification of Myxophyceae from central and southern coastal Delaware. No claim is made that it is complete. It represents a condensation of pertinent information from many sources. The descriptions of the families, genera and species presented are derived from the original Latin texts of the primary authors wherever possible. English translations of the texts are provided for comparison. Notes on the general habitats of the species and other related comments are derived, in part, from those of the primary authors. Care should be taken not to take such remarks too literally. They are proffered only as general aids to the fullest possible understanding of the species. Considerable deviation from such generalities must be expected.

Following the descriptions and general remarks on habitat are presented lists of all the collections of each species which have been examined by this writer. The dates and places of collection and the collectors are noted as they appeared on the original herbarium sheets. The herbaria in which the collections may be found and the numbers, if any, by which the appropriate sheets may be positively identified are also noted. If a species has not previously been reported from Delaware prior to this writing, note has been made of that, as well.

The descriptions of the species are accompanied by pen and ink drawings of representative ecophenes as a further aid to identification. It should not cause great concern if a specimen does not appear exactly as its representations do. Extreme morphological variation may be expected in many species. The Latin descriptions must always serve as the final authorities in critical determinations, never the illustrations. Where sufficient ambiguity exists to afford several reasonable alternative identifications on the basis of the information presented here, consider the possibility that the specimen is other than any of the species represented and go to a broader source.

On the pages immediately following appears a dichotomous key to the species. The key is based, in large part, on artificial and semi-technical distinctions. These are not meant to follow natural divisions reflecting the taxonomic or phylogenetic relationships within the group. The key is basically non-technical. Some species may be keyed under several alternatives to account for commonly made errors, inherent variation or apparent similarities between species from divergent groups.



KEY TO THE MYXOPHYCEAE OF SOUTHERN COASTAL DELAWARE

- 1) Plants uni-, pluri- or multicellular;  
 cells occurring singly, doubly in  
 eucapsoid series or in colonies or  
 masses.....2
- Plants multicellular; cells in true trichomes  
 or filaments.....16
- 2) Cells always occurring singly, long-  
 cylindrical, ours evidently spiraled  
 throughout.
- Spirulina subsalsa (Oscillatoriaceae)
- Cells occurring singly, doubly, in eucapsoid  
 series or in colonies or masses, coccoid  
 to short-cylindrical or irregularly  
 shaped, not at all spiraled.....3
- 3) Plants producing large cells containing  
 few to many endospores (Entophysalis;  
Entophysalidaceae).....4
- Plants not producing endospores, vegetative  
 cells all roughly of the same size.  
 (Chroococcaceae).....5
- 4) Plants epi- or endophytic, rarely free-  
 living.
- Entophysalis conferta
- Plants not epi- or endophytic, usually free-  
 living, on solid substrates.
- Entophysalis deusta
- 5) Cell division in one plane only; cell  
 pairs in division often appearing keg-  
 shaped to more or less cylindrical,  
 the long axis perpendicular to the  
 plane of division (Coccochloris).....6

- 5) Cell division in two or three planes perpendicular to one another; cell pairs in division generally globose or cordiform, rarely truncate-cylindrical.....8

- 6) Cells up to 3 times as long as broad, commonly truncate-ovoid or truncate cylindrical.

Coccochloris stagnina

Cells longer, more than 3 times as long as broad, commonly long-cylindrical.....7

- 7) Cells often curving, comma-shaped, rotund or tapering at the ends, 1—3 micra in diameter, up to 12 times as long as broad.

Coccochloris Peniocystis

Cells not curving, straight, often keg-shaped or long-cylindrical, ends often squarish, 2—6 micra broad, up to 8 times as long as broad.

Coccochloris elabens

- 8) Plant mass constituting a flat or curved plate; cells arranged regularly in two rows perpendicular to one another (Agmenellum).....9

Plant mass otherwise, not flat; cells rarely in regular rows.....10

- 9) Cells 1—3.5 micra broad, globose.

Agmenellum quadruplicatum

Cells 4—10 micra broad, ovoid or cylindrical.

Agmenellum thermale

- 10) Plant mass regularly spherical or ovoid; cells usually pyriform, often cordiform in division, radially arranged in a single peripheral layer. (Gomphosphaeria).

Gomphosphaeria aponina

Plant mass otherwise; cells spherical or ovoid before division, occurring singly, doubly, in eucapsoid series or in colonies or masses (Anacystis).....11

- 11) Cells packed with pseudovacuoles (gas vacuoles), usually forming fresh water blooms.

Anacystis cyanea

Cells commonly without pseudovacuoles, or if so, then not customarily forming water blooms.....12

- 12) Cells very small, 0.5—2 micra broad.

Anacystis marina

Cells larger, 2 micra or more broad.....13

- 13) Cells up to 6 micra broad.

Anacystis montana

Cells larger, 6 micra or more broad.....14

- 14) Cells mostly 6—12 micra in diameter, usually becoming rounded promptly after division.....15

Cells mostly larger, (8—)12—50 micra broad, cells usually remaining strongly angular after division within the persistent sheath of the mother cell.

Anacystis dimidiata

- 15) Cells commonly forming macroscopic masses on various substrates in brackish or marine habitats.

Anacystis aeruginosa

Cells rarely forming macroscopic masses, colonies usually microscopic, planktonic, usually in fresh water habitats.

Anacystis thermalis

- 16) Trichomes without heterocysts; spores never produced (*Oscillatoriaceae*).....17
- Trichomes with evident heterocysts; spores often produced (*Nostocaceae*).....33
- 17) Trichome consisting of one more or less tightly spiraled cell.
- Spirulina subsalsa
- Trichomes multicellular, straight or curving or spiraled.....18
- 18) Granules present on either side of the cross walls.....19
- Granules absent at the cross walls, or, if present, then only two, very prominent, shining and bead-like.....22
- 19) End wall of the terminal cell becoming conspicuously thickened, the older trichomes appearing capped (Microcoleus).....20
- End wall of the terminal cell never becoming thickened; the terminal cell commonly becoming long-attenuate in one species (Arthrospira).....21

- 20) Granules along the cross walls and side walls in dense protoplasm; trichomes often slightly attenuated at the tips but usually rounded at the apex, often very robust.

Microcoleus lyngbyaceus

Granules along the cross walls only; trichomes becoming long-attenuate and usually low-conical at the apex, commonly more slender.

Microcoleus vaginatus

- 21) Terminal cell becoming conical, often long-attenuate, cells usually much shorter than broad; trichomes straight or curving or rarely evenly spiraled; common in brackish and marine habitats.

Arthrospira neapolitana

Terminal cell hemispherical, cells roughly quadrate; trichome commonly evenly spiraled throughout; common in fresh water habitats.

Arthrospira Jenneri

- 22) End wall of the terminal cell becoming conspicuously thickened, the older trichomes appearing low dome-capped (Oscillatoria).....23
- End wall of the terminal cell never becoming thickened.....27
- 23) Cells discoid, less and 1/3 as long as broad.....24
- Cells not discoid, 1/3 as long as broad or longer.....25



- 24) Ends of the trichomes becoming conspicuously tapered to the apices, very robust; fresh water habitats.

Oscillatoria princeps

Ends of the trichomes scarcely, if at all tapered, much more slender, ours commonly epiphytic; brackish or marine habitats.

Oscillatoria lutea

- 25) Thickened end wall of the terminal cell low-conical or hemispherical.

Oscillatoria submembranacea

Thickened end wall of the terminal cell only slightly convex.....26

- 26) Cells mostly shorter than broad, terminal cell short-cylindrical; our ecophene commonly epiphytic.

Oscillatoria lutea

Cells mostly quadrate or longer, terminal cell long-cylindrical, often somewhat tapering toward the apex; not epiphytic; more robust.

Oscillatoria Retzii

- 27) Trichomes not attenuate at the tips except for the terminal cell (Schizothrix).....28

Trichomes long-attenuate at the tips through several cells (Porphyrosiphon).....32

- 28) Terminal cells rotund, at most slightly attenuate, not at all conical.....29

Terminal cells becoming conical or long-attenuate.....31

- 29) Terminal cell becoming cylindrical and rotund at the tip; trichomes 2—10 micra broad; uncommon in brackish or marine habitats.

Schizothrix Friesii

Terminal cell becoming hemispherical or almost spherical; trichomes 0.2—3.5 micra broad; very common throughout.

Schizothrix calcicola

- 30) Terminal cells becoming long-attenuate, seemingly threadlike.

Schizothrix tenerrima

Terminal cells becoming merely conical.....31

- 31) Trichomes constricted at the cross walls; often contributing substantially to the formation of coherent algal mats over bare marsh soil.

Schizothrix arenaria

Trichomes not constricted at the cross walls; if found in coherent mats of algae then not contributing substantially to their bulk.

Schizothrix rubella

- 32) Terminal cell becoming capitate, appearing to bear a terminal bead; trichomes fine.

Porphyrosiphon splendidus

Terminal cell becoming long-attenuate, often hairlike, not capitate, often twisted or spiraled; trichomes often robust.

Porphyrosiphon Notarisii

- 33) Trichomes cylindrical, not at all torulose; here and there and very slightly constricted at the cross walls.....34
- Trichomes often torulose, conspicuously constricted at the cross walls throughout.....38
- 34) Trichomes, in our ecophenes, with an obvious, expanded basal portion and tapering to the apex through many cells (Calothrix).....35
- Trichomes, in our ecophenes, without an obvious basal portion, not tapering to the apices, equidiametric throughout.....36
- 35) Trichomes tapering uniformly to the terminal cell; the terminal cell conical at the tip; mostly in fresh water habitats.

Calothrix parietina

Trichomes often with an abrupt reduction in diameter towards the apices, then gradually tapering to the terminal cell; the terminal cell long-attenuate, often hairlike; mostly in brackish or marine habitats.

Calothrix crustacea

- 36) Trichomes, in our ecophenes, commonly branched, the branching false; cells commonly quadrate or longer than broad. (Scytonema).

Scytonema Hofmannii

Trichomes unbranched; cells commonly discoid or lenticular, much shorter than broad (Nodularia).....37

- 37) Trichomes commonly less than 8 micra  
broad; cells lenticular.

Nodularia Harveyana

Trichomes commonly more than 8 micra  
broad; cells discoid.

Nodularia spumigena

- 38) Trichomes with an obvious basal portion,  
often with a singly, very large  
spore contiguous to the single  
basal heterocyst (Cylindrospermum).

Cylindrospermum licheniforme

Trichomes without an obvious basal  
portion; spores, when present,  
usually in series, not so much  
larger than the vegetative cells.....39

- 39) Heterocysts intercalary, rarely terminal.....40

Heterocysts intercalary and terminal.....43

- 40) Trichomes commonly within a discrete,  
cylindrical sheath; cells discoid  
or lenticular, shorter than their  
diameter; spores in catenate series;  
terminal cells hemispherical  
(Nodularia).....41

Trichomes commonly naked or disposed in  
amorphous mucus; cells equal to or  
slightly longer than the diameter;  
spores solitary or in pairs or, at  
most, in short series; the terminal  
cells becoming conical (Anabaena).....42

- 41) Trichomes commonly less than 8 micra  
broad; cells lenticular.

Nodularia Harveyana

- 41) Trichomes commonly more than 8 micra broad;  
cells discoid.

Nodularia spumigena

- 42) Mature spores cylindrical, contiguous to  
the heterocysts.

Anabaena torulosa (1)

Mature spores globose or ovoid, remote  
from the heterocysts.

Anabaena variabilis

- 43) Cells discoid or lenticular, much shorter  
than broad (Nodularia) . . . . . 44

Cells globose or short-cylindrical, often  
depressed at the ends but never discoid  
or lenticular, usually just as long as  
broad or very slightly longer (Nostoc) . . . . 45

- 44) Trichomes commonly less than 8 micra broad;  
cells lenticular.

Nodularia Harveyana

Trichomes commonly more than 8 micra broad;  
cells discoid.

Nodularia spumigena

- 45) Cells short-cylindrical or keg-shaped;  
terminal heterocysts commonly  
cylindrical.

Nostoc ellipsosporum (2)

[1] This and the next species may simply represent  
different ecophenes or life stages of the single  
polymorphic species Anabaena oscillarioides  
(Drouet, 1972, personal communication).

[2] This and the remaining two species may all  
simply represent different ecophenes or life  
stages of the single polymorphic species  
Nostoc commune (Drouet, 1972, personal  
communication).

- 45) Cells subspherical or globose, often depressed; terminal heterocysts commonly low rotund-conical or obovoid.....46
- 46) Plant masses firm; trichomes tightly coiled into discrete packets, invested with a heavy, often highly colored, lamellose sheath; spores unknown.

Nostoc commune

Plant masses softer; trichomes free or entangled or loosely spiraled or twisted within an amorphous mucus, not usually arranged in discrete packets or invested with a heavy sheath; spores commonly present, globose.

Nostoc muscorum



TAXONOMIC ACCOUNT OF THE MYXOPHYCEAE

CHROOCOCCACEAE Nägeli, 1849.

Plantae uni—multi-cellulares, microscopicae vel macroscopicae, forma et magnitudine et ambitu diversae, libere in aqua natantes vel in stratis crescentes, cellulis sphaericis, discoideis, ovoideis, ellipticis, cylindraceis, vel pyriformibus, unaquidque in duas cellulas-filias aequales dividente, unaquidque mox ab aliis cum gelatino vaginale se separante; reproductione a fragmentatione. (Drouet and Daily, 1956 pg. 12)

Plants uni- to multicellular, microscopic or macroscopic, highly variable in shape and size, freely floating in water or growing in layers; cells spherical, discoid, ovoid, elliptical, cylindrical or pyriform, each capable of dividing into two equal daughter cells which may become separated from the others by the gelatinous sheath; reproduction by fission.

Agmenellum Brébisson, 1839.

Plantae (laminae) microscopicae vel macroscopicae, cellulis sphaericis vel ovoideis vel cylindraceis, in lamina in seriebus regularibus aliis ad alias perpendicularibus dispositis; divisione cellularum seriatim in duobus planis unoquodque ad alia et ad superficiem laminae perpendicularibus procedente; gelatino vaginali hyalino. (Drouet and Daily, 1956 pg. 86)

Plants (plates) microscopic or macroscopic, cells spherical, ovoid, or cylindrical, disposed within the plate in regular rows perpendicular to one another; division of the cells proceeding successively in two planes perpendicular to each other and to the surface of the plate; the gelatinous sheath is hyaline.



Agmenellum quadruplicatum Brèbisson, 1839.

Plantae (laminae) aerugineae, olivaceae, violaceae, vel roseae, rectangulares, 1—256-cellulares, cellulis post divisionem globosis diametro 1—3.5 micra crassis, per gelatinum vaginale laxè vel conferte distributis; gelatino vaginale firmo vel (saepe omnino) diffluyente; protoplasmate aerugineo, olivaceo, violaceo, vel roseo, homoganeo vel tenui-granuloso. (Drouet and Daily, 1956 pg. 88)

Plants plate-like, blue-green, olive, violet or red, rectangular, 1—256-celled, cells globose after division, 1—3.5 micra broad, arranged loosely or tightly packed within a gelatinous matrix; the gelatinous sheath firm or (often entirely) diffluent; protoplasm blue-green, olive or red, homogeneous or finely granulose.

See Figure I.

Habitat:

In shallow fresh and brackish water and on mud and wet sand; often seen in the plankton of rivers and lakes. (Drouet and Daily, 1956 pg. 88)

Collections:

Not previously reported from Delaware.

Agmenellum thermale (Kützing) Drouet & Daily, 1956.

Plantae (laminae) aerugineae, olivaceae, vel violaceae, primum rectangulares et microscopicae, deinde ad 4 cm. longae ambitu irregulares increscentes, cellulis post divisionem globosis, ovoideis, vel cylindraceis diametro 4—10 micra crassis, 4—20 micra longis, per gelatinum vaginale plerumque conferte distributis; gelatino vaginale hyalino, firmo vel (saepe omnino) diffluyente; protoplasmate aerugineo, homogeneo vel tenui-granuloso. (Drouet and Daily, 1956 pg. 90)

Plants plate-like, blue-green, olive or violet, at first rectangular and microscopic, later up to four (4) centimeters long, the margins becoming irregular; cells after division globose, ovoid or cylindrical, 4—10 micra broad, 4—20 micra long, mostly crowded within a gelatinous matrix; the gelatinous sheath hyaline, firm or (often entirely) diffluent; protoplasm blue-green, homogeneous or finely granulose.

See Figure II.

Habitat:

In shallow fresh, brackish, or salt water or on mud. (Drouet and Daily, 1956 pg. 90)

Collections:

SJ-1, ditch water in upper marsh, St. Jones marsh, Barkers Landing, Kent County, Delaware; R.D. Ralph, July 7, 1972 (# 720712SJ1 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Not previously reported from Delaware.

Anacystis Meneghini, 1837.

Plantae microscopicae vel macroscopicae, cellulis in divisione binis plus minusve hemisphaericis, aetate provecta globosis, per gelatinum vaginale irregulariter vel in seriebus in tribus planis unoquodque ad alia perpendicularibus distributis; divisionibus cellularum seriatim in tribus planis unoquodque ad alia perpendicularibus procedentibus; gelatino vaginale hyalino vel deinde (in A. montana) rubrescentes vel coerulescentes vel lutescentes. (Drouet and Daily, 1956 pg. 35)

Plants microscopic or macroscopic, pairs of cells in division more or less hemispherical, older cells becoming globose, distributed in a gelatinous matrix either irregularly or in rows in three planes perpendicular to one another; cell divisions proceed successively in three planes perpendicular to one another; the gelatinous sheath is hyaline or later (in A. montana) becomes reddish, pale-bluish or yellowish.

Anacystis aeruginosa (Zanardini) Drouet & Daily, 1948.

Plantae pallide aeruginosae, roseae, violaceae, vel decoloratae, primum microscopicae demum bullosae ad plura centimetra crassae, cellulis in divisione binis depresso—sub-sphaericis, aetate provecta globosis diametro 6—12 (aut minoria) micra crassis, sine ordine aut in seriebus eucapsoidis per gelatinum vaginale distributis; gelatino vaginale hyalino, homoganeo nonnumquam indistincte lamelloso, evidenter limitato vel (saepe omnino) difffluente; protoplasmate pallide aerugineo, roseo, vel violaceo, homoganeo vel sparse tenui-granuloso. (Drouet and Daily, 1956 pg. 76)

Plants pale blue-green, red, violet, or colorless, at first microscopic, later expanding to many centimeters, pairs of cells in division depressed-sub-spherical, older cells globose, 6—12 micra (or sometimes less) broad, arranged at random or sometimes in eucapsoid series within a gelatinous matrix; the gelatinous sheath hyaline, homogeneous, sometimes indistinctly lamellose, obviously delimited or (often entirely) diffluent; protoplasm pale blue-green, red, or violet, homogeneous or sparsely fine-granulose.

See Figure III.

Habitat:

In brackish and more or less quiet marine waters, often forming gelatinous masses on rocks, wood, larger plants, and attached animals. (Drouet and Daily, 1956 pg. 76)

Collections:

From a culture "RB-8" dated 6/13/73, originally collected 5/4/72 in the water of a pool in the Spartina patens zone, Big Nose Island marsh, Delaware Seashore State Park, Sussex County; R.D. Ralph, May 4, 1972 (# 720504RB8 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Not previously reported from Delaware.

Anacystis cyanea (Kützing) Drouet & Daily, 1952.

Plantae smaragdinae vel laete aeruginosae, microscopicae, sphaericae, cylindratae, vel ovoideae, varie et irregulariter lobatae et invaginatae vel clathratae, saepe conferte confluentes, planctonicae, cellulis in divisione binis depresso—sub-sphaericis, aetate provecta globosis diametro (2.5—)3—7(—10.5) micra crassis, sine ordine (aut in seriebus eucapsoideis) per gelatinum vaginale distributis; gelatino vaginale hyalino, homoganeo, ad superficiem distincte delimitato vel (saepe omnino) diffluente; protoplasmate dilute aerugineo, pseudovacuoilis farcto. (Drouet and Daily, 1956 pg. 37)

Plants emerald or bright blue-green, microscopic, spherical, cylindrical or ovoid, variously and irregularly lobed and invaginated or clathrate, often tightly packed and confluent, planktonic, pairs of cells in division depressed-sub-spherical, older cells globose (2.5—)3—7(—10.5) micra broad, arranged at random (or, at most, in eucapsoid series) within a gelatinous matrix; the gelatinous sheath hyaline, homogeneous, clearly delimited at the margins or (often entirely) diffluent; protoplasm faint blue-green, packed with pseudovacuoles.

See Figure IV.

Habitat:

In the plankton of freshwater lakes, ponds, and sluggish rivers, often appearing as conspicuous and heavy water blooms during the warm seasons of the year. Often confused with this species are the various growth-forms of the bacterial Lamprocystis rosea (Kütz.) Drouet & Daily, the plants of which contain a red pigment in most living conditions (Drouet and Daily, 1956, pg. 37).

Collections:

From a bloom in the southwest corner of Silver Lake, Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 12, 1964 (# 14886 in herb. F. Drouet).

SJ-1, constituting a thick water bloom in a fresh water pool in the extreme upper marsh, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, August 3, 1972 (# 720803SJ1 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). RMP-1, from a conspicuous water bloom along the eastern shore of Red Mill Pond, Star Landing, Sussex County; R.D. Ralph, August 18, 1973 (# 730818RMP-1 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Not previously reported from Delaware.

Anacystis dimidiata (Kützing) Drouet & Daily, 1952.

Plantae aerugineae, violaceae, roseae, vel olivaceae, praecipuius microscopicae 2—16-cellulares, cellulis in divisione binis truncato-hemisphaericis, aetate provecta truncato-globosis vel raro exacte sphaericis, diametro (8—)12—50 micra crassis, sine ordine (aut in seriebus eucapsoidis) per gelatinum vaginale distributis; gelatino vaginale hyalino (rarissime pallidi-luteo), tenue, homogoneo vel plus minusve lamelloso; protoplasmate aerugineo, violaceo, roseo, vel olivaceo, tenui- vel sparse grossigranuloso. (Drouet and Daily, 1956 pg. 71)

Plants blue-green, violet, red, or olive, chiefly microscopic, 2—16-celled, pairs of cells in division truncate-hemispherical, older cells becoming truncate-globose or rarely exactly spherical, (8—)12—50 micra broad, distributed at random (or sometimes in eucapsoid series) within a gelatinous matrix; the gelatinous sheath hyaline (very rarely pale yellow), thin, homogeneous or more or less lamellose; protoplasm blue-green, violet, red, or olive, finely or sparsely and coarsely granulose.

See Figure V.

Habitat:

In shallow fresh, brackish, and marine waters and in seepage, usually mixed with other algae; often encountered in the plankton. (Drouet and Daily, 1956 pg. 71)

Collections:

RB-6, pool water and bottom debris from the Distichlis spicata zone, Big Nose Island marsh, Delaware Seashore State Park, Sussex County; R.D. Ralph, July 12, 1972 (# 720712RB6B in herb. Univ of Del. and Acad. Nat. Sci. Phila.). CC-6, black crust dried over a shellheap on the roadbed in mid-marsh, vicinity of the Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC6 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-12, on a shellheap in a mid-marsh spoil area, vicinity Fisher homesite, Canary

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Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph,  
October 11, 1972 (# 721011CC12 in herb. Univ. of Del. and  
Acad. Nat. Sci. Phila.).

Not previously reported from Delaware.



Anacystis marina (Hansgirg) Drouet & Daily, 1948.

Plantae laete aerugineae, praecipue sphaericae vel ovoideae microscopicae, aut in strata gelatinosa macroscopica evolventes, cellulis in divisione binis depresso—sub-sphaericis, aetate provecta globosis diametro 0.5—2 micra crassis sine ordine (frequenter conferte) per gelatinum vaginale distributis; gelatino vaginale hyalino, homoganeo, (saepe omnino) diffluente; protoplasmate aerugineo, homoganeo. (Drouet and Daily, 1956 pg. 44)

Plants pale blue-green, chiefly spherical or ovoid, microscopic, or sometimes in spreading macroscopic gelatinous layers, pairs of cells in division depressed-sub-spherical, older cells globose, 0.5—2 micra broad, arranged at random (frequently crowded) within a gelatinous matrix; the gelatinous sheath hyaline, homogeneous, (often entirely) diffluent; protoplasm blue-green, homogeneous.

See Figure VI.

Habitat:

In old pools of standing fresh or brackish water, and among other algae on wet rocks, wood, and soil; often developing in old aquaria and cultures. Coccoid bacteria may be easily confused with this species. (Drouet and Daily, 1956 pg. 44)

Collections:

Not previously reported from Delaware.

Anacystis montana f. montana Drouet & Daily, 1956.

Plantae aerugineae, rubrae, nigrae, violaceae, vel olivaceae, in stratum gelatinosum vel libere inter alias algas ivolventes, cellulis in divisione binis depresso—sub-sphaericis (raro truncato-hemisphaericis) aetate provecta globosis diametro 2—6 micra (ad 20 micra ubi a fungis parasitatis) crassis, per gelatinum vaginale homoganeo vel lamelloso, primum hyaline deinde vulgo partim vel omnino rubrescente vel coerulescente vel lutescente; protoplasmate aerugineae, olivaceae, vel violaceae, homoganeo vel granuloso. (Drouet and Daily, 1956 pg. 52)

Plants blue-green, red, black, violet or olive, growing freely among other algae or in gelatinous layers, pairs of cells in division depressed-sub spherical (rarely truncate-hemispherical), older cells becoming globose 2—6 micra (up to 20 micra when parasitized by fungi) broad, arranged at random within an homogeneous or lamellose gelatinous matrix, at first hyaline, later becoming partly or entirely reddish, pale-bluish or yellowish; protoplasm blue-green, olive or violet, homogeneous or granulose.

See Figure VII.

Habitat:

In strata and among other algae on rocks, wood and soil wet by rains, and especially in seepage; often found in temporary pools and on emergent shores. (Drouet and Daily, 1956 pg. 52)

Collections:

Culture of algae from White Clay Creek at the University of Delaware, Newark, New Castle County; Marjorie Krauss (sic), August, 1969 (in herb. Acad. Nat. Sci. Phila.). In a pond in the dunes one mile south of Cape Henlopen, north of Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 21, 1948 (#'s 8522 and 8575 in herb. F. Drouet). On the wet southeast shore of Silver Lake, Rehoboth Beach, Sussex County; F. Drouet and H.B.

Louderback, August 12, 1948 (# 14889 in herb. Acad. Nat. Sci. Phila.). Laboratory culture from White Clay Creek at the University of Delaware, Newark, New Castle County; Marjorie Krauss (sic), August 22, 1973 (# UNI in herb. F. Drouet).

RB-D, on broken shells from marsh beach in bay water below the low water line, Big Nose Island marsh, Delaware Seashore State Park, Sussex County; R.D. Ralph, June 12, 1972 (# 720612RBD in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). RB-6, pool water with floating mats in the mixed Spartina patens - Distichlis zone, Big Nose Island marsh, Delaware Seashore State Park, Sussex County; R.D. Ralph, July 12, 1972 (# 720712RB6A in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-6, upper marsh pool bottom in mixed Spartina patens and Distichlis spicata, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, July 12, 1972 (# 720712SJ6 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-6, black crust dried over a shellheap on the roadbed in mid-marsh, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC6 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-12, on a shellheap in a mid-marsh spoil area, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, October 11, 1972 (# 721011CC12 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-A, on Spartina patens culms over ice, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, January 19, 1973 (# 730119SJA in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Previously reported from Delaware in Drouet and Daily, 1956 pg. 59.

Anacystis thermalis f. thermalis Drouet & Daily, 1956.

Plantae aerugineae, olivaceae, luteolae, violaceae, vel roseae, microscopicae, vulgo 1—8-cellulares, cellulis in divisione binis depresso—sub-sphaericis (raro truncato-hemisphaericis), aetate provecta globosis diametro (4—) 6—12 micra crassis, sine ordine per gelatinum vaginale distributis; gelatino vaginale hyalino, tenue, homoganeo vel lamelloso, firmo vel (etiam omnino) diffluyente; protoplasmate aerugineo, olivaceo, luteolo, violaceo, vel roseo, plerumque (saepe grossi-) granuloso. (Drouet and Daily, 1956 pg. 79)

Plants blue-green, olive, yellowish, violet or red, microscopic, commonly 1—8-celled, pairs of cells in division depressed-sub-spherical (rarely truncate-hemispherical), older cells becoming globose (4—) 6—12 micra broad, arranged at random within a gelatinous matrix; the gelatinous sheath hyaline, thin, homogeneous or lamellose, firm or (sometimes entirely) diffluent; protoplasm blue-green, olive, yellowish, violet or red, not uncommonly (often coarse-) granulose.

See Figure VIII.

Habitat:

Among other algae in seepage and in shallow fresh water, rarely in brackish water. Macroscopic plants rarely develop. In brackish water, plants interpreted as of this form may appear to be derived from the superficial cells of Entophysalis crustacea. (Drouet and Daily, 1956 pg. 79)

Collections:

CC-12, on a shellheap in mid-marsh spoil area, vicinity of the Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, October 11, 1972 (# 721011CC12 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Not previously reported from Delaware.

Coccochloris Sprengel, 1827.

Plantae microscopicae vel macroscopicae, 1—pluri-cellulares, cellulis in divisione subsphaericis usque ad cylindraceas, aetate provecta ovoideis usque ad longi-cylindraceas, divisione semper in uno plano ad axem cellulae perpendiculare; gelatino vaginale hyalino vel deinde (in C. stagnina) lutescente, homoganeo vel lamelloso. (Drouet and Daily, 1956 pg. 14)

Plants microscopic or macroscopic, uni- to pluri-cellular, cells in division subspherical up to cylindrical, becoming ovoid up to long-cylindrical when older, division always in one plane perpendicular to the axis of the cell; the gelatinous sheath hyaline or becoming (in C. stagnina) yellowish, homogeneous or lamellose.

Coccochloris elabens (Brébisson) Drouet & Daily, 1948.

Plantae aeruginosae, olivaceae, luteolae, violaceae, vel roseae, microscopicae vel macroscopicae, 1—pluri—multi-cellulares, cellulis in divisione binis quadrato-sphaericis usque ad elliptico-cylindraceas, aetate provecta cylindraceis, ad apices truncato-rotundis, diametro 2—6 micra crassis, usque ad 8-plo longiores, rectis, in matrice gelatinosa saepe conferte completis; gelatino vaginale hyaline, homoganeo, nonnumquam omnino diffluyente; protoplasmate aerugineo, olivaceo, luteolo, violaceo, vel roseo, homoganeo vel granuloso. (Drouet and Daily, 1956 pg. 29)

Plants blue-green, olive, yellowish, violet or red, microscopic or macroscopic, uni-, pluri- or multicellular, pairs of cells in division quadrate-spherical tending to elliptic-cylindrical, older cells becoming truncate-rotund at the apices, 2—6 micra broad, up to eight (8) times as long as broad, straight, often packed tightly together within a gelatinous matrix; the gelatinous sheath hyaline, homogeneous, sometimes entirely diffluent; protoplasm blue-green, olive yellowish, violet or red, homogeneous or granulose.

See Figure IX.

Habitat:

On wet rocks, wood, and soil, in seepage, in shallow fresh, brackish, and marine waters, and in the plankton. (Drouet and Daily, 1956 pg. 29)

Collections:

Not previously reported from Delaware.

Coccochloris Peniocyctis (Kützing) Drouet & Daily, 1948.

Plantae violaceae, roseae, vel aerugineae, microscopicae vel macroscopicae, 1—pluri—multi-cellulares, cellulis in divisione binis cylindraceis, aetate provecta longi-cylindraceis et ad apices rotundis, haud raro attentuato-conicis (sic), diametro 1—3 micra crassis, usque ad 12-plo longiores, curvatis vel rectis; gelatino vaginale hyaline, homoganeo vel lamelloso, saepe omnino diffluyente; protoplasmate violaceo, roseo, vel aerugineo, homoganeo, nonnumquam granuloso. (Drouet and Daily, 1956 pp. 32-33)

Plants violet, red, or blue-green, microscopic or macroscopic, uni-, pluri- or multicellular, pairs of cells in division cylindrical, older cells becoming long-cylindrical and rotund, not uncommonly attenuate-conical at the apices, 1—3 micra broad, up to twelve (12) times as long as broad, curved or straight; the gelatinous sheath hyaline, homogeneous or lamellose, often entirely diffluent; protoplasm violet, red or blue-green, homogeneous, but sometimes granulose.

See Figure x.

Habitat:

On wet rocks, wood, and soil, in seepage, in shallow and deep fresh water, and in the plankton. (Drouet and Daily, 1956 pg. 33)

Collections:

Not previously reported from Delaware.

Coccochloris stagnina Sprengel, 1807.

Plantae aerugineae, olivaceae, luteolae, brunneae, roseae, violaceae, vel nigrae, microscopicae vel macroscopicae, (1—)pluri—multi-cellulares, cellulis in divisione binis truncato-hemisphaericis usque ad truncato-ovoideas, aetate provecta ovoideis, ellipticis, vel raro elliptico-cylindraceutis, diametro (3—)4—8 micra crassis, usque ad 3-plo longiores; gelatino vaginale primum hyalino deinde lutescente vel brunnescente, homogeneo vel saepe conspicue lamelloso, nonnumquam omnino diffluente; protoplasmate aerugineo, olivaceo, luteolo, roseo, vel violaceo, plerumque homogeneo. (Drouet and Daily, 1956 pp. 18-19)

Plants blue-green, olive, yellowish, brownish, red or black, microscopic or macroscopic, uni-, pluri- or multi-cellular, pairs of cells in division truncate-hemispherical tending to truncate-ovoid, older cells ovoid, elliptical or rarely elliptic-cylindrical, (3—)4—8 micra broad, up to three (3) times as long as broad; the gelatinous sheath at first hyaline, later yellowish or brownish, homogeneous or often conspicuously lamelloso, sometimes entirely diffluent; protoplasm blue-green, olive, yellowish, red or violet, usually homogeneous.

See Figure XI.

Habitat:

Commonly found on soil, rocks, and wood in aerial and subaerial situations and in shallow fresh (occasionally in brackish and marine) waters, or free-floating in lakes and ponds. (Drouet and Daily, 1956 pg. 19)

Collections:

CC-6, black crust dried over a shellheap on the roadbed in mid-marsh, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC6 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-12, on a shellheap in a mid-marsh spoil area, vicinity Fisher homesite, Canary



Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph,  
October 11, 1972 (# 721011CC12 in herb. Univ. of Del. and  
Acad. Nat. Sci. Phila.).

Not previously reported from Delaware.

Gomposphaeria Kützing, 1836.

Plantae microscopicae, multicellulares, sphaericae vel ovoideae, varie tuberculosae et in divisione constrictae, cellulis sphaericis, ovoideis, cylindraceis, obovoideis, vel pyriformibus, radiatim in superficie thalli irregulariter aut in seriebus aliis ad alias perpendicularibus dispositis; divisione cellulae seriatim in duobus planis unoquodque ad alium et ad superficiem thalli perpendicularibus procedente; gelatino vaginale hyalino, homoganeo vel circum cellulas laminoso, saepe conspicua filiola dichotome ramosa a cellulis ad centrum thalli exhibente. (Drouet and Daily, 1956 pg. 93)

Plants microscopic, multicellular, spherical or ovoid, variously tuberclose and in division constricted, cells spherical, ovoid, cylindrical, obovoid, or pyriform, disposed at the surface of the thallus radiately either irregularly or in rows perpendicular to one another; cell division proceeds successively in two planes perpendicular to one another and to the surface of the thallus; the gelatinous sheath hyaline, homogeneous or around the cells laminose, often exhibiting conspicuous dichotomously branched filaments running from the cells to the center of the thallus.

Gomphosphaeria aponina Kützing, 1836.

Plantae aerugineae, olivaceae, luteolae, violaceae, vel roseae, sphaericae vel ovoideae aetate provecta varie constrictae, cellulis ovoideis, cylindraceis, obovoideis, vel pyriformibus, in divisione saepe cordiformibus, diametro ante divisionem 4—15 micra crassis, in superficie thalli irregulariter vel in seriebus aliis ad alias perpendicularibus ordinatis; gelatino vaginale hyalino, vulgo firmo nonnumquam (etiam omnino) diffluentes (sic), homoganeo vel lamellosa (sic), filiola dichotoma ad centrum thalli plerumque exhibente; protoplasmate aerugineo, olivaceo, luteolo, violaceo, vel roseo, homoganeo vel tenui-granuloso. (Drouet and Daily, 1956 pg. 98)

Plants blue-green, olive, yellowish, violet or red, spherical or ovoid, older plants becoming variously constricted, cells ovoid, cylindrical, obovoid or pyriform, in division often cordiform, before division 4—15 micra broad, arranged at the surface of the thallus either irregularly or in rows perpendicular to one another; the gelatinous sheath hyaline, perfectly firm sometimes (and also entirely) diffluent, homogeneous or lamellose, sometimes displaying dichotomous fibers at the center of the thallus; protoplasm blue-green, olive, yellowish, violet or red, homogeneous or fine-granulose.

See Figure XII.

Habitat:

In shallow fresh, brackish, and marine waters, in seepage, and in the plankton. (Drouet and Daily, 1956 pg. 98)

Collections:

Not previously reported from Delaware.

ENTOPHYSALIDACEAE (Borzi) Geitler, 1925.

Plantae uni—multi-cellulares, aquaticae, microscopicae vel macroscopicae, cellulis primum solitariis basim ad substratum affixis, unaquidque seriatim in cellulas-filias primo inaequales deinde aequales dividente et mox ab aliis cum gelatino vaginale se separante, deinde sursum supra superficiem substrati radiatim in stratum vel pulvinum solidum et deorsum intus substratum in filia ramosa increscentibus; cellulis quibuspiam se amplificare atque interne in paucas vel multas endosporas se dividere potentibus; reproductione a fragmentatione vel ab endosporis. (Drouet and Daily, 1956 pg. 100)

Plants uni- to multicellular, aquatic, microscopic or macroscopic, cells at first solitary basally affixed to the substrate, dividing successively into at first unequal and later equal daughter cells which may become separated from each other by the gelatinous sheath, growing above the surface of the substrate into solid layers or cushions and penetrating below the surface of the substrate in branched filaments; the cells are capable of enlarging and dividing internally at any time into a few or many endospores; reproduction via fission or endospores.

Entophysalis Kützing, 1843.

Plantae primo microscopicae aetate provecta macroscopicae, supra et intus substratum increscentes, cellulis solitariis forma diversis; cellulis pulvini sphaericis, ellipticis, cylindraccis, vel polyhedroideis, in seriebus indistincte radialibus vel erectis ordinatis; cellulis filorum intus substratum penetrantium cylindricis, hemisphaericis, sphaericis, ovoideis, vel polyhedroideis; endosporangiis diversiformibus; membrana endosporangii tenue. (Drouet and Daily, 1956 pg. 102)

Plants at first microscopic becoming macroscopic, growing above and within the substrate, solitary cells of diverse shapes; cells in the cushions spherical, elliptical, cylindrical, or polyhedral, arranged indistinctly in radial or vertical rows; cells of the filaments penetrating the substrate cylindrical, hemispherical, spherical, ovoid, or polyhedral; endosporangia of diverse forms; the walls of the endosporangia thin.

Entophysalis conferta (Kützing) Drouet & Daily, 1948

Plantae epi- vel endophyticae, microscopicae vel macroscopicae, primo unicellulares aetate provecta in stratum vel pulvinum olivaceum, aerugineum, violaceum, vel rubrum increscentes, cellulis solitariis sphaericis vel ovoideis vel pyriformibus, diametro ad 20 micra crassis; cellulis strati vel pulvini sphaeroideis, post divisiones praecipue sphaericis vel polyhedroideis, diametro (1—) 3—6 micra crassis; cellulis filorum penetrantium sphaericis, ovoideis, cylindraceis, vel polyhedroideis, diametro 3—8 micra crassis; endosporangiis sphaericis, obovoideis, cylindraceis, pyriformibus, vel tubaeformibus, diametro ad 50 micra crassis, solitariis vel disciformiter aggregatis; protoplasmate aerugineo, olivaceo, violaceo, vel roseo, homoganeo vel tenui-granuloso. (Drouet and Daily, 1956 pg. 113)

Plants epi- or endophytic, microscopic or macroscopic, at first unicellular, older plants growing in olive, blue-green, violet, or red layers or cushions, solitary cells spherical or ovoid or pyriform, up to 20 micra broad; cells of the layers or cushions spheroid, after divisions chiefly spherical or polyhedral, (1—) 3—6 micra broad; cells of the filaments penetrating the substrate spherical, ovoid, cylindrical or polyhedral, 3—8 micra broad; endosporangia spherical, obovoid, cylindrical, pyriform or trumpet-shaped, up to 50 micra broad, solitary or aggregated in discs; protoplasm blue-green, olive, violet or red, homogeneous or fine-granulose.

See Figure XIII.

Habitat:

Epiphytic and endophytic on larger algae of marine and brackish waters, the smaller growth-forms developing on ephemeral hosts, the more massive growth-forms on the perennial hosts (Drouet and Daily, 1956 pp. 113-114)

Collections:

CC-7, on Microcoleus lyngbyaceus in a dry panne, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, August 3, 1972 (# 720803CC7 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-2, on Microcoleus lyngbyaceus in the mixed Spartina alterniflora var. pilosa and Salicornia zone, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph September 14, 1972 (# 720914CC-2 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Not previously reported from Delaware.

Entophysalis deusta (Meneghini) Drouet & Daily, 1948.

Plantae in stratum aut pulvinum microscopicum vel macroscopicum, olivaceum, violaceum, roseum, brunneum, vel nigrum, firmum vel molle vel dissolvens increscentes, cellulis solitariis sphaericis, ovoideis, vel pyriformibus, diametro ad 10 micra crassis; cellulis pulvini sphaeroideis, post divisiones praecipue polyhedroideis, diametro (1—) 3—6 micra crassis; cellulis filorum intus substratum penetrantium ovoideis, sphaericis, cylindraccis, vel polyhedroideis, vulgo uniseriatis interdum multiseriatis, diametro (1—) 2—15 micra crassis; endosporangiis sphaericis vel ovoideis, diametro ad 30 micra crassis; gelatino vaginale primum hyalino demum lutescente vel raro rubrescente vel coerulescente, homoganeo vel lamelloso; protoplasmate aerugineo, olivaceo, luteolo, violaceo, vel roseo, vulgo homoganeo. (Drouet and Daily, 1956 pg. 105)

Plants in microscopic or macroscopic layers or cushions, blue-green, violet, red, brownish or black, firm or soft or becoming broken up; solitary cells spherical, ovoid or pyriform, up to 10 micra broad; cells in the cushions spheroid, after division chiefly polyhedral, (1—) 3—6 micra broad; cells in filaments penetrating the substrate ovoid, spherical, cylindrical or polyhedral, generally uniseriate, occasionally multiseriate, (1—) 2—15 micra broad; endospores spherical or ovoid, up to 30 micra broad; the gelatinous matrix at first hyaline, later yellowish or rarely reddish or pale-bluish, homogeneous or lamellose; protoplasm blue-green, olive, yellowish, violet or red, commonly homogeneous.

See Figure XIV.

Habitat:

Intertidal or below low tide mark on marine rocks, shells, wood, and soil, and on similar substrata in brackish water. (Drouet and Daily, 1956 pg. 105)

Collections:

On a wooden jetty, Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 24, 1948 (# 8562 in herb. F. Drouet). On barnacles on iron breakwater at the

lighthouse, Harbor of Refuge, Lewes, Sussex County; J.S. Zaneveld, W.D. Barnes and H.W. West, June 17, 1961 (# D-74 in herb. F. Drouet). On a stone breakwater, Rehoboth Bay, Sussex County; J.S. Zaneveld, W.D. Barnes and H.W. West, June 20, 1961 (# D-85 in herb. F. Drouet).

CH-A, tidal flats south of Cape Henlopen on shells at the high water line on the bay shore, Cape Henlopen State Park, Sussex County; R.D. Ralph, June 12, 1972 (# 720612CHA in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). RB-D, on broken shells from marsh beach in bay water below the low water line, Big Nose Island marsh, Delaware Seashore State Park, Sussex County; R.D. Ralph, June 12, 1972 (# 720612RBD in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Previously reported from Delaware in Drouet and Daily, 1956 pg. 107, and in Zaneveld, 1966 pg. 113, and 1972 pg. 128.



## NOSTOCACEAE Nägeli, 1847.

Cellulae in trichomatibus filiformibus conjunctae, saepius uniseriatae. Propagatio fragmentis trichomatis motu praeditis (hormogoniis) perfecta. Trichomata e cellulis dissimilibus formata, aliis vegetativis ad divisionem indefinite repetitam valentibus, aliis in heterocystas vel in pilum mutatis. (Bornet and Flahault, 1886 pg. 337)

Cells joined together in filiform trichomes, most often uniseriate. Propagation effected via fragmentation of the trichomes at will into hormogones. Trichomes made up of dissimilar cells, some vegetative capable of indefinitely repeated division, others changed into heterocysts or hair-like processes.

"Myxophyceae of which the uniseriate trichomes may develop heterocysts, but do not branch, constitute the Nostocaceae." (Drouet, 1973 pg. 1).

Anabaena Bory, 1822.

Trichomata aequalia vel ad apices sensim attenuata, evaginata vel vaginis saepius evanescentibus cincta, libera vel in stratum mucosum congesta. Cellulae apicales difformes. Heterocystae intercalares plures. Sporae situs varii, modo heterocystis utrinque contiguae, modo inter cellulas vegetativas ortae, solitariae vel catenatae. (Bornet and Flahault, 1888 pg. 224)

Trichomes of equal diameter throughout or apparently attenuated at the apices, naked or ensheathed or only often ephemerally so, free or massed in mucous layers. Terminal cells of various forms. Many intercalary heterocysts. Spores variously situated, sometimes contiguous to the heterocysts, sometimes between vegetative cells, solitary or in catenate series.

Anabaena torulosa (Carmichael) Lagerheim, 1883.

Strato mucoso, tenui, aerugineo; trichomatibus 4.2—5 micra crassis, cellula ultima acute conica; articulis doliiformibus diametro aequicrassis vel paulo brevioribus; heterocystis sub-sphaericis vel ovoideis, 6 micra crassis, 6—10 micra longis; sporis brevibus, subcylindratis, 7—12 micra crassis, diametro saepius duplo longioribus, apicibus depressis, in media parte saepius leviter constrictis, heterocysta proximis, evolutione centripeta, episporio laevi, in sporis maturis pallide fuligineo. (Bornet and Flahault, 1888 pg. 237)

In thin, blue-green, mucous layers; trichomes 4.2—5 micra broad, the terminal cell acute conical; cells keg-shaped, equal to or a little shorter than broad; heterocysts subspherical or ovoid, 6 micra broad, 6—10 micra long; spores short, subcylindrical, 7—12 micra broad, nearly twice as long as broad, depressed at the apices, very slightly constricted at the middle, produced centripetally, contiguous to the heterocysts, episporia thin, in mature spores pale smoke-colored.

See Figure XV.

Habitat:

On moist soil, or in still water, floating or attached to aquatic plants, found in both fresh water and saltwater. (Cocke, 1967 pg. 99)

Collections:

In a shallow brackish pond in the dunes behind the beach about one mile south of Cape Henlopen, north of Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 24, 1948 (#'s 8572 & 8573 in herb. F. Drouet; filed as Anabaena oscillarioides).

CC-1, part of extensive mats over bare mud on a marsh trail in natural pannes in the Salicornia - Distichlis zone near the upper marsh margin, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, August 3, 1972 (# 720803CC-1A in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).  
CC-10, on a natural panne in the Distichlis zone of the upper marsh margin, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC10 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Not previously reported from Delaware.

Anabaena variabilis Kützing, 1843.

Strato gelatinoso ad terram expanso, vel libere natante, atroviridi; trichomatibus flexuosis, 4—6, saepius 4.2—5 micra crassis, plerumque evaginatibus, cellula terminali obtuse conica; articulis doliiformibus 2.5—6 micra longis, vel subquadratis, geniculis parum constrictis; heterocystis sphaericis vel ovalibus, 6 micra latis, 8 micra longis; sporis ovalibus, apicibus truncatis, plurimis catenatis, 7—9 micra crassis, 8—14 micra longis, ab heterocystis remotis, evolutione centrifuga, episporio in sporis maturis laevi, luteo-fusco. (Bornet and Flahault, 1880 pp. 226-227)

In dark green gelatinous layers spreading on soil, or freely floating; trichomes flexuous, 4—6, more often 4.2—5 micra broad, frequently without a sheath, terminal cells obtuse conical; cells keg-shaped, 2.5—6 micra long, or subquadrate, slightly constricted at the joints; heterocysts spherical or oval, 6 micra broad, 8 micra long; spores oval, truncate at the ends, many in catenate series produced centrifugally and remote from the heterocysts, episporia in mature spores thin, yellowish-brown.

See Figure XVI.

Habitat:

Common on damp soil or floating with other algae in either fresh water or saltwater. (Cocke, 1967 pg. 97)

Collections:

In a shallow brackish pond in the dunes behind the beach about one mile south of Cape Henlopen, north of Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 24, 1948 (# 8573 in herb. F. Drouet; filed as Anabaena oscillarioides).

Not previously reported from Delaware.

Calothrix Agardh, 1824.

Trichomata cylindrica vel plus minusve torulosa, unum extremum vel utrinque extrema saepe per aliquot cellulas attentuantia atque decolorantia vel tumefacientia, septata, ambitu recta vel curvantia vel spiralia, cellulis terminalibus vegetativis primum hemisphaericis demum obtuse conicis aut cylindricis atque ad extrema rotundis; heterocystis plus minusve sphaericis vel cylindraceis terminalibus vel intercalaribus; sporis plus minusve cylindricis vel ovoideis. Materia vaginalis dispersa vel mucosa vel discreta. Planta trichomata nuda vel in muco vel in vaginis cylindraceis discretis saepe ramosis comprehens. (Drouet, 1973 pg. 98)

Trichomes cylindrical or more or less torulose, attenuating and often becoming hyaline through several cells, or becoming swollen, at one or both ends, septate, straight or curving or spiraled, the terminal vegetative cells at first hemispherical becoming obtuse-conical or cylindrical and at the tips rotund; heterocysts terminal or intercalary, more or less spherical or cylindrical; spores more or less spherical or ovoid. Sheath material dispersed or mucous or discrete. Plant composed of naked trichomes or trichomes in mucus or discrete, more or less cylindrical, often branched sheaths.

Calothrix crustacea Schousboe & Thuret, 1876.

Trichomata aeruginea, luteo-viridia, olivacea, fusca, rosea, violacea, vel cinereo-viridia, cylindrica vel ad extrema abrupte attenuata vel ad unum extremum tumida, ad dissepimenta constricta vel non-constricta, diametro 3—22 micra crassa, partim aut passim increscentia partim decrescentia, ambitu recta vel curvantia vel spiralia, longitudine indeterminata, per destructionem cellulae intercalaris aut per constrictionem ad dissepimentum frangentia, ad unum extremum vel ad utrinque extrema per paucas pluresve cellulas attenuatas decolorantes terminantia. Cellulae diametro trichomatis breviores vel longiores, 2—20 micra longae, protoplasmate homoganeo vel granuloso raro pseudovacuoolato, dissepimentis non granulatis; heterocystae vulgo ad solum extremum nonnumquam ad utrinque extrema terminales, vel intercalares, interdum seriatae, hemisphaericae vel quasi-sphaericae vel discoideae vel cylindricae, diametro 4—23 micra crassae; sporae ignotae; cellulae vegetativae terminales primum hemisphaericae demum obtuse conicae. Materia vaginalis primum hyalina demum lutea vel fusca. Planta trichomata longa vel brevia vulgo in vaginis descretis laminosis cylindricis saepe ramosis aut in gelatina distributa comprehens. (Drouet, 1973 pg. 180)

Trichomes blue-green, yellow-green, olive, brown, red, violet, or gray-green, cylindrical or abruptly attenuated at one end or at both ends or swollen at one end, constricted or not constricted at the cross walls, 3—22 micra in diameter, in part here and there increasing or decreasing in diameter, straight or curving or spiraled, indeterminate in length, breaking by the destruction of an intercalary cell or by constriction at a cross wall, often terminating at one end or at both ends in few or many attenuated colorless cells. Cells shorter or longer than the diameter of the trichome, 2—20 micra long, the protoplasm homogeneous or granulate, rarely pseudovacuoolate, the cross walls not granulated; heterocysts terminal at one end or at both ends, or intercalary, sometimes seriate, hemispherical or almost spherical or discoid or cylindrical, 4—23 micra in diameter; spores unknown; terminal vegetative cells at first hemispherical, becoming obtuse-conical. Sheath material at first hyaline, becoming yellow or brown. Plant consisting of long or short trichomes commonly in discrete laminate cylindrical, often branching, sheaths, or distributed in gelatinous matrices.

See Figure XVII.

Habitat:

Exclusively from marine and brackish water, covers rocks, wood, shells, metal, and larger plants and animals between and below tide limits, cosmopolitan, often in association with Schizothrix calcicola (Ag.) Gom., Microcoleus lyngbyaceus (Kütz.) Cr. and Entophysalis deusta (Mene.) Dr. & Daily. (Drouet, 1973 pg. 181)

Collections:

Above the high tide line level on wooden jetty near Hotel Henlopen, Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 24, 1948 (# 8562 in herb. F. Drouet). Rehoboth Bay, Sussex County; J.S. Zaneveld, R.J. Smith, H.W. West and W.D. Barnes, June 20, 1961 (# D-87 in herb. Acad. Nat. Sci. Phila.). On the outer breakwater, Harbor of Refuge, Lewes, Sussex County; J.S. Zaneveld, W.D. Barnes and H.W. West, June 19, 1961 (# D-79b in herb. Acad. Nat. Sci. Phila.).

CC-12, on a shellheap in a mid-marsh spoil area, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, October 11, 1972 (# 721011CC12 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Previously reported from Delaware in Zaneveld, 1966 pp. 114-115, and 1972 pg. 128, and in Drouet, 1973 pg. 189.

Calothrix parietina (Nägeli) Thuret, 1875.

Trichomata aeruginea, luteo-viridia, olivacea, fusca, rosea, violacea, vel cinereo-viridia, cylindrica vel extrema longe et sensim attenuantia, vel ad unum extremum tumida, ad dissepimenta constricta vel non-constricta, diametro 3—24 micra crassa, partim aut passim increscentia partim decrescentia, ambitu recta vel curvantia vel spiralia, longitudine indeterminata, per destructionem cellulae intercalaris vel per constrictionem ad dissepimentum frangentia, ad unum extremum vel utrinque extrema per paucas vel plures cellulas angustas perlongas decolorantes terminantia. Cellulae diametro trichomatis longiores vel breviores, 3—20 micra longae, protoplasmate homoganeo vel granuloso saepe pseudovacuolato, dissepimentis non granulatis; heterocystae saepe ad solum extremum nonnumquam ad utrinque extrema terminales, vel intercalares, interdum seriatae, hemisphaericae vel quasi-sphaericae vel discoideae vel cylindricae, diametro 4—25 micra crassae; sporae cylindricae vel ovoideae raro sphaericae, solitariae vel seriatae, muris hyalinis vel lutescentibus vel fuscescentibus; cellulae vegetativae cylindricae ad extrema rotundae. Materia vaginalis primum hyalina demum lutea vel fusca. Planta trichomata longa vel brevia nuda aut vulgo in vaginis discretis cylindricis saepe ramosis, vulgo laminosis, aut in gelatina distributa comprehens. (Drouet, 1973 pg. 138)

Trichomes blue-green, yellow-green, olive brown, red, violet, or gray-green, cylindrical or toward the tips long and noticeably attenuating, or at one tip swollen, constricted or not constricted at the cross walls, 3—24 micra in diameter, straight or curving or spiraled, indeterminate in length, breaking by the destruction of an intercalary cell or by constriction at a cross wall, partly or here and there increasing or decreasing in diameter, often terminating at one end or at both ends in few to many long, narrow cells which lose their pigments. Cells longer or shorter than the diameter of the trichomes, 3—20 micra long; the protoplasm homogeneous or granulate, often pseudovacuolate, the cross walls not granulated; heterocysts often terminal at one end or at both ends of the trichome, or intercalary, sometimes seriate, hemispherical or almost spherical or discoid or cylindrical, 4—25 micra in diameter; spores cylindrical or ovoid, rarely spherical, solitary or seriate, the walls hyaline or becoming yellow or brown; terminal vegetative cells at first hemispherical, becoming obtuse-conical or cylindrical with rotund tips. Sheath material at first hyaline, becoming yellow or brown. Plants consisting of long or short naked trichomes or trichomes in discrete cylindrical, often branched sheaths, or distributed in gelatinous matrices.



See Figure XVIII.

Habitat:

Cosmopolitan, on rocks, soil, wood, larger plants and animals, shells, and other substrates, in places influenced by fresh water, seldom by brackish or slightly marine water. (Drouet, 1973, pg. 139)

Collections:

In shallow water, freshwater pond south of the golf course, Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 23, 1948 (# 8539 in herb. F. Drouet).

Previously reported from Delaware in Drouet, 1973 pg. 153.

Cylindrospermum Kützing, 1843.

Trichomata aequalia, brevia, evaginata, muco amorpho involuta, in stratum indefinite expansum aggregata; articuli cylindrici diametro longiores. Heterocystae terminales. Sporae sub heterocysta ortae, singulae, rarius plurimae seriatae. (Bornet and Flahault, 1888 pg. 249)

Trichomes of equal diameter throughout, short, naked, enveloped in an amorphous mucus, aggregated in indefinitely expanded layers; cells cylindrical, longer than broad. Heterocysts terminal. Spores arising beneath the heterocysts, single, very rarely many in a series.

Cylindrospermum licheniforme Kützing, 1847.

Strato mucoso orbiculari-confluente, demum late expanso, intense nigro-viridi; trichomatibus 4.2 micra crassis, laete aerugineis, articulis 4—5 micra longis, ad genicula parum contractis; heterocystis oblongis, 5—6 micra crassis, 7—12 micra longis; sporis oblongis seu ventricoso-ellipticis utroque polo truncatis, 12—14 micra crassis, 20—30 micra, rarius usque ad 38 micra longis, episporia laevi fusco-rubrescente. (Bornet and Flahault, 1888 pg. 253)

In intensely blackish-green, orbicular-confluent mucous layers, later becoming expanded; trichomes 4.2 micra broad, light blue-green, cells 4—5 micra long, slightly constricted at the joints; heterocysts oblong, 5—6 micra broad, 7—12 micra long; spores oblong or if ventricose-elliptical, then truncate at the apices, 12—14 micra broad, 20—30 micra, rarely up to 38 micra long, the episporia thin, reddish-brown.

See Figure XIX.

Habitat:

Common on moist soil, mud, and submerged objects in shallow water. (Cocke, 1967 pg. 84)

Collections:

Mud on the margin of the freshwater pond between Hotel Henlopen and the water-tower, Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 23, 1948 (#'s 8544, 8547 & 8556 in herb. F. Drouet).

Not previously reported from Delaware.

Nodularia Mertens, 1822.

Fila libera vaginata. Trichomata sterilia eximie aequalia. Vagina hyalina arcta, plerumque tenerrima, mucosa, nonnumquam evanescens. Articuli breves depressi, disciformes. Heterocystae compressae. Sporae globosae, subglobosae vel disciformes, in intervallo heterocystarum seriatae, episporio laevi. (Bornet and Flahault, 1888 pg. 243)

Filaments free, ensheathed. Sterile trichomes exceedingly close in diameter throughout. Sheath hyaline, arched, sometimes very soft, mucous, occasionally disappearing. Cells short, depressed, discoid. Heterocysts compressed. Spores globose, subglobose or discoid, borne in series in the spaces between the heterocysts, episporous thin.

Nodularia Harveyana (Thwaites) Thuret, 1875.

Filis tenuioribus, 4—5, interdum 6 micra crassis, utroque fine attenuatis et cellula obtuse conica terminatis; vagina tererrima, hyalina, distincta; articulis ante divisionem diametro fere aequilongis vel paulo longioribus; sporis subglobosis, luteo-fuscis, 8 micra crassis. (Bornet and Flahault, 1888 pg. 244)

Filaments 4—5 micra, sometimes 6 micra broad, fine-attenuated and terminated by obtuse conical cells; sheaths thin, colorless, distinct; cells before division about as long as broad or a little longer; spores 8 micra broad, somewhat spherical, yellowish-brown.

See Figure xx.

Habitat:

Grows well in either salt water or fresh water. Common in shallow ponds and pools. (Cocke, 1967 pg. 88)

Collections:

CC-12, on a shellheap in a mid-marsh spoil area, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, October 11, 1972 (# 721011CC12 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Not previously reported from Delaware.

Nodularia spumigena Mertens, 1822.

Filis in stratum mucosum implicatis vel sparsis, interdum libere natantibus, subrectis vel circinnatis; vagina nunc tenui, nunc crassiori; articulis brevissimis disciformibus trichomatis diametro 3- ad 4-plo brevioribus; heterocystis articularum deametro paulo majoribus; sporis ab heterocystis remotis, saepius numerosis, luteo-fuscis. (Bornet and Flahault, 1888 pp. 245-246)

Filaments densely entangled or scattered in a mucous layer, sometimes freely floating, nearly straight or variously curved; sheath sometimes thin, sometimes broader; cells very short, discoid, three (3) to four (4) times shorter than broad; heterocysts a little larger than the cells; spores remote from the heterocysts, often numerous, yellowish-brown.

var. litorea (Kützing) Bornet & Flahault, 1888.

Filis 12—16 micra crassis; sporis sphaerico-compressis 14 micra circiter latis, 10 micra longis. (Bornet and Flahault, 1888 pg. 247)

Filaments 12—16 micra broad; spores compressed-spherical, 14 micra across the middle, 10 micra long.

See Figure XXI.

Habitat:

Floating or attached in standing water, either salt water or fresh water. (Cocke, 1967 pg. 88)

Collections:

Not previously reported from Delaware.

Nostoc Vaucher, 1803.

Thallus mucosus, gelatinosus vel coriaceus, initio globosus vel oblongus, demum in speciebus diversis formas varias induens (globosus, foliosus, filiformis, bullosus, maculiformis), solidus vel cavus, liber vel affixus, strato corticali densiori (peridermide dicto) et saturatius colorato cinctus. Fila flexuoso-curvata et implicata, in thallum coalita; vaginae nunc ubique distinctae, nunc confluentes indiscernendae. Trichomata saepius torulosa. Articuli sphaerico-depressi, doliiformes vel cylindrici. Heterocystae intercalares et (in junioribus) terminales. Sporae sphaericae vel oblongae, ad medium inter heterocystas seriatae, evolutione centrifuga. (Bornet and Flahault, 1938 pg. 181).

Thallus mucous, gelatinous or coriaceous, at first globose or oblong, later in diverse species assuming various forms (globose, foliose, filiform, bullose, maculiform), solid or hollow, free or attached, the superficial surrounding layer (called the periderm) more dense and highly colored. Filaments flexuous-curved and entangled in the thallus; sheaths sometimes quite distinct, sometimes confluent and indistinct. Trichomes nearly always torulose. Cells spherical-depressed, keg-shaped or cylindrical. Heterocysts intercalary and in younger trichomes terminal. Spores spherical or oblong, produced centrifugally in series midway between the heterocysts.

Nostoc commune Vaucher, 1803.

Thallo gelatinoso firmo, primum globoso, dein applanato difformi, demum in laminas undulato-plicatas, carnosas vel membranaceas, integras vel laciniatas, saepe pertusas, superficie coriaceas explanato, colore aerugineo, olivaceo vel fusco; filis flexuosis intricatis; vaginis exterioribus plerumque fuscescentibus, interioribus plus minus distinctis saepius hyalinis; trichomatibus 4.5—6, saepius 5 micra crassis, articulis sphaerico-depressis vel doliiformibus; heterocystis 7 micra crassis subsphaericis saepe ternis quinisque; sporis haud notis. (Bornet and Flahault, 1888<sup>e</sup> pg. 206)

Thallus firm, gelatinous, at first globose, later becoming flattened, eventually in undulate-folded layers, or fleshy or membranaceous, entire or lacinate, often perforate, superficially coriaceous sheets, colored blue-green, olive or brown; filaments flexuous, entangled; sheath toward the exterior somewhat brownish, towards the interior often more or less distinctly hyaline; trichomes 4.5—6 micra, often 5 micra, broad; cells depressed-spherical or keg-shaped; heterocysts 7 micra broad, subspherical, often in groups of three (3) or five (5); spores unknown.

See Figure XXII.

Habitat:

On soil in damp places and in ditches and ponds or on flood plains, cosmopolitan. (Bornet and Flahault, 1888 pg. 206)

Collections:

CC-12, on a hollow in a old-marsh spoil area, vicinity Fisher home site, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.E. Ralph October 11, 1972 (# 721011CC12 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Not previously reported from Delaware.



Nostoc ellipso sporum (Desmazières) Rabenhorst, 1865.

Thallo gelatinoso expanso, pagina inferiori adnato, irregulariter mamilloso, rufo-fusco; filis flexuosis laxè intricatis; trichomatibus 4 micra crassis conformibus, dilute aeruginosis vel olivaceis, articulis cylindricis 6—14 micra longis; heterocystis subsphaericis vel oblongis, 6—7 micra latis, 6—14 micra longis; sporis ellipticis vel oblongo-cylindricis, 6—8 micra crassis, 14—19 micra longis, episporio laevi, hyalino vel lutescente. (Bornet and Flahault, 1888 pp. 198-199).

Thallus gelatinous, expanded, adhering by the underside, irregularly mamilllose, reddish-brown; filaments flexuous, laxly entangled; trichomes uniformly 4 micra broad, pale blue-green or olive; cells cylindric 6—14 micra long; heterocysts subspherical or oblong, 6—7 micra broad, 6—14 micra long; spores elliptical or oblong-cylindrical, 6—8 micra broad, 14—19 micra long, walls smooth, hyaline or yellowish.

See Figure XXIII.

Habitat:

On moist soil often with mosses and liverworts.  
(Cocke, 1967 pg. 91)

Collections:

CC-12, on a shellheap in a mid-marsh spoil area, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph October 11, 1972 (# 721011CC12 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Not previously reported from Delaware.

Nostoc muscorum Agardh, 1812.

Thallo gelatinoso-membranaceo irregulariter expanso, pagina inferiori adnato, tuberculoso, sordide olivaceo vel fusco; filis flexuosis dense intricatis; trichomatibus 3—4 micra crassis, conformibus, olivaceis, articulis sphaericodoliiformibus vel cylindratis diametro subduplo longioribus; heterocystis subglobosis, 6—7 micra latis; sporis oblongis catenatim seriatis, numerosis, 4—8 micra latis, 8—12 micra longis (saepius 8 et 12 micra), episporio laevi lutescente. (Bornet and Flahault, 1888 pp. 200-201)

Thallus gelatinous-membranaceous, irregularly expanded, adhering by the lower surface, tuberclose, dull olive or brown; filaments flexuous, densely entangled; trichomes uniformly 3—4 micra broad, olive, cells spherical or keg-shaped or cylindrical, about twice as long as broad or less; heterocysts subglobose, 6—7 micra broad; spores oblong, numerous in catenate series, 4—8 micra broad, 8—12 micra long (often 8 and 12 micra, respectively), episporium smooth, yellowish.

See Figure XXIV.

Habitat:

With mosses and on the soil in damp places.  
(Bornet and Flahault, 1888 pg. 201)

Collections:

Raymond pool (fresh), Sombay Hook Wildlife Refuge, Smyrna, Kent County; P.F. Springer, July 28, 1953 (# 47 in herb. F. Lecout).

Not previously reported from Delaware.

Scytonema Agardh, 1812.

Trichomata cylindrica vel plus minusve torulosa, septata, ambitu recta vel curvantia vel spiralia, ad extrema tumescentia aut apices saepe per aliquot cellulas attenuantia, cellulis terminalibus vegetativis hemisphaericis demum fere sphaericis, heterocystis plus minusve sphaericis vel cylindricis terminalibus vel intercalariibus, sporis plus minusve cylindricis. Materia vaginalis dispersa vel mucosa vel discreta. Planta trichomata nuda vel in muco vel in vaginis plus minusve cylindraceis discretis saepe ramosis comprehens. (Drouet, 1973 pg. 21)

Trichomes cylindrical or more or less torulose, septate, either straight or curving or spiraling, swollen at the apices or otherwise often attenuated through several cells, the terminal vegetative cells menispherical later becoming nearly spherical, heterocysts more or less spherical or cylindrical, terminal or intercalary, spores more or less cylindrical. Sheath material disperse or mucous or discrete. Plants of naked trichomes or of trichomes in mucus or in more or less discrete cylindrical, often branched sheaths.

Scytonema Hofmannii Agardh, 1817.

Trichomata aeruginea, luteo-viridia, olivacea, fusca, rosea, violacea, vel cinereo-viridia, praecipuius cylindrica atque ad dissepimenta plus minusve constricta, raro partim torulosa, diametro 3—30 micra crassa, partim et passim decrescens passim increscens, ambitu recta vel curvata vel spiralia, longitudine indeterminata, per destructionem cellulae intercalaris vel per constrictionem ad dissepimentum frangens, ad externa aliquantulum tumescens aut apices saepe per paucas vel plures cellulas terminales attenuans. Cellulae diametro trichomatis longiores vel breviores, 3—20 micra longae, protoplasmate homogeneo vel granuloso, raro pseudovacuolato, dissepimentis non granulatis; heterocystae intercalares et terminales nonnumquam seriatae, cylindricae vel hemisphaericae vel quasisphaericae vel discoideae, diametro 4—30 micra crassae; sporae cylindricae, seriatas, muris lutescentibus vel fusciscentibus; cellulae vegetativae terminales hemisphaericae usque ad fere sphaericis. Materia vaginalis primum hyalina demum lutea vel fusca. Planta trichomata longa vel brevia vulgo in vaginis discretis cylindricis ramosis, saepe laminosis, raro in gelatina distributa comprehens. (Drouet, 1973 pg. 63)

Trichomes blue-green, yellow-green, olive, brown, red, violet or gray-green, mostly cylindrical and more or less constricted at the cross walls, rarely in part torulose, 3—30 micra broad, here and there and in part increasing or decreasing, either straight or curved or spiraled, indeterminate in length, breaking by means of the destruction of intercalary cells or by constriction at a cross wall, somewhat swollen at the ends or attenuated through few or many terminal cells at the apices. Cells longer or shorter than the diameter of the trichome, 3—20 micra long, protoplasm homogeneous or granular, rarely pseudovacuate, cross walls not granulated; heterocysts intercalary and terminal sometimes seriate, cylindrical or hemispherical or quasi-spherical or discoid, 4—30 micra broad; spores cylindrical, seriate, the walls becoming yellowish or brownish; the terminal vegetative cells hemispherical up to nearly spherical. Sheath material at first hyaline later yellow or brown. Plants of long or short trichomes commonly in discrete cylindrical, often laminose sheaths, rarely disposed in gelatine.

See Figure XXV.

Habitat:

Cosmopolitan, occupying habitats influenced by fresh water and often becoming acclimated to marine waters. (Drouet, 1973 pg. 64)

Collections:

Not previously reported from Delaware.

OSCILLATORIACEAE (S.F. Gray) Harvey, 1841.

Plantae trichomata anheterocystosa non-ramosa nuda vel in muco vel in vaginis cylindraceis plus minusve discretis comprehentes. Trichomata cylindracea vel plus minusve torulosa, diametro 0.4—90 micra crassa, longitudine indeterminata, dissepimentis a membrana externa ad centrum perpendiculare crescentibus divisa, per destructionem cellularum intercalarium vel per constrictionem ad dissepimenta frangentia, ad apices cylindrica vel attenuata. Cellulae diametro longiores vel breviores, protoplasmate homogeneo vel granuloso, dissepimentis (in aliquot speciebus) granulatis. Cellulae apicales hemisphaericae vel conicae, membrana superna tenui vel (in aliquot speciebus) incrassata. (Drouet, 1962 pg. 15)

Plants of unbranched trichomes without heterocysts, naked or in mucus or in more or less discrete cylindrical sheaths. Trichomes cylindrical or more or less torulose, 0.4—90 micra broad, indeterminate in length, divided by cross walls which grow from the outer walls centripetally toward the center, breaking by the destruction of intercalary cells or by constriction at a cross wall, at the tips cylindrical or attenuate. Cells longer or shorter than broad, protoplasm homogeneous or granular, the cross walls (in some species) granulated. Apical cells hemispherical or conical, the outer membrane thin or (in some species) thickened.

Arthrospira Stizenberger, 1854.

Trichomata cylindrica vel plus minusve torulosa, septata, ambitu recta vel curvantia vel spiralia, ad apices saepe attenuata, apicibus rotundis vel conicis, membrana superna cellulae terminalis non incrassata, protoplasmate homogeneo vel granuloso, dissepimentis atque membranis parietalibus dense granulatis. Materia vaginalis nulla vel mucosa vel discreta. Planta trichomata nuda vel in muco vel in vaginis cylindraceutis discretis comprehens. (Drouet, 1968 pg. 215)

Trichomes cylindrical or more or less torulose, septate, either straight or curved or spiraled, often attenuated toward the apices, the apices rotund or conical, the outer membrane of the terminal cell not thickened, protoplasm homogeneous or granulate, the cross walls and side walls densely granulated. Sheath material absent or mucous or discrete. Plants of naked trichomes or of trichomes in mucus or in discrete cylindrical sheaths.

Arthrospira Jenneri (Hassall) Stizenberger, 1854.

Trichomata aeruginea, luteo-viridia, olivacea, fusca, rosea, violacea, vel cinereo-viridia, cylindrica, ad dissepimenta passim constricta, diametro 3—8 micra crassa, partim et passim increscentia passim decrescentia, ambitu spiralia nonnumquam curvantia vel recta, longitudine indeterminata, per destructionem cellulae intercalaris vel per constrictionem ad dissepimentum frangentia, aliquot cellulas terminales saepe aliquantum attenuantia. Cellulae quadratae vel brevioris quam latae, 2—4 micra longae, protoplasmate homoganeo vel granuloso, nonnumquam pseudo-vacuolato, dissepimentis et membranis parietalibus granulatis. Cellula apicalis primum cylindrica deinde hemisphaerica, membrana superna non incrassata. Materia vaginalis hyalina, chlorozincico iodurato non caerulescens. Planta trichomata longa vel brevia nuda aut in muco amorpho vel solitaria in vaginis plus minusve discretis comprehens. (Drouet, 1968 pg. 217)

Trichomes blue-green, yellow-green, olive, brown, red, violet, or gray-green, cylindrical, constricted here and there at the cross walls, 3—8 micra broad, in part and here and there increasing or decreasing in diameter, spiraled or sometimes curving or straight, capable of indeterminate growth in length, breaking by means of the destruction of an intercalary cell or by constriction at a cross wall, somewhat attenuated at the tips, the attenuation involving several cells. Cells quadrate or shorter than broad, 2—4 micra long, protoplasm homogeneous or granulate, sometimes pseudovacuolate, the cross walls and outer walls lined with dense granulate protoplasm. Terminal cell at first cylindrical, becoming hemispherical, the outer membrane not thickened. Sheath material hyaline, not turning blue in chlor-zinc-iodide. Plant consisting of long or short naked trichomes, or of trichomes in an homogeneous mucus, or of solitary trichomes in more or less discrete sheaths.

See Figure XXVI.

Habitat:

Permanent bodies of fresh water, rarely seen in brackish and salt waters. (Drouet, 1968 pg. 217)



Collections:

SJ-2, on the mud in the Spartina patens zone,  
St. Jones marsh, Barkers Landing, Kent County; R.D.  
Ralph, August 3, 1972 (# 720803SJ2B in herb. Univ. of  
Del. and Acad. Nat. Sci. Phila.).

Not previously reported from Delaware.

Arthrospira neapolitana (Kützing) Drouet, 1969.

Trichomata aeruginea, luteo-viridia, olivacea, fusca, rosea, violacea, vel cinereo-viridia, cylindracea, dissepimentis passim vel partim constricta, diametro 2—10 micra crassa, partim et passim increscentia passim decrescentia, recta vel curvantia vel spiralia, longitudine indeterminata, per destructionem cellulae intercalaris aut per constrictionem ad dissepimentum frangentia, extremitates per aliquot cellulas longe attenuantia, apicibus acute conicis. Cellulae breves, diametro trichomatis usque ad 6-plo breviores, 1.5—4 micra longis, cellulis terminalibus ad 6-plo longiores increscentibus, protoplasmate homoganeo vel granuloso, nonnumquam pseudovacuoolato, dissepimentis et membranis parietalibus granulis protoplasmaticis vestitis. Cellula terminalis primum rotundata vel truncato-conica demum longe acute conica producta, membrana superne non incrassata. Materia vaginalis hyalina, chlorozincico iodurato non aut partim passimve caerulescens. Planta trichomata longa vel brevia nuda aut in muco amorpho vel laminoso aut solitaria vel pauca vel plura in vaginis cylindraceis plus minusve discretis saepe ramosis comprehens. (Drouet, 1968 pg. 220)

Trichomes blue-green, yellow-green, olive, brown, red, violet, or gray-green, cylindrical, here and there and in part constricted at the cross walls, 2—10 micra broad, in part and here and there decreasing or increasing in diameter, straight or curved or spiraled, capable of indeterminate growth in length, breaking by means of the destruction of an intercalary cell or by constriction at a cross wall, the tips becoming attenuated through several or many cells, acute conical. Cells short, up to 6 times as short as broad, 1.5—4 micra long, the terminal cell up to 6 times as long as broad, protoplasm homogeneous or granulo, sometimes pseudovacuolate, the cross walls and outer wall lined with densely granular protoplasm. Terminal cell at first rotund or truncate-conical then becoming long-acute-conical, the outer membrane not thickened. Sheath material hyaline, not, or only here and there and in part, turning blue in chlor-zinc-iodide. Plant consisting of long or short naked trichomes or of trichomes in an homogeneous or laminose mucus or of one to many trichomes within a more or less discrete, often branched sheath.

See Figure XXVII.

Habitat:

In fresh and brackish waters, often seen on ground which requires a long period for drying, where almost pure growths of it appear about bird droppings and other decaying organic matter. (Drouet, 1968 pg. 221)

Collections:

On sand in a drying pool in the dunes along the beach one mile south of Cape Henlopen, north of Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 24, 1948 (# 8569 in herb. F. Drouet). On the wet southeast shore of Silver Lake, Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 12, 1964 (# 14889 in herb. F. Drouet and Acad. Nat. Sci. Phila.).

CC-5, on a marsh shellheap over clay and shells forming green-black mats very leathery and thick, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, October 20, 1971 (# 711920035 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). In the dwarf Spartina alterniflora zone, clipped to the mud surface and fertilized with  $\text{NH}_4\text{NO}_3$ , preserved in sea water and formalin, forming coherent mats over the mud, Canary Creek marsh, Green Hill (Lewes), Sussex County; E. Sullivan, June 15, 1972 (# 720615HS in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). RB-6, pool water with floating mats in the mixed Spartina patens - Distichlis zone, Big Nose Island marsh, Delaware Seashore State Park, Sussex County; R.D. Ralph, July 12, 1972 (# 720712RB6A in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-2, thick black-green mats on planks near ditch in upper marsh, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, July 12, 1972 (# 720712SJ2 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-1, forming extensive mats over bare mud with other algae on a marsh trail and in natural pannes in the Salicornia - Distichlis zone near the upper marsh margin, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, August 3, 1972 (# 720803-CC-1-A in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-7, dry panne soil surface with thick mats and associated sand and debris, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, August 3, 1972 (# 720803CC7 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-2, Spartina alterniflora zone marsh pools, floating black-green masses, St. Jones marsh,

Barkers Landing, Kent County; R.D. Ralph, August 3, 1972 (# 720803SJ2A in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-2, in mixed Spartina alterniflora (dwarf) and Salicornia, forming extensive mats with other algae in the low marsh, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC-2 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-4, marsh margin in pools surrounded by mats of Vaucheria sp. upper marsh, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, September 14, 1972 (# 720914SJ4 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-12, on a shellheap in a mid-marsh spoil area, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, October 11, 1972 (# 721011CC12 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-A, on Spartina patens culms over ice, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, January 19, 1973 (# 730119SJA in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Previously reported from Delaware in Drouet, 1968 pg. 222, as Arthrospira brevis (Kützing) Drouet (= A. neapolitana).

Microcoleus Desmazières, 1823.

Trichomata cylindrica vel plus minusve torulosa, septata, ambitu recta vel curvantia vel spiralia, ad apices saepe attenuata, apicibus truncatis vel depresso-conicis vel hemisphaericis, membrana superna cellulae apicalis incrassata, protoplasmae homoganeo vel granuloso, dissepimentis (et, in M. lyngbyaceo, membranis parietalibus) granulatis. Materia vaginalis nulla vel mucosa vel discreta. Planta trichomata nuda vel in muco vel in vaginis cylindraceis discretis comprehens. (Drouet, 1968 pg. 225)

Trichomes cylindrical or more or less torulose, septate, either straight or curved or spiraled, often attenuated towards the apices, the apices truncate or depressed-conical or hemispherical, the outer membrane of the terminal cell thickened, protoplasm homogeneous or granular, the cross walls (and, in M. lyngbyaceus, the side walls) granulated. Sheath material absent or mucous or discrete. Plants of naked trichomes or of trichomes in mucus or in discrete cylindrical sheaths.

Microcoleus lyngbyaceus (Kützing) Crouan, 1867.

Trichomata aeruginea, luteo-viridia, lutea, olivacea, fusca, rosea, violacea, vel cinereo-viridia, cylindracea, dissepimentis passim et/vel partim constricta, diametro 3.5—80 micra crassa, partim et passim incrementa passim decrescentia, recta vel curvantia vel spiralia, longitudine indeterminata, per destructionem cellulae intercalaris aut per constrictionem ad dissepimentum frangentia, apices non aut per aliquot cellulas longe vel breviter attenuantia. Cellulae vulgo diametro trichomatis breviores, usque ad 15-plo breviores, raro quadratae, 1.5—8 micra longae, protoplasmate homogeneo vel granuloso, saepe pseudovacuoolato, dissepimentis et membranis parietalibus granulis protoplasmaticis vestitis. Cellula terminalis rotunda, membrana superna primum tenui aetate protracta incrassata depresso-rotunda vel depresso-hemisphaerica vel depresso-conica. Materia vaginalis hyalina, haud raro pigmenta lutea vel fusca efficiens, chlorozincico iodurato non aut partim passimve caeruleo. Planta trichomata longa vel brevia nuda aut in mucro amorpho vel laminoso aut solitaria vel pauca vel plura in vaginis cylindraceis plus minusve discretis saepe ramosis comprehens. (Drouet, 1968 pg. 290)

Trichomes blue-green, yellow-green, yellow, olive, brown, red, violet, or gray-green, cylindrical, constricted (sometimes only here and there or in parts) at the cross walls, 3.5—80 micra broad, here and there or in part decreasing or increasing in diameter, straight or curving or spiraled, capable of growth to an indeterminate length, breaking by means of the destruction of intercalary cells or by the separation of cells at a cross wall, cylindrical or long- or short-attenuate at the tips. Cells commonly shorter than broad, up to 15 times as short as broad, rarely quadrate, 1.5—3 micra long, the protoplasm homogeneous or granular, often pseudovacuoolate, the cross walls and side walls lined with a layer of granules. Terminal cell rotund, the outer membrane at first thin, becoming thickened in a depressed-rotund, depressed-hemispherical, or depressed-conical shape. Sheath material hyaline, often developing yellow or brown pigments, not at all or only in part turning blue in chlor-zinc-iodide. Plant consisting of long or short naked trichomes, or of trichomes in an homogeneous or laminose mucus, or of one or few or many trichomes in a more or less discrete, often branched sheath.

See Figure XXVIII.

Habitat:

Cosmopolitan in marine, brackish, and fresh waters, and in habitats influenced by them. It does not survive desiccation well except where salt concentrations are high. (Drouet, 1968 pg. 291)

Collections:

On wet sand (brackish?) in the dunes behind the beach about one mile south of Cape Henlopen, north of Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 21, 1948 (#'s 8519, 8520 & 8567 in herb. F. Drouet). Floating in the freshwater pond between the Hotel Henlopen and the water tower, Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 23, 1948 (#'s 8548 & 8551 in herb. F. Drouet). Raymond pool (fresh) Bombay Hook Wildlife Refuge, Smyrna, Kent County; P.F. Springer, August 18, 1953 (# 43 in herb. F. Drouet). Floating in artesian well pond, Bombay Hook Wildlife Refuge, Smyrna, Kent County; P.F. Springer, September 17, 1953 (in herb. F. Drouet). Covering mud flat near mouth of Christiana River, Wilmington, New Castle County; Ruth Patrick, June 29, 1949 (# 10 in herb. F. Drouet). Intertidal on sandy shore of Rehoboth Bay at Bellevue St., Rehoboth Beach, Sussex County; grown in fresh water under a lamp; F. Drouet and H.B. Louderback, August 12, 1964 (# 14885a in herb. F. Drouet). In a tide pool on the breakwater, Indian River Inlet, Sussex County; J.S. Zaneveld, W.D. Barnes and H.W. West, June 26, 1961 (# D-16 in herb. Acad. Nat. Sci. Phila.). Sunset Lake Project #1, Sta. 1, Sunset Lake, New Castle County, R.R. Grant, Jr., May 20, 1969 (in herb. Acad. Nat. Sci. Phila.). Stine #3; algae middle riff on rock just out of water, DuPont Stine Laboratory Survey, Sta. 3, Christiana River, New Castle County; Ruth Patrick, May, 1951 (in herb. Acad. Nat. Sci. Phila.). Bayside Island on a stranded barge, near Lewes, Sussex County; J.S. Zaneveld, W.D. Barnes and H.W. West, June 20, 1961 (# D-88 in herb. Acad. Nat. Sci. Phila.). Stojie breakwater, Rehoboth Bay, Sussex County; J.S. Zaneveld, W.D. Barnes, H.W. West and R.J. Smith June, 1961 (# D-86 in herb. Acad. Nat. Sci. Phila.). Refuge Harbor on outer stone breakwater, Sussex County; J.S. Zaneveld, W.D. Barnes and H.W. West, June 18, 1961 (in herb. Acad. Nat. Sci. Phila.). Outer stone breakwater at the coastal side at high water, Harbor of Refuge, Sussex County; J.S. Zaneveld, W.D. Barnes and H.W. West, June 18, 1961 (#'s D-76 & D-78 in herb. Acad. Nat. Sci.

Phila.). Sta. 3 and 7, right bank of the Lewes-Rehoboth Canal, Sussex County; Ruth Patrick, October 5, 1953 (in herb. Acad. Nat. Sci. Phila.).

CC-5, on a marsh shellheap over clay and shells forming green-black mats very leathery and thick, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, October 20, 1971 (# 711020CC5 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). In the dwarf *Spartina alterniflora* zone, forming coherent mats over the mud after clipping to the mud surface and fertilization with  $\text{NH}_4\text{NO}_3$ , Canary Creek marsh, Green Hill (Lewes), Sussex County; M. Sullivan, June 15, 1972 (# 720615MS in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). RB-6, pool water with floating mats in the mixed *Spartina patens* - *Distichlis* zone, Big Nose Island marsh, Delaware Seashore State Park, Sussex County; R.D. Ralph, July 12, 1972 (# 720712RB6A in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-2, thick black-green mats on planks near ditch in upper marsh, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, July 12, 1972 (# 720712SJ2 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-1, forming extensive mats over bare mud on a trail and in natural pannes in mixed *Salicornia* and *Distichlis* near the upper marsh margin, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, August 3, 1972 (# 720803CC-1A in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-1', on bare mud in a roadbed in the upper marsh, extensive thick mats, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, August 3, 1972 (# 720803CC-1B in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-7, dry panne soil surface with thick mats and associated sand and debris, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, August 3, 1972 (# 720803CC7 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-2, *Spartina alterniflora* zone marsh pools, floating black-green masses, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, August 3, 1972 (# 720803SJ2A in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-1, panne mats in upper marsh in the *Salicornia* zone, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC1 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-2, in mixed *Spartina alterniflora* (dwarf) and *Salicornia* forming extensive mats in the low marsh, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC-2 in herb. Univ. of Del. and Acad. Nat. Sci.



Phila.). CC-6, black crust dried over a shellheap on the roadbed in mid-marsh, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC6 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-7, mats on marsh roadbed in mid-marsh on bare mud, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC7 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-4, marsh margin in pools surrounded by mats of Vaucheria sp. upper marsh, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, September 14, 1972 (# 720914SJ4 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-12, on a shellheap in a mid-marsh spoil area, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, October 11, 1972 (# 721011CC12 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-A, on Spartina patens culms over ice, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, January 19, 1973 (# 730119SJ A in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). Sample #5, forming tenuous mats on a panne to the east of the great lateral ditch, vicinity of the Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; this material prepared by Kim Nelson from frozen material for G.F. Somers' work on biochemical properties of sheaths (George Clark) on 1/17/74; coll. G.F. Somers and M. Brown, August 10, 1973 (# 730819CC5A in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Previously reported from Delaware in Zaneveld, 1966 pp. 119-121 as Lyngbya confervoides C. Agardh ex Gomont, Lyngbya aestuarii (Mertens) Lyngbye in Liebman ex Gomont, and Lyngbya semiplena (C. Agardh) J. Agardh, in Zaneveld, 1972 pg. 129 as the same species, and in Drouet, 1968 pg. 299.

Microcoleus vaginatus (Vaucher) Gomont, 1890.

Trichomata aeruginea, luteo-viridia, olivacea, fusca, rosea, violacea, vel cinereo-viridia, cylindracea, dissepimentis raro constricta, diametro 2.5—9 micra crassa, partim et passim increscentia passim decrescentia, ambitu recta vel curvantia vel spiralia, longitudine indeterminata, per destructionem cellulae intercalaris aut nonnumquam per constrictionem ad dissepimentum frangentia, extremitates breves et per aliquot cellulas attenuantia, apicibus haud raro capitatis. Cellulae quadratae vel diametro breviores vel longiores, 1—10 micra longae, protoplasmate homoganeo vel granuloso, saepe pseudovacuoolato, dissepimentis granulis protoplasmaticis vestitis. Cellula terminalis conica, hemisphaerica, vel truncato-cylindrica, membrana superna conica, hemisphaerica vel vix convexa rigide concretescente. Materia vaginalis hyalina, chloro-zincico iodurato non aut partim passimve caerulescens. Planta trichomata longa vel brevia nuda aut in mucro amorpho vel laminoso aut solitaria vel paucis vel plura in vaginis cylindraceis plus minusve discretis saepe ramosis comprehens. (Drouet, 1968 pg. 244)

Trichomes blue-green, yellow-green, olive, brown, red, violet or gray-green, cylindrical, rarely constricted at the cross walls, 2.5—9 micra broad, straight or curving or spiraled, capable of growth to an indeterminate length, breaking by means of the destruction of an intercalary cell or rarely by separation of two cells at a cross wall, attenuated through usually several cells at the tips, the tips not rarely capitate; cells quadrate or shorter or longer than the diameter, 1—10 micra long; the protoplasm homogeneous or granular, often pseudovacuate, the cross walls lined on either side with a layer of granules; terminal cell conical, hemispherical, truncate-cylindrical, the outer membrane becoming thickened into a rigid cone, cup, or convex disc; sheath material hyaline, not at all or only in part and here and there turning blue in chloro-zinc-iodide; plant consisting of long or short naked trichomes, or of trichomes in an homogeneous or laminose mucus, or of single, few, or many trichomes within a more or less discrete cylindrical, often branched, sheath.

See Figure XXIX.

Habitat:

One of the most widespread of the Oscillatoriaceae, occupying almost every kind of habitat which receives fresh water and sunlight, cosmopolitan. It grows well here and there, also, in brackish and marine waters of low salt content. It is capable of surviving long periods of desiccation. (Drouet, 1968 pg. 245)

Collections:

Christiana River, DuPont Stine Laboratory Survey, Sta. 3, New Castle County; Ruth Patrick, May, 1951 (# 22 in herb. F. Drouet). West Branch, DuPont Stine Laboratory Survey, Sta. 2, New Castle County; Ruth Patrick, May, 1951 (in herb. F. Drouet and Acad. Nat. Sci. Phila.). In a slight depression in sand in the scrub forest between Rehoboth Bay and the ocean, about two miles south of Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 22, 1948 (# 8536 in herb. F. Drouet). Left bank of the Lewes-Rehoboth Canal on clams, Sussex County; Ruth Patrick, October 5, 1953 (in herb. Acad. Nat. Sci. Phila.). Coll. #9, Sunset Lake Project #1, Sta. 1, board scrapings, New Castle County; R.R. Grant, Jr., May 20, 1969 (in herb. Acad. Nat. Sci. Phila.). Red Clay Creek opposite Hoopes Reservoir, Sta. 3, coll. #22, bright blue-green patches on rock, not uncommon, Red Clay Creek Survey #2, New Castle County; R.W. Reimer, October 11, 1966 (in herb. Acad. Nat. Sci. Phila.). Red Clay Creek Survey #2, 2 miles below Ashland, Sta. 3, blue-green on rocks, New Castle County, R.W. Reimer, October 8, 1966 (in herb. Acad. Nat. Sci. Phila.).

SJ-2, thick black-green mats on planks near ditch in upper marsh, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, July 12, 1972 (# 720712SJ2 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-6, upper marsh pool bottom in mixed Spartina patens and Distichlis, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, July 12, 1972 (# 720712SJ6 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). RMP-1, on a concrete spillway forming extensive, slimy black mats, very thick, Red Mill Pond, Star Landing, Sussex County; R.D. Ralph, August 3, 1972 (# 720803RMP1 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-2, Spartina alterniflora zone marsh pools,

floating black-green masses, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, August 3, 1972 (# 720803SJ2A in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-A, on Spartina patens culms over ice, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, January, 19, 1973 (# 730119SJA in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Previously reported from Delaware in Drouet, 1968  
pg. 251.

Oscillatoria Vaucher, 1803.

Trichomata cylindrica vel plus minusve torulosa, septata, ambitu recta vel curvantia vel spiralia, ad apices saepe attenuata, apicibus truncatis vel hemisphaericis vel depresso-conicis, membrana superna cellulae terminalis incrassata, protoplasmate homoganeo vel granuloso, dissepimentis non granulatis. Materia vaginalis nulla vel mucosa vel discreta. Planta trichomata nuda vel in muco vel in vaginis cylindraceis discretis comprehens. (Drouet, 1968 pg. 174)

Trichomes cylindrical or more or less torulose, septate, either straight or curved or spiraled, often attenuated towards the apices, the apices truncate or hemispherical or depressed-conical, the outer membranes of the terminal cells thickened, protoplasm homogeneous or granulate, the cross walls not granulated. Sheath material absent or mucous or discrete. The plants of naked trichomes or of trichomes in mucus or in discrete cylindrical sheaths.

Oscillatoria lutea Agardh, 1824.

Trichomata aeruginosa, luteo-viridia, olivacea, fusca, rosea, violacea, vel cinereo-viridia, cylindrica, ad dissepimenta passim vix constricta, diametro 2.5—10 micra crassa, partim et passim increscentia passim decrescentia, ambitu recta vel curvantia vel spiralia, longitudine indeterminata, per destructionem cellulae intercalaris vel raro per constrictionem ad dissepimentum frangentia, ad apices cylindrica vel cellulas terminales sensim attenuantia. Cellulae quadratae vel diametro trichomatis breviores, saepe brevissimae, 1—7 micra longae, protoplasmae homogeneo vel granuloso raro pseudovacuolato, dissepimentis non granulatis. Cellula terminalis brevis, late truncato-conica, membrana superna primum tenui aetate provecta incrassata, convexo-laminoidea. Materia vaginalis hyalina, chlorozincico iodurato saepe caerulescens. Planta trichomata longa vel brevia nuda aut in muco amorpho vel laminoso aut solitaria vel pauca vel plura in vaginis cylindraceis plus minusve discretis saepe ramosis comprehens. (Drouet, 1968 pg. 187)

Trichomes blue-green, yellow-green, olive, brown, red, violet, or gray-green, cylindrical, scarcely constricted here and there at the cross walls, 2.5—10 micra broad, here and there and in part increasing or decreasing in diameter, straight or curving or spiraled, indeterminate in growth in length, fragmenting by means of the destruction of an intercalary cell or by separation of cells at a cross wall, cylindrical or attenuating somewhat through one or more cells at the tips. Cells as long as or shorter than broad, often very short, 1—7 micra long, the protoplasm homogeneous or granular, rarely pseudovacuolate, the cross walls not granulated. Terminal cell broadly truncate-conical, the outer membrane at first thin, becoming thickened in age, convex-platelike. Sheath material hyaline, often turning blue in chlor-zinc-iodide. Plant consisting of long or short trichomes, naked or in an homogeneous or laminose mucus, or solitary or few or many in more or less discrete, often branched, cylindrical sheaths.

See Figure XXX.

Habitat:

Marine and fresh waters, and ground and other substrates wet by them, especially abundant along sea-coasts. (Drouet, 1968 pg. 188)

Collections:

Not previously reported from Delaware.

Oscillatoria princeps Vaucher, 1803.

Trichomata aeruginea, luteo-viridia, olivacea, fusca, rosea, violacea, vel cinereo-viridia, cylindracea, dissepimentis passim vix constricta, diametro 9—90 micra crassa, partim et passim increscentia passim decrescentia, ambitu recta vel curvantia vel spiralia, longitudine indeterminata, per destructionem cellulae intercalaris frangentia, apices per aliquot cellulis breviter sed manifesto attenuantia. Cellulae diametro trichomatis plerumque usque ad 12-plo breviores, 3—8 micra longae, in apicibus attenuatis longioris, protoplasmate homoganeo vel granuloso, nonnumquam pseudovacuoleta, dissepimentis non granulatis. Cellula terminalis truncate depresso-conica, membrana superna primum tenui aetate provecta incrassata, depresso-rotunda. Materia vaginalis hyalina, nonnumquam pigmenta lutea efficiens, chlorozincico iodurato non aut paritum passimve caerulescens. Planta trichomata longa vel brevia nuda aut in muco amorpho vel laminoso aut solitaria vel pauca in vaginis cylindraceis plus minusve discretis saepe ramosis comprehens. (Drouet, 1968 pg. 177)

Trichomes blue-green, yellow-green, olive, brown, red, violet, or gray-green, cylindrical, occasionally somewhat constricted at the cross walls, 9—90 micra broad, here and there and in part increasing or decreasing in breadth, straight or curving or spiraled, indeterminate in longitudinal growth, breaking by means of the destruction of an intercalary cell, briefly and conspicuously attenuating through several cells at the tips. Cells mostly up to 12 times shorter than broad, 3—8 micra long, longer in the attenuated tips, the protoplasm homogeneous or granulate, sometimes becoming pseudovacuoletate, the cross walls not granulated. Terminal cell becoming truncate-depressed-conical, the outer membrane at first thin, becoming thickened and depressed-hemispherical. Sheath material hyaline, sometimes developing yellow or brown pigments, not at all or only here and there in part turning blue in chlor-zinc-iodide. Plant consisting of long or short trichomes, naked or in an homogeneous or laminose mucus, or solitary or few in cylindrical, more or less discrete, often branched sheaths.

See Figure XXXI.



Habitat:

In fresh-water habitats which rarely become entirely desiccated, cosmopolitan. (Drouet, 1968 pg. 178)

Collections:

Floating in the fresh-water pond between the Hotel Henlopen and the water tower, Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 23, 1948 (# 8551 in herb. F. Drouet). Sta. 4, coll. #2, dark filaments common on plant stems, Sunset Lake Project #1, Sunset Lake, New Castle County; R.R. Grant, Jr., May 2, 1969 (in herb. Acad. Nat. Sci. Phila.). On the mud of a swamp, Rehoboth Bay, Sussex County; J.S. Zaneveld and R.J. Smith, June 20, 1961 (# D-81 in herb. Acad. Nat. Sci. Phila.).

SJ-2, Spartina alterniflora zone marsh pools, floating black-green masses, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, August 3, 1972 (# 720803SJ2A in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).  
 SJ-4, marsh margin in pools surrounded by mats of Vaucheria sp. upper marsh, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, September 14, 1972 (# 720914SJ4 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Previously reported from Delaware in Zaneveld, 1966 pp. 121-122, 1972 pg. 129, and in Drouet 1968 pg. 180.

Oscillatoria Retzii Agardh, 1812.

Trichomata aeruginosa, luteo-viridia, olivacea, fusca, rosea, violacea, vel cinereo-viridia, cylindrica vel ad dissepimenta plus minusve constricta, diametro 2.5—10 micra crassa, partim et passim increscentia passim decrescentia, ambitu recta vel curvantia vel spiralia, longitudine indeterminata, per destructionem cellulae intercalaris vel per constrictionem ad dissepimentum frangentia, cellulas terminales paullo sed sensim attenuantia. Cellulae vulgo quadratae vel diametro trichomatis longiores (in trichomatibus majoribus breviores), 5—15 micra longae, protoplasmate homoganeo vel granuloso raro pseudovacuoolato, dissepimentis non granulatis. Cellula terminalis truncato-cylindrica vel aliquantulum truncato-conica, membrana superna primum tenui acetate provecta incrassata, late depresso-hemisphaerica vel praecipuius convexo-laminoidea. Materia vaginalis hyalina, chlorozincico iodurato saepe caerulescens. Planta trichomata longa vel brevia nuda aut in muco amorpho vel laminoso aut solitaria vel pauca in vaginis cylindraceutis plus minusve discretis saepe ramosis comprehens. (Drouet, 1968 pp. 194-195)

Trichomes blue-green, yellow-green, olive, brown, red, violet, or gray-green, cylindrical or more or less constricted at the cross walls, 2.5—10 micra broad, here and there and in part decreasing or increasing in breadth, straight or curved or spiraling, capable of growth to an indeterminate length, breaking by means of the destruction of an intercalary cell or by constriction at a cross wall, the terminal cell becoming slightly attenuated. Cells generally quadrate or longer than broad (those of trichomes of larger diameters commonly shorter), 5—15 micra long, the protoplasm homogeneous or granuloze, rarely pseudovacuoolate, the cross walls not granulated. Terminal cell truncate-cylindrical or somewhat truncate-conical, the outer membrane at first thin, becoming thickened and broadly depressed-hemispherical or, chiefly, convex-lamincid. Sheath material hyaline, often turning blue in chlor-zinc-iodide. Plant consisting of long or short naked trichomes, or of trichomes in an homogeneous or laminose mucus, or of solitary or few trichomes in a more or less discrete, often branched, sheath.

See Figure XXXII.

Habitat:

Fresh water, most frequently seen on various substrates at or just beneath the surface of relatively unpolluted water in lakes, streams, and springy places. It is commonly found in swales which gradually dry up during the summer. (Drouet, 1968 pg. 195)

Collections:

On the west margin of the pond between the Hotel Henlopen and the water tower, Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 23, 1948 (#'s 8543 & 8549 in herb. Fr. Drouet). West Branch, New Castle County, DuPont Stine Laboratory Survey, Sta. 2; Ruth Patrick, May, 1951 (in herb. F. Drouet and Acad. Nat. Sci. Phila.). Culture of algae at the University of Delaware, Newark, New Castle County; Marjorie Krauss (sic), August, 1969 (in herb. Acad. Nat. Sci. Phila.). Sta. 3, blue-green on rock just out of water, DuPont Stine Laboratory Survey, Christiana River, New Castle County; Ruth Patrick, May 1951 (in herb. Acad. Nat. Sci. Phila.). Sta. #4, Sunset Lake Project #1, Sunset Lake, New Castle County; R.R. Grant, Jr., May 2, 1969 (in herb. Acad. Nat. Sci. Phila.).

SJ-4, on mud and debris beneath Phragmites communis, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, July 7, 1972 (# 720712SJ-4 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-4, marsh margin in pools surrounded by mats of Vaucheria sp. upper marsh, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, September 14, 1972 (# 7209143J4 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Previously reported from Delaware in Drouet, 1968 pg. 198.

Oscillatoria submembranacea Ardissonne & Strafforello, 1877.

Trichomata aeruginea, luteo-viridia, olivacea, fusca, rosea, violacea, vel cinereo-viridia, torulosa vel cylindrica vel toruloso-cylindrica, diametro 2.5—9 micra crassa, partim et passim increscentia passim decrescentia, ambitu recta vel curvantia vel spiralia, longitudine indeterminata, per destructionem cellulae intercalaris vel per separationem ad dissepimentum frangentia, cellulas terminales non aut paullo attenuantia. Cellulae quadratae aut diametro longiores vel breviores, 3—11 micra longae, protoplasmate homoganeo vel granuloso raro pseudovacuoolato, dissepimentis non granulatis, Cellula terminalis truncato-cylindrica vel truncato-conica, membrana superna primum tenui aetate provecta incrassata depresso-conica vel fere depresso-hemisphaerica. Materia vaginalis hyalina, chloro-zincico iodurato vulgo caerulea. Planta trichomata longa vel brevia nuda aut in muco amorpho vel laminoso aut solitaria vel pauca vel plura in vaginis cylindraceis plus minusve discretis saepe ramosis comprehens. (Drouet, 1968 pg. 205)

Trichomes blue-green, yellow-green, olive, brown, red, violet, or gray-green, torulose or cylindrical or torulose-cylindrical, 2.5—9 micra broad, in part here and there increasing or decreasing in breadth, fragmenting by means of the destruction of an intercalary cell or by separation of two cells at a cross wall, the tips not at all or only slightly attenuated. Cells quadrate or longer or shorter than broad, 3—11 micra long, the protoplasm homogeneous or granulate, rarely pseudovacuoolate, the cross walls not granulated. Terminal cell truncate-cylindrical or truncate-conical, the outer membrane at first thin, later becoming thickened and depressed-conical or somewhat depressed-hemispherical. Sheath material hyaline, commonly turning blue when placed in chlor-zinc-iodide. Plant consisting of long or short naked trichomes, or of trichomes in an homogeneous or laminose mucus, or of solitary, few, or many trichomes in more or less discrete, often branched, cylindrical sheaths.

See Figure XXXIII.

Habitat:

Cosmopolitan in marine and fresh waters, forming crusts on soil and other substrates which dry out for considerable periods. (Drouet, 1968 pg. 206)

Collections:

Intertidal on sand on the shore of Rehoboth Bay, at Bellevue Street, Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 12, 1964 (# 14885 in herb. F. Drouet). Blue-green on bridge, coll. #4, Delaware Marsh Survey #1, Smyrna River, Kent County; R.R. Grant, Jr., September 23, 1970 (in herb. Acad. Nat. Sci. Phila.).

SJ-A, on Spartina patens culms over ice, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, January 19, 1973 (# 730119SJA in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Not previously reported from Delaware.

Porphyrosiphon Kützing, 1850.

Trichomata cylindrica vel plus minusve torulosa, septata, ambitu recta vel curvantia vel spiralia, apices per aliquot cellulas attenuantia, cellulis terminalibus hemisphaericis vel conicis, membrana superna tenui non incrassata, protoplasmate homoganeo vel granuloso, dissepimentis non granulatis. Materia vaginalis nulla vel mucosa vel discreta. Planta trichomata nuda vel in muco vel in vaginis cylindraceis discretis comprehens. (Drouet, 1968 pp. 142-143)

Trichomes cylindrical or more or less torulose, septate, either straight or curved or spiraled, the apices attenuating through several cells, the terminal cells hemispherical or conical, the outer membranes thin, not thickened, protoplasm homogeneous or granulose, the cross walls not granulated. Sheath material absent or mucous or discrete. Plants of naked trichomes or of trichomes in mucus or in discrete cylindrical sheaths.

Porphyrosiphon Notarisii (Meneghini) Kützing, 1850.

Trichomata aeruginosa, luteo-viridia, olivacea, fusca, rosea, violacea, vel cinereo-viridia, cylindrica ad dissepimenta vulgo constricta, diametro 3—40 micra crassa, partim et passim increscentia passim decrescentia, ambitu recta vel curvantia vel spiralia, longitudine indeterminata, per destructionem cellulae intercalaris vel per constrictionem ad dissepimentum frangentia, aliquot cellulas terminales longe et sensim attenuantia. Cellulae diametro trichomatis breviores vel longiores, 3—15 micra longae, protoplasmate homoganeo vel granuloso nonnumquam pseudovacuoolato, dissepimentis non granulatis. Cellula terminalis primum hemisphaerica, aetate provecta obtuse vel acute conica, membrana superna tenui non incrassata, Materia vaginalis primum hyalina deinde pigmenta lutea, fusca, rosea, violacea, vel caerulea saepe efficiens, chlorozincico iodurato plerumque caerulescens. Planta trichomata longa vel brevia nuda aut in muco amorpho vel laminoso aut solitaria vel pauca vel plura in vaginis cylindraceis plus minusve discretis saepe ramosis comprehens. (Drouet, 1968 pg. 152)

Trichomes blue-green, yellow-green, olive, brown, red, violet, or gray-green, cylindrical, commonly constricted (at least here and there) at the cross walls, 3—40 micra broad, here and there and in part increasing or decreasing in breadth, straight or curving or spiraled, capable of indeterminate growth in length, breaking by means of the destruction of an intercalary cell or by separation of cells at a cross wall, at the ends evidently long-attenuated through several cells. Cells shorter or longer than broad, 3—15 micra long, the protoplasm homogeneous or granulate, sometimes pseudovacuoolate, the cross walls not granulated. Terminal cell at first hemispherical, becoming obtuse- or acute-conical, the outer membrane not thickened. Sheath material at first hyaline, later often developing yellow, brown, red, violet, or blue pigments, mostly turning blue in chlor-zinc-iodide. Plant consisting of long or short naked trichomes, or of trichomes in an homogeneous or laminose mucus, or of one to many trichomes in a more or less discrete, often branched, cylindrical sheath.

See Figure XXXIV.

Habitat:

Cosmopolitan, growing wherever sufficient water and sunlight are available. Naked trichomes inhabit salt and fresh waters and hot springs. Subaerial forms excrete sheath material which often produces pigments of various colors (Drouet, 1968 pg. 152).

Collections:

RB-6, pool water with floating mats in the mixed Spartina patens - Distichlis zone, Big Nose Island marsh, Delaware Seashore State Park, Sussex County; R.D. Ralph, July 12, 1972 (# 720712RB6A in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-7, dry panne soil surface with thick mats and associated sand and debris, vicinity Fisher home-site, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, August 3, 1972 (# 720803CC7 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-7, mats on marsh road-bed in mid-marsh on bare mud, vicinity Fisher homesite, R.D. Ralph, September 14, 1972 (# 720914CC7 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Not previously reported from Delaware.



Porphyrosiphon splendidus (Gréville) Drouet, 1968.

Trichomata aeruginea, luteo-viridia, olivacea, fusca, rosea, violacea, vel cinereo-viridia, cylindrica, ad dissepimenta passim constricta, diametro 1—4 micra crassa, partim et passim increscentia passim decrescentia, ambitu recta vel curvantia vel spiralia, longitudine indeterminata, per destructionem cellulae intercalaris vel per constrictionem ad dissepimentum frangentia, aliquot cellulas terminales longe attenuantia, ad apices plus minusve capitata. Cellulae diametro trichomatis longiores, 2—7 micra longae, protoplasmate homoganeo vel granuloso, dissepimentis passim binis vel quaternis granulis protoplasmaticis notatis. Cellula apicalis primum cylindrica deinde in media parte longe attenuata et ad apicem bulbosa, membrana superna non incrassata. Materia vaginales hyalina, chlorozincico iodurato non caerulescens. Planta trichomata longa vel brevia nuda aut in mucos amorpho comprehens. (Drouet, 1968 pg. 167)

Trichomes blue-green, yellow-green, olive, brown, red, violet, or gray-green, cylindrical, here and there constricted at the cross walls, 1—4 micra broad, here and there and in part increasing or decreasing in diameter, straight or curving or spiraled, capable of indeterminate growth in length, breaking by means of the destruction of an intercalary cell or by constriction at a cross wall, long and narrowly attenuated through several cells at each tip, more or less capitate at the apices. Cells longer than broad, 2—7 micra long, the protoplasm homogeneous or granulo, often with one or two granules near either side of a cross wall. Terminal cell at first cylindrical, then becoming long and narrow and bulbous at the tip, the outer membrane not thickened. Sheath material hyaline, not turning blue in chlor-zinc-iodide. Plant consisting of long or short naked trichomes or of trichomes in an homogeneous mucus.

See Figure XXXV.

Habitat:

In permanent bodies of fresh water. (Drouet, 1968 pg. 168)

Collections:

On mud of a swamp, Rehoboth Bay, Sussex County;  
J.S. Zaneveld and R.J. Smith, June 20, 1961 (# D-80 in  
herb. Acad. Nat. Sci. Phila.).

Previously reported from Delaware in Zaneveld,  
1966 pg. 122 as Cscillatoria splendida Greville ex Gomont  
(= Porphyrosiphon splendidus), in Zaneveld, 1972 pg. 129,  
and in Drouet, 1968 pg. 169.

Schizothrix Kützing, 1843.

Trichomata cylindrica vel torulosa, septata, ambitu recta vel curvantia vel spiralia, ad apices non aut breve (tantummodo in cellula apicali) attenuata, apicibus hemisphaericis vel rotundo-cylindraceutis vel conicis, membrana superna tenui non incrassata, protoplasmate homogeneo vel granuloso, ad dissepimenta granulis protoplasmaticis nullis vel 1--2. Materia vaginalis nulla vel mucosa vel discreta. Planta trichomata nuda vel in muco vel in vaginis cylindraceutis discretis comprehens. (Drouet, 1968 pg. 26) :

Trichomes cylindrical or torulose, septate, either straight or curved or spiraled, not attenuated at the apices or only briefly (entirely in the apical cell), the apices hemispherical or rotund-cylindrical or conical, the outer membranes thin, not thickened, protoplasm homogeneous or granuloso, without protoplasmatic granulose at the cross walls or with one (1) or two (2). Sheath material absent or mucous or discrete. Plants of naked trichomes or of trichomes in mucus or in discrete cylindrical sheaths.

Schizothrix arenaria (Berkeley) Gomont, 1892.

Trichomata aeruginea, luteo-viridia, olivacea, fusca, rosea, violacea, vel cinereo-viridia, dissepimentis plerumque constricta, saepe toruloso-cylindrica, diametro 1—6 micra crassa, partim et passim increscentia passim decrescentia, ambitu recta vel curvantia vel spiralia, longitudine indeterminata, per destructionem cellulae intercalaris vel per constrictionem ad dissepimentum frangentia, apices saepe abrupte et acute attenuantia. Cellulae quadratae vel diametro trichomatis longiores, 2—10 micra longae, protoplasmate homoganeo vel granuloso raro pseudovacuolate, dissepimentis raro binis granulis protoplasmaticis notatis. Cellula terminalis acute vel truncate conica aut raro plus minusve cylindrico-conica concretescens, membrana superna tenue non incrassata. Materia vaginalis hyalina aut partim lutescens vel fusca raro rosea vel violacea vel caerulea, chlorozincico iodurato non aut saepe partim caerulescens. Planta trichomata longa vel brevia nuda aut in muco amorpho vel laminoso aut solitaria vel pauca vel plura in vaginis cylindraceutis plus minusve discretis saepe ramosis comprehens. (Drouet, 1968 pg. 115)

Trichomes blue-green, yellow-green, olive, brown, red, violet, or gray-green, predominantly constricted at the cross walls, often torulose-cylindrical, 1—6 micra broad, here and there and in part increasing or decreasing in breadth, straight or curving or spiraled, capable of indeterminate growth in length, breaking by means of the destruction of an intercalary cell or by separation of adjacent cells, becoming abruptly conical at the tips. Cells quadrate or longer than broad, 2—10 micra long, the protoplasm homogeneous or granulose, rarely pseudovacuolate, with rarely a single granule developing on either side of a cross wall. Terminal cells becoming acutely or obtusely conical, rarely more or less cylindric-conical, the outer wall not becoming thickened. Sheath material hyaline or in part becoming yellow or brown, rarely red, violet, or blue, not at all or only here and there turning blue in chlor-zinc-iodide. Plant consisting of long or short naked trichomes, or of trichomes in an homogeneous or laminose mucus, or of one, few, or many trichomes in a more or less discrete cylindrical, often branched, sheath.

See Figure XXXVI.

Habitat:

In salt and fresh waters and on substrates influenced by them. It flourishes with Microcoleus lyngbyaceus on tidal flats and in salt marshes. It comprises a permanent part of soil crusts on barren ground. Brown pigments develop in the sheaths especially in habitats influenced by salt water and subject to desiccation and intense insolation. (Drouet, 1968 pg. 115)

Collections:

On the beach, Woodland Beach, Kent County; J.S. Zaneveld, W.D. Barnes and H.W. West, June, 1961 (# D-92 in herb. F. Drouet and Acad. Nat. Sci. Phila.). On a wooden jetty, Fowler's Beach, Sussex County; J.S. Zaneveld, W.D. Barnes and H.W. West, June 1961 ( in herb. Acad. Nat. Sci. Phila.). Intertidal on sand on the shore of Rehoboth Bay at Bellevue St., Rehoboth beach, Sussex County; F. Drouet and H.B. Louderback, August 12, 1948 (# 8567 in herb. F. Drouet and Acad. Nat. Sci. Phila.). Lower riff, on rocks out of water, liverwort, DuFont Stine Laboratory Survey, Christiana River, New Castle County; Ruth Patrick, May, 1951 ( in herb. Acad. Nat. Sci. Phila.). Blue-green on peat, coll. #7, Delaware Marsh Survey #1, Kent County; R.R. Grant, Jr., September 23, 1970 ( in herb. Acad. Nat. Sci. Phila.).

CC-5 on a marsh shellheap over clay and shells forming green-black mats very leathery and thick, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, October 20, 1971 (# 71102CCC5 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-2, thick black-green mats on planks near ditch in upper marsh, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph July 12, 1972, (# 720712SJ2 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-1, forming extensive mats over bare mud on a marsh trail and in natural pannes in the Salicornia and Distichlis zone near the upper marsh margin, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, August 3, 1972 (# 730803CC-1A in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-1', on bare mud in a roadbed in the upper marsh, extensive thick mats, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, August 3, 1972 (# 720803CC-1B in herb. Univ. of Del. and Acad. Nat. Sci.

Phila.). CC-7, dry panne soil surface with thick mats and associated sand and debris, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, August 3, 1972 (# 720803CC7 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-1, panne mats in upper marsh in the Salicornia zone, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC1 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-2, in mixed Spartina alterniflora var. pilosa and Salicornia forming extensive mats in the low marsh, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC-2 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-6, black crust dried over a shellheap on the roadbed in mid-marsh, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC6 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-7, mats on marsh roadbed in mid-marsh on bare mud, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC7 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-10, on a natural panne in the Distichlis zone of the upper marsh margin, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC10 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-1, shellheap in roadbed of mid-marsh on clam shells, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, October 11, 1972 (# 721011CC1 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-10, on a natural panne in the Salicornia zone, mats appeared to be breaking up, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, October 11, 1972 (# 721011CC10 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-12, on a shellheap in a mid-marsh spoil area, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, October 11, 1972 (# 721011CC12 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Previously reported from Delaware in Zaneveld, 1966 pp. 116-117 and 123 as Microcoleus chthonoplastes (Mertens) Zanardini ex Gomont (= Schizothrix arenaria) and Oscillatoria laetevirens Crouan ex Gomont (= Schizothrix arenaria), respectively, and in Zaneveld, 1972, pg. 129 as the same species, and in Drouet, 1968 pg. 118.

Schizothrix calcicola (Agardh) Gomont, 1890.

Trichomata aeruginea, luteo-viridia, lutea, olivacea, fusca, rosea, violacea, vel cinereo-viridia, cylindracea vel torulosa vel dissepimentis paullo constricta, diametro 0.2—3.5 micra crassa, partim et passim incrementa passim decrescentia, ambitu recta vel curvantia vel spiralia, longitudine determinata vel indeterminata, per destructionem cellulae intercalaris aut per constrictionem ad dissepimentum frangentia. Cellulae quadratae vel diametro trichomatis breviores nonnumquam longiores, 0.2—6 micra longae, protoplasmate homogeneo vel granuloso saepe pseudovaccolato, dissepimentis passim binis vel quaternis granulis protoplasmaticis notatis. Cellula terminalis cylindrica vel plus minusve bulbosa saepe ampliata, primum quasi-truncata deinde rotundata vel raro excentrice tumida, membrana superna tenui non incrassata. Materia vaginalis hyalina, nonnumquam pigmenta lutea vel fusca vel careulea vel violacea vel rosea efficiens, chlorozincico iodurato non vel passim vel omnino caerulescens. Planta trichomata longa vel brevia nuda aut in mucosae amorpho vel laminoso aut solitaria vel pauca vel plura in vaginis cylindraceis plus minusve discretis saepe ramosis comprehens. (Drouet, 1968 pg. 66)

Trichomes blue-green, yellow-green, yellow, olive, brown, red, violet, or gray-green, cylindrical or torulose or somewhat constricted at the cross walls, 0.2—3.5 micra broad, here and there and in part increasing or decreasing in breadth, straight or curving or spiraled, capable of determinate or indeterminate growth in length, breaking by means of the destruction of an intercalary cell or by constriction at a cross wall. Cells quadrate or shorter, sometimes longer, than broad, 0.2—6 micra long, the protoplasm homogeneous or granular, often pseudovacolate, often with one or two granules developing at either side of a cross wall. Terminal cell at first cylindrical, becoming bulbous, often enlarged, the outer membrane not thickened, at first quasi-truncate, then becoming rotund or rarely excentrically swollen. Sheath material hyaline, sometimes developing yellow, brown, blue, violet, or red pigments, often turning blue in chlor-zinc-iodide. Plant consisting of long or short naked trichomes, or of trichomes in an homogeneous or laminose mucus, or of solitary or few or many trichomes within a more or less discrete cylindrical, often branched, sheath.

See Figure XXXVII.

Habitat:

The most widely distributed and most hardy of all species of Oscillatoriaceae. In most habitats in or influenced by marine and fresh waters where a minimal amount of light is available, cosmopolitan. (Drouet, 1968 pg. 67)

Collections:

In a dried pool in the dunes behind the beach one mile south of Cape Henlopen north of Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 21, 1948 (#'s 8523, 8525 and 8566 in herb. F. Drouet). In tide pool on southern breakwater, Indian River Inlet, Sussex County; J.S. Zaneveld, W.D. Barnes and H.W. West, June 26, 1961 (in herb. Acad. Nat. Sci. Phila.). On the wet shore of Silver Lake, Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 12, 1964 (# 14888 in herb. F. Drouet and Acad. Nat. Sci. Phila.). Near low tide level on a wooden jetty near the Hotel Henlopen, Rehoboth Beach, Sussex County; F. Drouet and H.B. Louderback, August 24, 1948 (# 8561 in herb. F. Drouet). Culture of algae (from White Clay Creek) at the University of Delaware, Newark, New Castle County; Marjorie Krauss (sic), August, 1969 (in herb. Acad. Nat. Sci. Phila.). Brown-black blue-green, very common, coll. #23, Sta. 3, Red Clay Creek opposite Hoopes Reservoir, Red Clay Creek Survey #2, New Castle County; R.W. Reimer, October 11, 1966 (in herb. Acad. Nat. Sci. Phila.). Sta. #21, Red Clay Creek Survey #2, Red Clay Creek 2 miles below Ashland, New Castle County; R.W. Reimer, October 11, 1966 (in herb. Acad. Nat. Sci. Phila.). On sticks, Delaware River, Kent County; R.R. Grant, Jr., September 23, 1970 (in herb. Acad. Nat. Sci. Phila.). Rock scrapings, slow water, Red Clay Creek, New Castle County; M.H. Hohn, Fall, 1958 (in herb. Acad. Nat. Sci. Phila.). Sunset Lake, New Castle County; R.R. Grant, Jr., May 2, 1969 (in herb. Acad. Nat. Sci. Phila.).

CC-5, on a marsh shellheap over clay and shells forming green-black mats very leathery and thick, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, October 20, 1971 (# 7110200C5 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CH-A, tidal flats south of Cape Henlopen on shells at the high water line on the bay shore, Cape Henlopen State Park, Sussex County; R.D. Ralph, June 12, 1972 (# 720612CHA in



herb. Univ. of Del. and Acad. Nat. Sci. Phila.). RB-D, on broken shells from marsh beach in bay water below the low water line, Big Nose Island marsh, Delaware Seashore State Park, Sussex County; R.D. Ralph, June 12, 1972 (# 720612RBD in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). In the dwarf Spartina alterniflora zone, forming coherent mats over the mud after clipping to the mud surface and fertilization with  $\text{NH}_4\text{NO}_3$ , vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; E. Sullivan, June 15, 1972 (# 720615 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). RB-6, pool water with floating mats in the mixed Spartina patens - Distichlis zone, Big Nose Island marsh, Delaware Seashore State Park, Sussex County; R.D. Ralph, July 12, 1972 (# 720712RB6A in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-2, thick black-green mats on planks near ditch in upper marsh, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, July 12, 1972 (# 720712SJ2 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-6, upper marsh pool bottom in mixed Spartina patens and Distichlis, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, July 12, 1972 (# 720712SJ6 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-1, forming extensive mats over bare mud on a marsh trail and in natural pannes in the Salicornia - Distichlis zone near the upper marsh margin, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, August 3, 1972 (# 720803CC-1A in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-1', on bare mud in a roadbed in the upper marsh, extensive thick mats, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, August 3, 1972 (# 720803CC-1B in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-1, panne mats in upper marsh in the Salicornia zone, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC1 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-2, in mixed Spartina alterniflora (dwarf) and Salicornia forming extensive mats in the low marsh, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC-2 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-6, black crust dried over a shellheap on the roadbed in mid-marsh, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC6 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-10, on a natural panne in the Distichlis zone of the upper marsh margin, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC10 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-4, marsh margin in pools surrounded by mats

of Vaucheria sp. upper marsh, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, September 14, 1972 (# 720914SJ4 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-1, shellheap in roadbed of mid-marsh on clam shells, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, October 11, 1972 (# 721011CC1 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-12, on a shellheap in a mid-marsh spoil area, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, October 11, 1972 (# 721011CC12 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-A, on Spartina patens culms over ice, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, January 19, 1973 (# 731019-SJA in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Previously reported from Delaware in Zaneveld, 1966 pg. 118 and 1972 pg. 129, and in Drouet, 1968 pg. 76.

Schizothrix Friesii (Agardh) Gomont, 1890.

Trichomata aeruginea, luteo-viridia, olivacea, fusca, rosea, violacea, vel cinereo-viridia, torulosa vel toruloso-cylindrica vel ad dissepimenta passim constricta, diametro 2—10 micra crassa, partim et passim increscentia passim decrescentia, ambitu recta vel curvantia vel spiralia, longitudine indeterminata, per destructionem cellulae intercalaris vel per constrictionem ad dissepimentum frangentia, apices non aut paullo attenuantia. Cellulae diametro trichomatis praecipue longiores vel paullo breviores, 3—20 micra longae, protoplasmate homoganeo vel granuloso raro pseudovacuo-lato, dissepimentis non granulatis. Cellula terminalis longi-cylindrica vel vix attenuato-cylindrica producens, membrana superna hemisphaerica et tenui non incrassata. Materia vaginalis hyalina nonnumquam pigmenta lutea, fusca, caerulea, violacea, vel rosea efficiens, chloro-zincico iodurato vulgo caerulesecens. Planta trichomata longa vel brevia nuda aut in muco amorpho vel laminoso aut solitaria vel pauca vel plura in vaginis cylindraccis plus minusve discretis saepe ramosis comprehens. (Drouet, 1968 pg. 103)

Trichomes blue-green, yellow-green, olive, brown, red, violet, or gray-green, torulose or torulose-cylindrical or constricted only here and there at the cross walls, 2—10 micra broad, here and there and in part increasing or decreasing in diameter, straight or curving or spiraled, capable of growing to indeterminate lengths, breaking by means of the destruction of an intercalary cell or by separation of cells at a cross wall. Cells longer or somewhat shorter than broad, 3—20 micra long, the protoplasm homogeneous or granulose, rarely pseudovacuo-late, the cross walls not granulated. Terminal cell long-cylindrical or slightly attenuate-cylindrical, the outer wall hemispherical, not thickened. Sheath material hyaline, often developing yellow, brown, blue, violet, or red pigments, commonly turning blue in chlor-zinc-iodide. Plant consisting of long or short naked trichomes, or of trichomes in an homogeneous or laminose mucus, or of solitary, few, or many trichomes in more or less discrete cylindrical, often branched, sheaths.

See Figure XXXVIII.

Habitat:

Widely distributed especially where there is abundant rainfall, usually not found in marine habitats. (Drouet, 1968 pg. 104)

Collections:

Christiana River, New Castle County; Ruth Patrick, May, 1951 (in herb. F. Drouet and Acad. Nat. Sci. Phila.).

RMP-2, on mud at the margin of the pond beneath Typha, Red Mill Pond, Star Landing, Sussex County; R.D. Ralph, July 12, 1972 (# 720712RMP2 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Not previously reported from Delaware.

Schizothrix rubella Gomont, 1892.

Trichomata aeruginea, luteo-viridia, olivacea, fusca, rosea, violacea, vel cinereo-viridia, cylindrica, ad dissepimenta non aut raro vix constricta, diametro 1.5—8 micra crassa, partim et passim incrementa passim decrescencia, ambitu recta vel curvantia vel spiralia, longitudine indeterminata, per destructionem cellulae intercalaris vel raro per constrictionem ad dissepimentum frangentia, extremitates abrupte et saepe acute attenuantia. Cellulae quadratae vel diametro trichomatis longiores vel plus minusve breviores, 2—10 micra longae, protoplasmate homogeneo vel granuloso raro pseudovacuelato, dissepimentis non granulatis. Cellula terminalis obtuse vel acute vel truncate conica aut raro plus minusve conico-cylindrica concrescens, membrana superna tenui non incrassata. Materia vaginalis hyalina, nonnumquam pigmentum roseum efficiens, chlorozincico iodurato non aut partim caerulescens. Planta trichomata longa vel breviter nuda aut in muco amorpho vel laminoso aut solitaria vel pauca vel plura in vaginis cylindraceutis plus minusve discretis saepe ramosis comprehens. (Drouet, 1968 pg. 128)

Trichomes blue-green, yellow-green, olive, brown, red, violet, or gray-green, cylindrical, rarely if at all constricted at the cross walls, 1.5—8 micra broad, here and there and in part increasing or decreasing in diameter, straight or curving or spiraled, capable of indeterminate growth in length, breaking by means of the destruction of an intercalary cell or rarely by constriction at a cross wall, the tips abruptly and often acutely attenuated. Cells quadrate or longer or somewhat shorter than broad, 2—10 micra long, the protoplasm homogeneous or granular, rarely pseudovacuelate, the cross walls not granulated. Terminal cell obtuse- or acute- or truncate-conical or rarely more or less conico-cylindrical, the outer membrane not thickened. Sheath material hyaline, sometimes developing a red pigment, not at all or only in part turning blue in chlor-zinc-iodide. Plant consisting of long or short naked trichomes, or of trichomes in an homogeneous or laminose mucus, or of one to many trichomes in a more or less discrete cylindrical, often branched, sheath.

See Figure XXXIX.

Habitat:

Cosmopolitan, in fresh water and on soil and other substrates. (Drouet, 1968 pg. 128)

Collections:

Christiana River, DuPont Stine Laboratory Survey, Sta. 3, New Castle County; Ruth Patrick, May, 1951 (#'s 7, 11 and 23 in herb. F. Drouet).

CC-12, on a shellheap in a mid-marsh spoil area, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, October 11, 1972 (# 721011CC12 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Previously reported from Delaware in Drouet, 1968 pg. 130.

Schizothrix tenerrima (Gomont) Drouet, 1968.

Trichomata aeruginea, luteo-viridia, olivacea, fusca, rosea, violacea, vel cinereo-viridia, cylindrica, ad dissepimenta saepe constricta, diametro 1—6 micra crassa, partim et passim incrementa passim decrescuntia, ambitu recta vel curvantia vel spiralia, longitudine indeterminata, per destructionem cellulae intercalaris vel per constrictionem ad dissepimentum frangentia, cellulam terminalem acutissime attenuantia. Cellulae diametro trichomatis ad 4-plo longiores, 3—12 micra longae, protoplasmae homogeneo vel granuloso nonnumquam pseudovacuo-lato, dissepimentis non granulatis. Cellula apicalis primum cylindrica deinde longi-conica atque longissime et acutissime acuminata, membrana superna non incrassata. Materia vaginalis hyalina, chlorozincico iodurato non aut partim passimque caerulescens. Planta trichomata longa vel brevia nuda aut in muco amorpho vel laminoso aut solitaria vel pauca vel plura in vaginis cylindraceutis plus minusve discretis saepe ramosis comprehens. (Drouet, 1968 pg. 136)

Trichomes blue-green, yellow-green, olive, brown, red, violet, or gray-green, cylindrical, often constricted at the cross walls, 1—6 micra broad, here and there and in part increasing or decreasing in breadth, straight or curving on spiraled, capable of indeterminate growth in length, breaking by means of the destruction of an intercalary cell or by separation of cells at a cross wall, the tips very acutely attenuated (in the end cell). Cells up to four (4) times as long as broad, 3—12 micra long, the protoplasm homogeneous or granular, sometimes pseudovacuo-lated, the cross walls not granulated. Terminal cells at first cylindrical, becoming long-conical, each tip extended into a long hairlike point, the outer membrane not thickened. Sheath material hyaline, turning blue here and there or not at all in chlor-zinc-iodide. Plant consisting of long or short naked trichomes, or of trichomes in an amorphous or laminose mucus, or of solitary or few or many trichomes in a more or less discrete, often branched, cylindrical sheath.

See Figure XL.

Habitat:

On rocks, wood, and soil and on other algae and animals in intertidal zones in the sea, or in places frequently wetted with fresh water. (Drouet, 1968 pg. 137)

Collections:

Not previously reported from Delaware.



Spirulina Turpin, 1827.

Trichomata cylindrica, sine dissepimentis, ambitu recta vel curvantia vel spiralia, ad apices non aut plus minusve attenuata, extremitatibus hemisphaericis, membrana superna tenui non incrassata, protoplasmate homoganeo vel granuloso. Materia vaginalis nulla vel mucosa. Planta trichomata nuda vel in muco comprehens. (Drouet, 1968 pg. 16)

Trichomes cylindrical, without cross walls, either straight or curved or spiraled, not at all or only a little attenuated at the apices, the ends hemispherical, the outer membranes thin, not thickened, protoplasm homogeneous or granuloze. Sheath material absent or mucous. Plants of naked trichomes or of trichomes in mucus.

Spirulina subsalsa Oersted, 1840-41.

Trichomata aeruginea, luteo-viridia, olivacea, fusca, rosea, violacea, vel cinereo-viridia, cylindrica, sine dissepimentis, diametro 0.4—4 micra crassa, partim et passim increscentia passim decrescentia, ambitu spiralia passim curvantia vel recta, longitudine indeterminata, per constrictionem frangentia. Protoplasma homogenum vel granulosum, nonnumquam pseudovacuolatum. Apices trichomatis hemisphaericae, membrana superna tenui non incrassata. Materia vaginalis hyalina, chlorozincico iodurato non caerulescens. Planta trichomata longa vel brevia nuda aut in muco amorpho comprehens. (Drouet, 1968 pp. 19-20)

Trichomes blue-green, yellow-green, olive, brown, red, violet, or gray-green, cylindrical, without cross walls, 0.4—4 micra broad, here and there and in part increasing or decreasing in breadth, spiraled or here and there curving or straight, capable of indeterminate growth in length, breaking by constriction. Protoplasm homogeneous or granulose, sometimes pseudovaculate. Ends of the trichomes hemispherical, the outer membrane thin, not becoming thickened. Sheath material hyaline, not turning blue in chlor-zinc-iodide. Plants consisting of long or short naked trichomes or of trichomes disposed in an amorphous mucus.

See Figure XLI.

Habitat:

In salt, brackish, and fresh water, especially where the last contains a considerable proportion of dissolved salts. It is probable that the higher the concentration of salts in the medium during growth the tighter a spiral the trichome achieves. (Drouet, 1968 pg. 20)

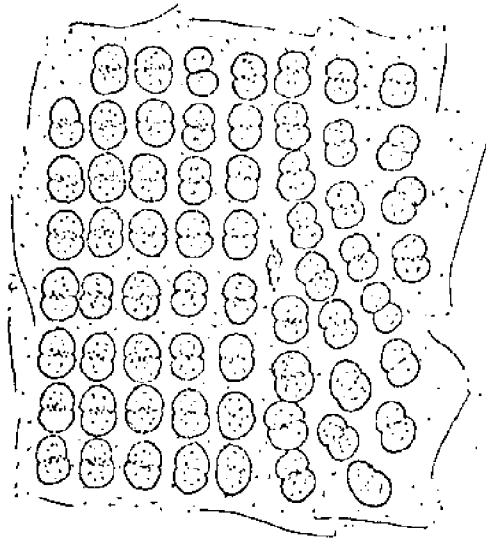
Collections:

In a pond in the dunes behind the beach one mile south of Cape Henlopen, north of Rehoboth Beach, Sussex

County; F. Drouet and H.B. Louderback, August 12, 1948 (#'s 8519 and 8521 in herb. F. Drouet). Harbor of Indian River Inlet, Sussex County; J.S. Zaneveld, W.D. Barnes and H.W. West, June 26, 1961 (in herb. Acad. Nat. Sci. Phila.).

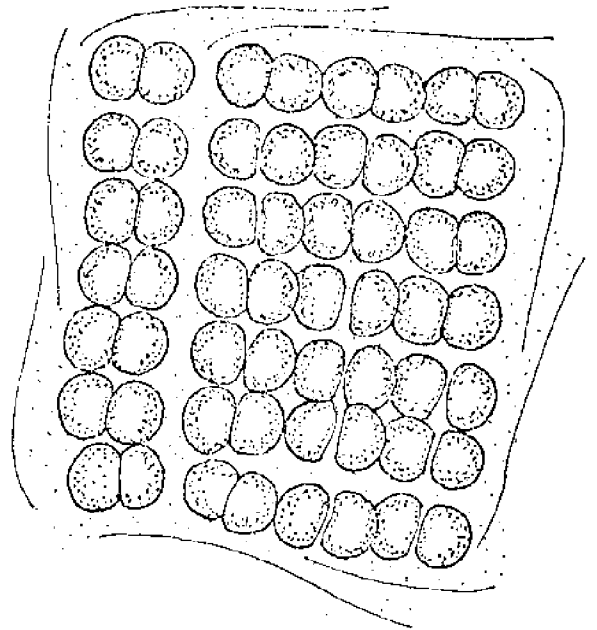
RB-9, pool water in the Spartina patens - Distichlis zone, Big Nose Island marsh, Delaware Seashore State Park, Sussex County; this specimen taken from an algal culture on modified salt Chu medium; R.D. Ralph, orig. coll. May 4, 1972 (# 720504RB9 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). RB-6, pool water with floating mats in the mixed Spartina patens - Distichlis zone, Big Nose Island marsh, Delaware Seashore State Park, Sussex County; R.D. Ralph, July 12, 1972 (# 720712RB6A in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-1', on bare mud in a road-bed in the upper marsh, extensive thick mats, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, August 3, 1972 (# 720803CC-1B in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-2, Spartina alterniflora zone marsh pools, floating black-green masses, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, August 3, 1972 (# 720803SJ2A in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). CC-2, in mixed Spartina alterniflora (dwarf) and Salicornia forming extensive mats in the low marsh, vicinity Fisher homesite, Canary Creek marsh, Green Hill (Lewes), Sussex County; R.D. Ralph, September 14, 1972 (# 720914CC-2 in herb. Univ. of Del. and Acad. Nat. Sci. Phila.). SJ-A, on Spartina patens culms over ice, St. Jones marsh, Barkers Landing, Kent County; R.D. Ralph, January 19, 1973 (# 730119SJA in herb. Univ. of Del. and Acad. Nat. Sci. Phila.).

Previously reported from Delaware in Zaneveld, 1966 pg. 124 and 1972 pg. 128, and in Drouet, 1968 pg. 22.



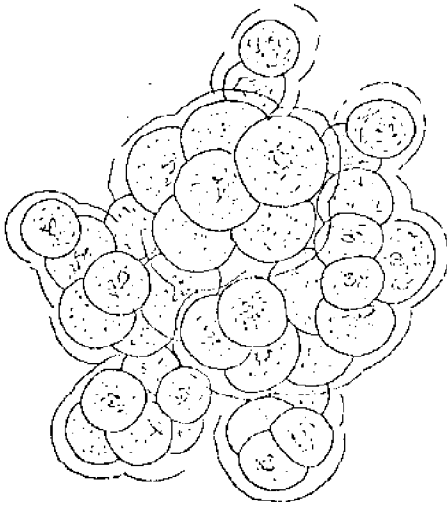
10 $\mu$

Figure I. *Agmenellum quadruplicatum*



20 $\mu$

Figure II. *Agmenellum thermale*



20 $\mu$

Figure III. *Anacystis aeruginosa*



10 $\mu$

Figure IV. *Anacystis cyanea*

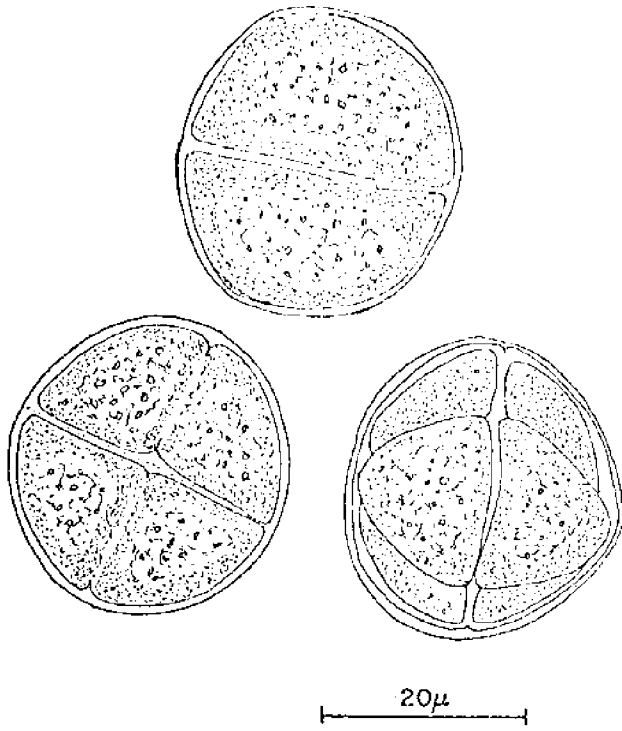


Figure V. *Anacystis dimidiata*

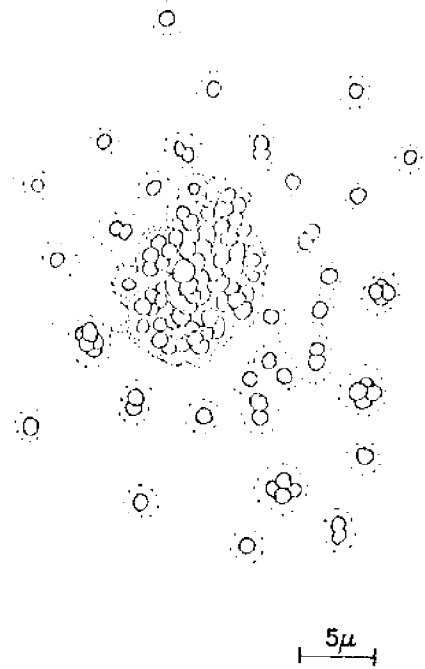


Figure VI. *Anacystis marina*

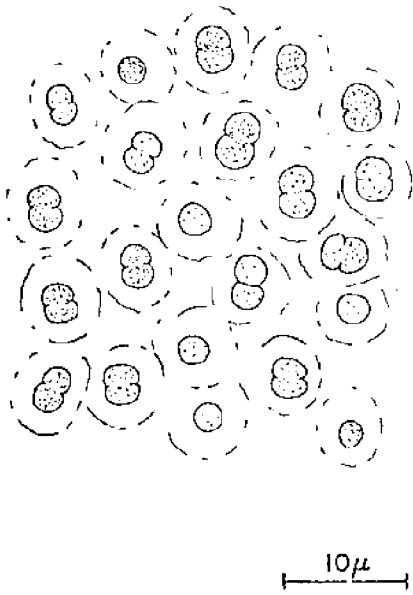


Figure VII. *Anacystis montana*

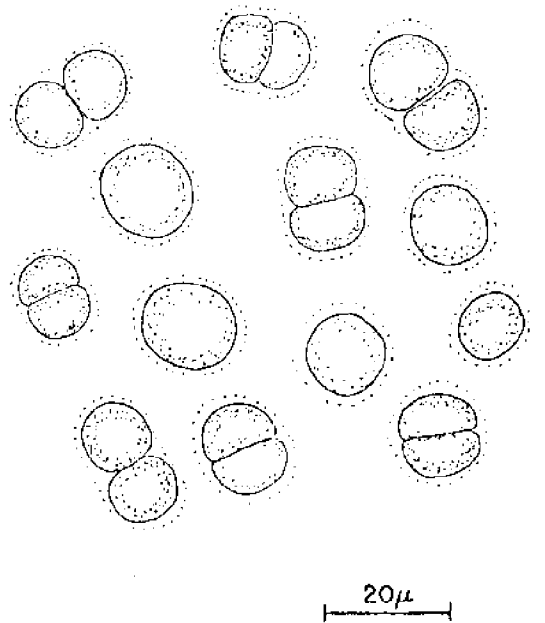
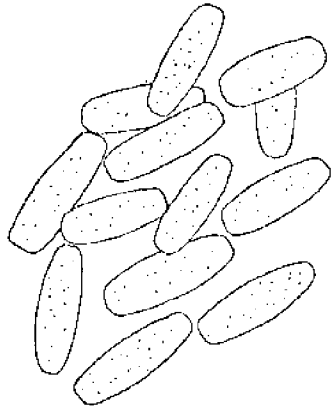
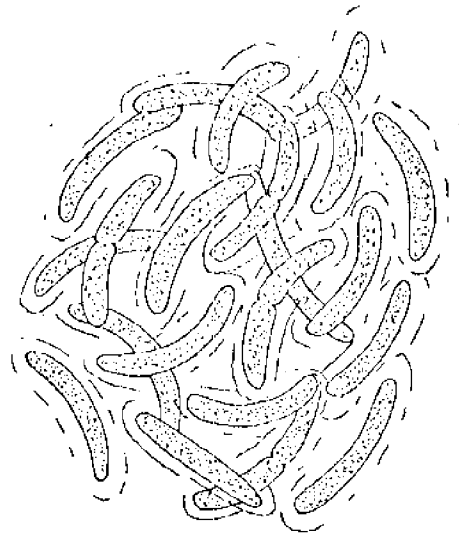


Figure VIII. *Anacystis thermalis*



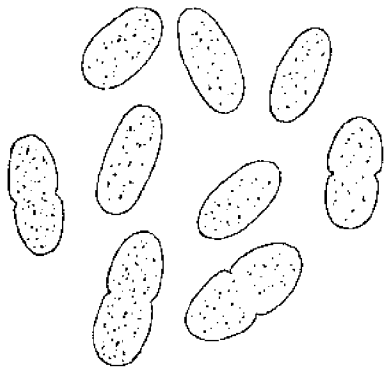
10 $\mu$

Figure IX. *Coccochloris elabens*



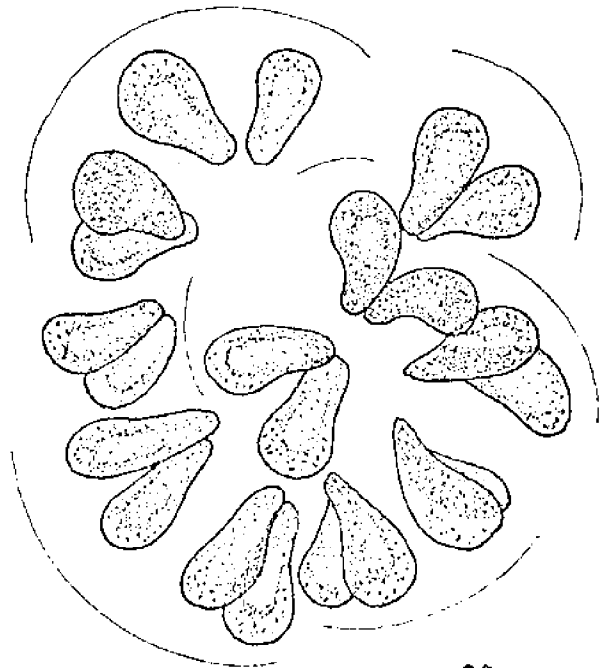
10 $\mu$

Figure X. *Coccochloris Peniocystis*



10 $\mu$

Figure XI. *Coccochloris stagnina*



20 $\mu$

Figure XII. *Gomphosphaeria aponina*

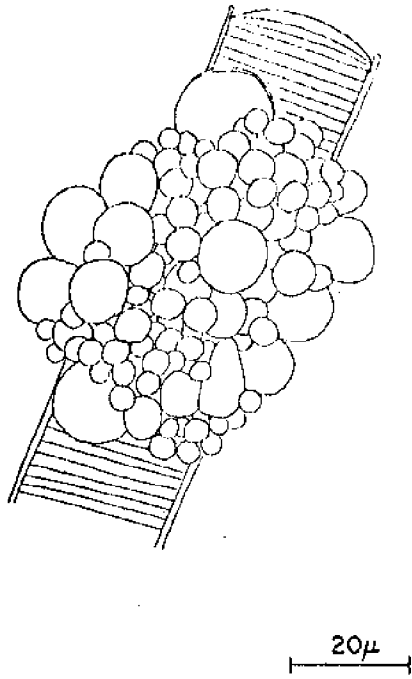


Figure XIII. *Entophysalis conferta*

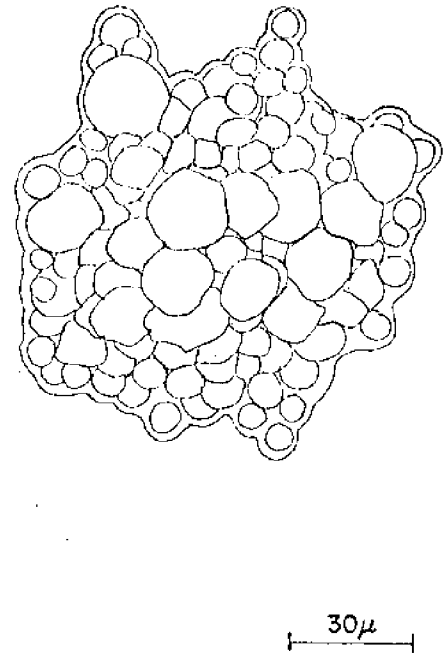


Figure XIV. *Entophysalis deusta*

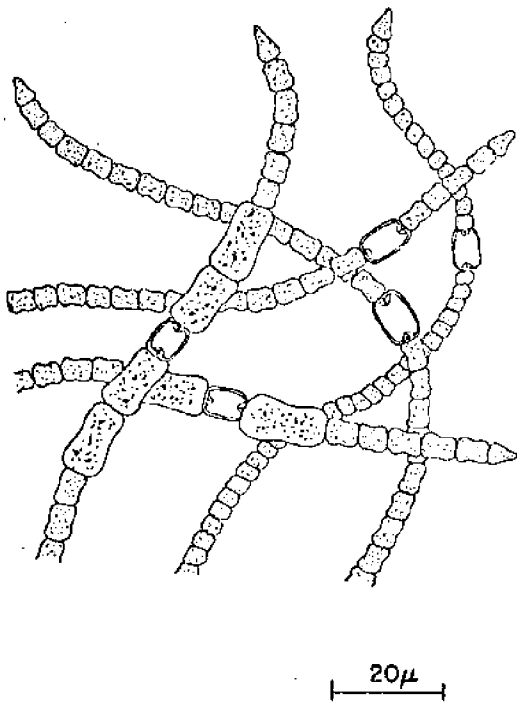


Figure XV. *Anabaena torulosa*

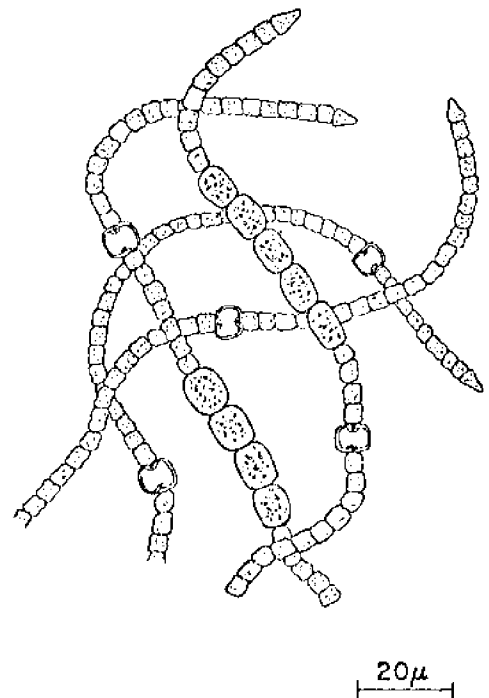


Figure XVI. *Anabaena variabilis*

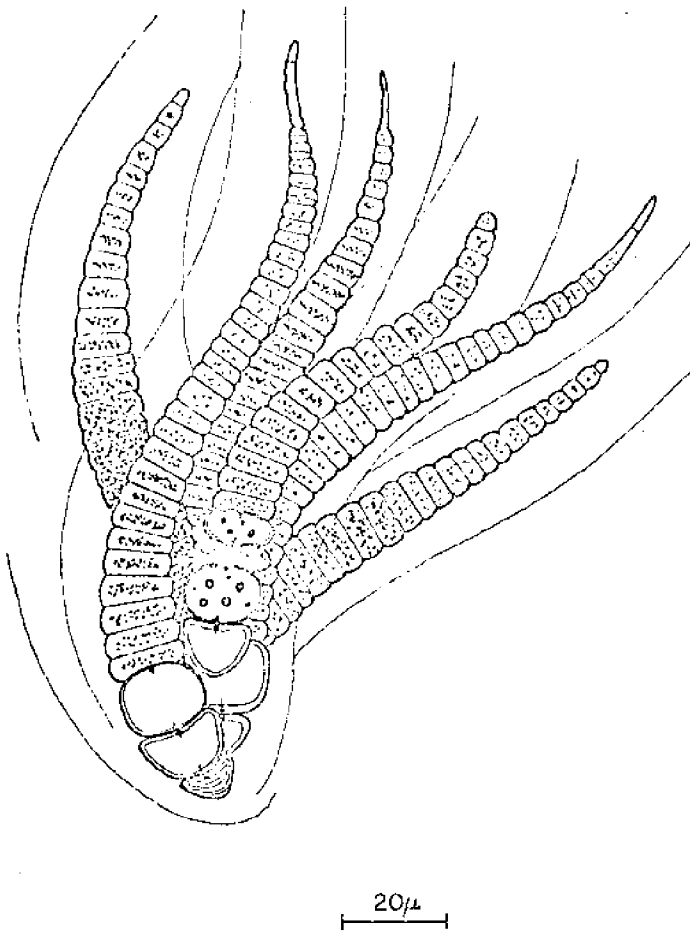


Figure XVII. *Calothrix crustacea*

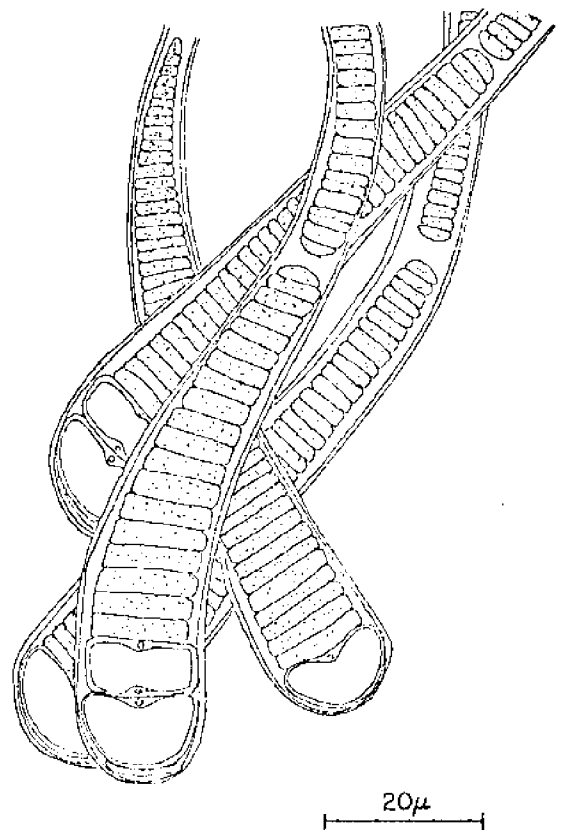


Figure XVIII. *Calothrix parietina*



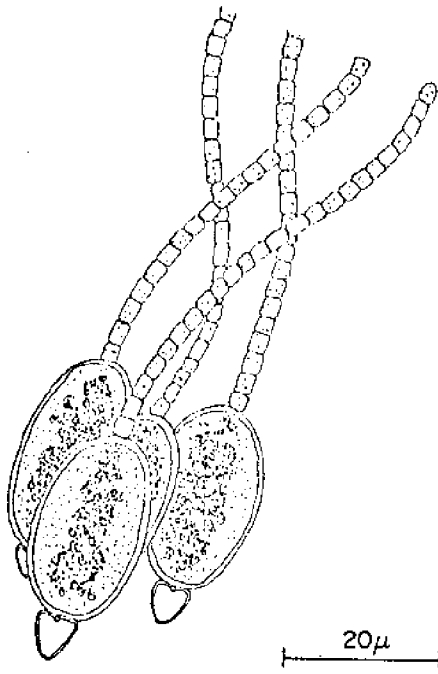


Figure XIX. *Cylindrospermum licheniforme*

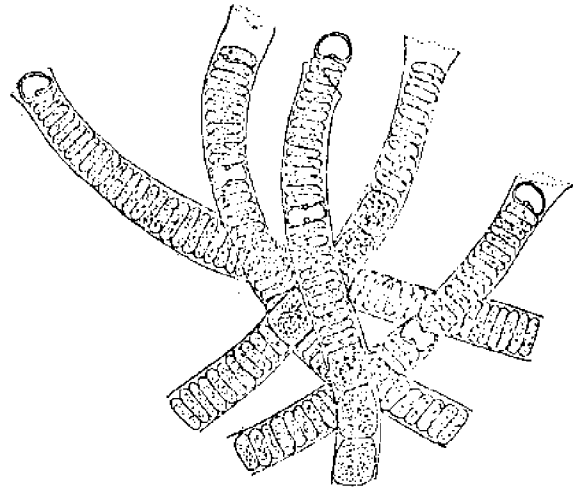


Figure XX. *Nodularia harveyana*

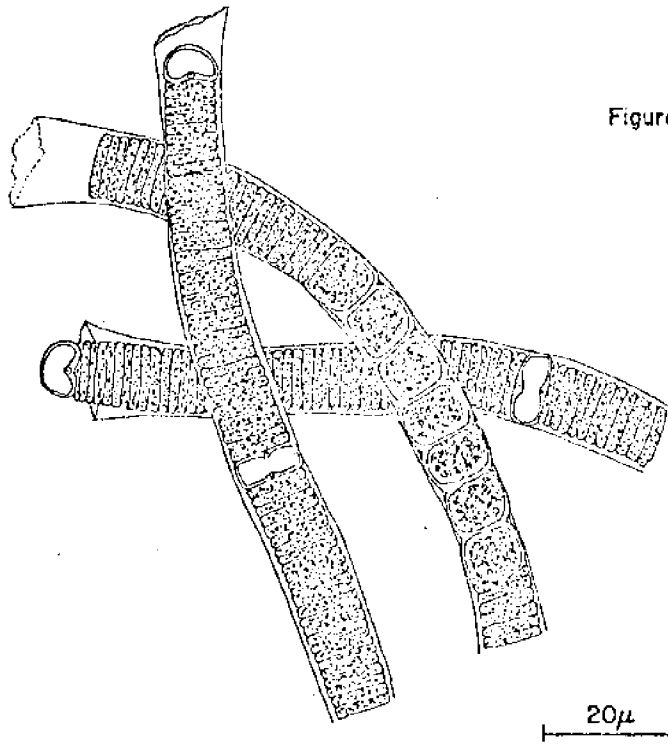
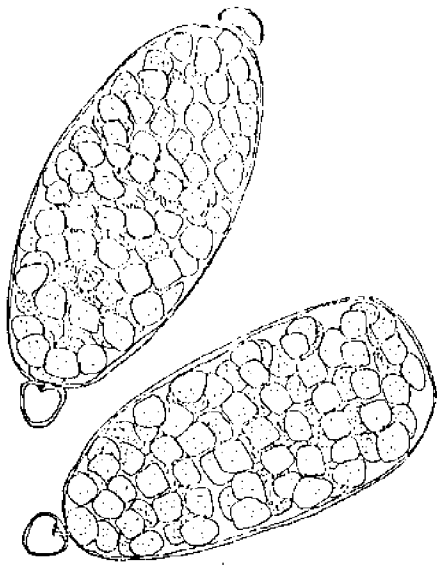
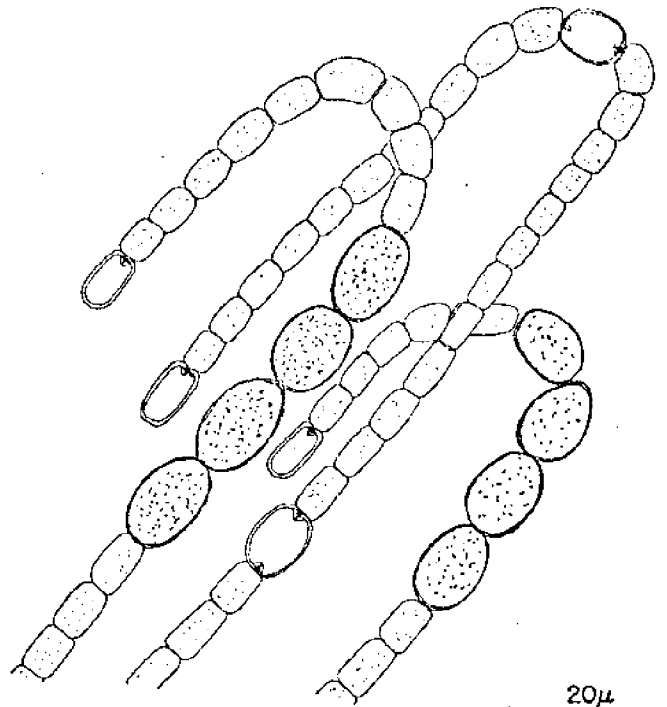


Figure XXI. *Nodularia spumigena*



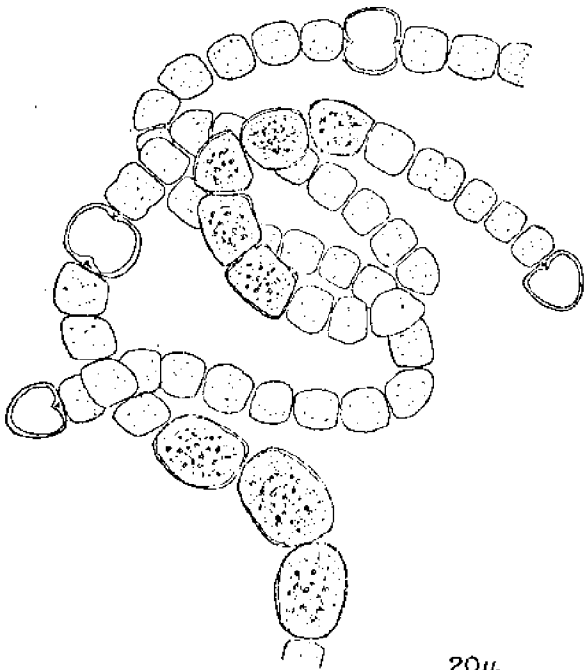
20μ

Figure XXII. *Nostoc commune*



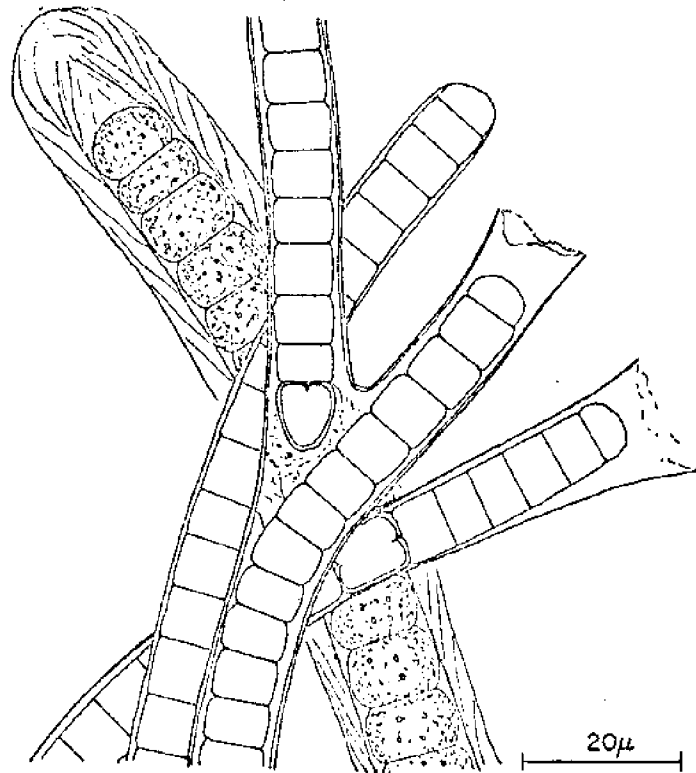
20μ

Figure XXIII. *Nostoc ellipsosporum*



20μ

Figure XXIV. *Nostoc muscorum*



20μ

Figure XXV. *Scytonema Hofmannii*

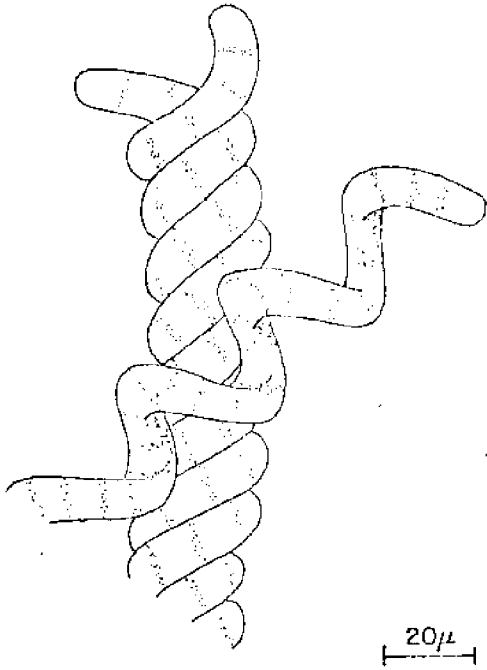


Figure XXVI. *Arthrospira Jenneri*

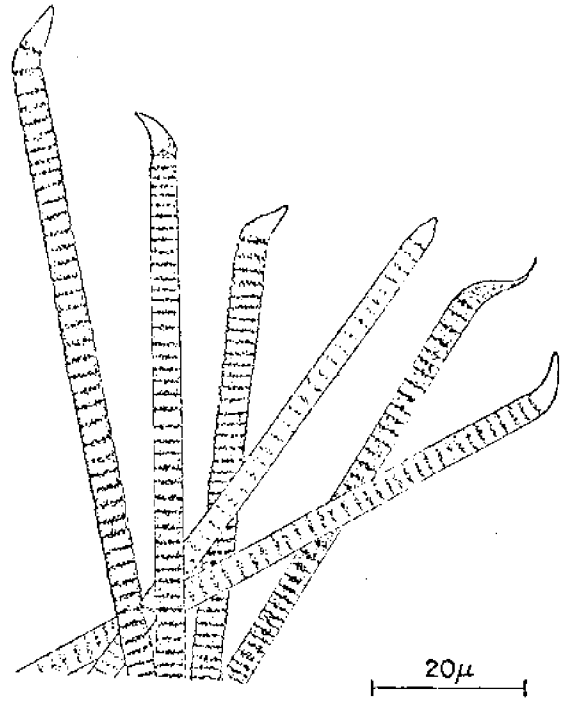


Figure XXVII. *Arthrospira neapolitana*

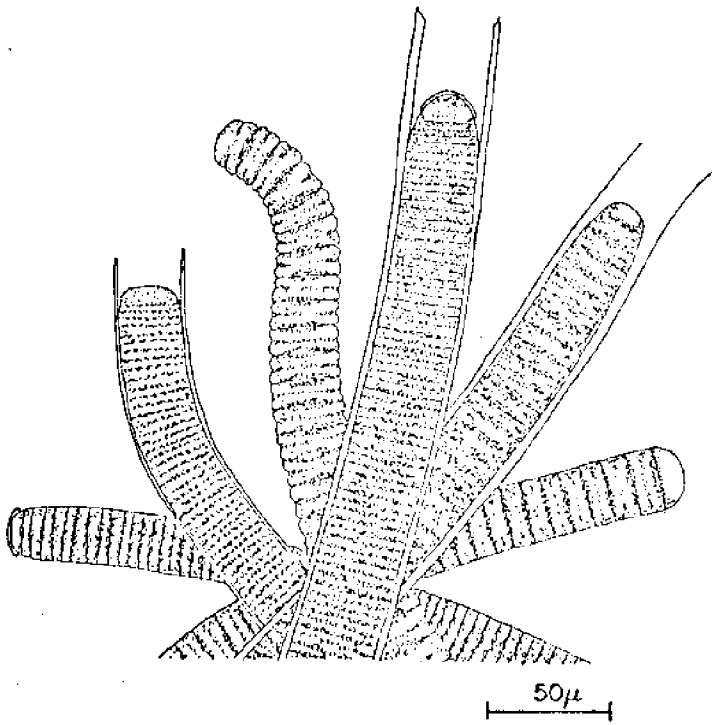


Figure XXVIII. *Microcoleus lyngbyaceus*

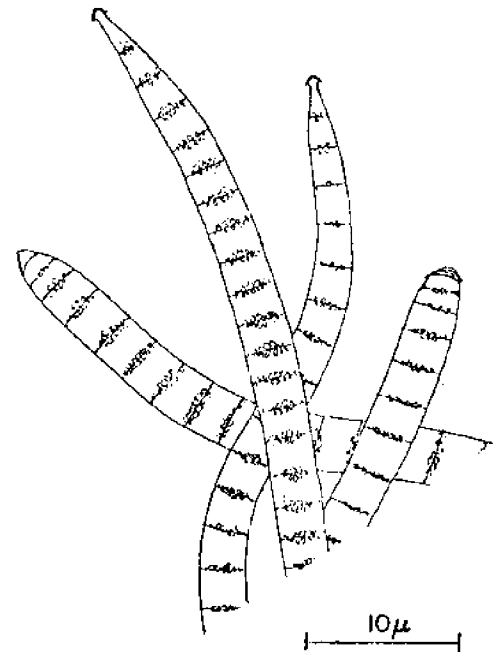


Figure XXIX. *Microcoleus vaginatus*

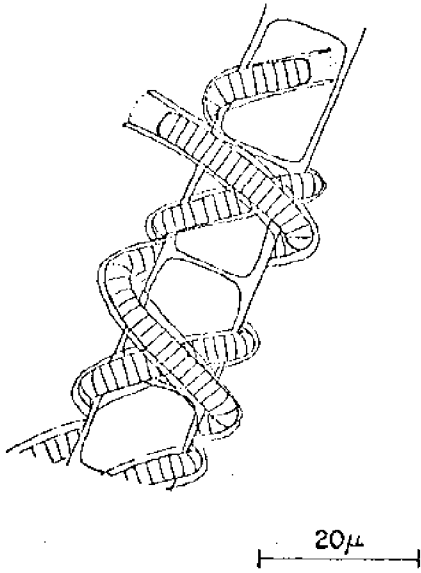


Figure XXX. *Oscillatoria lutea*

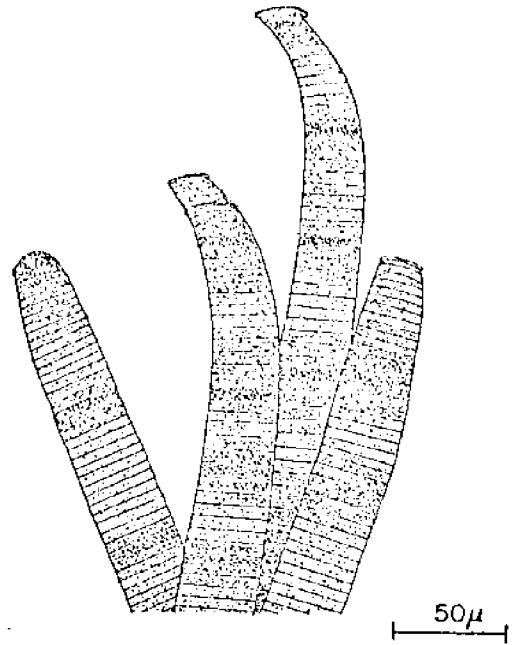


Figure XXXI. *Oscillatoria princeps*

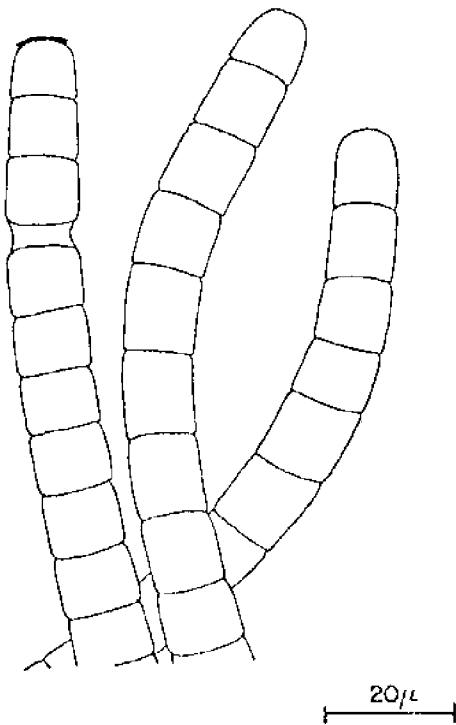


Figure XXXII. *Oscillatoria Retzii*

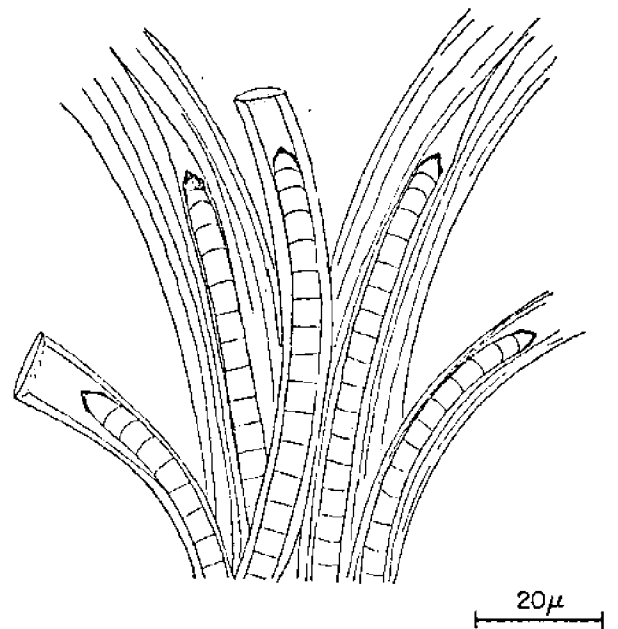


Figure XXXIII. *Oscillatoria submembranacea*

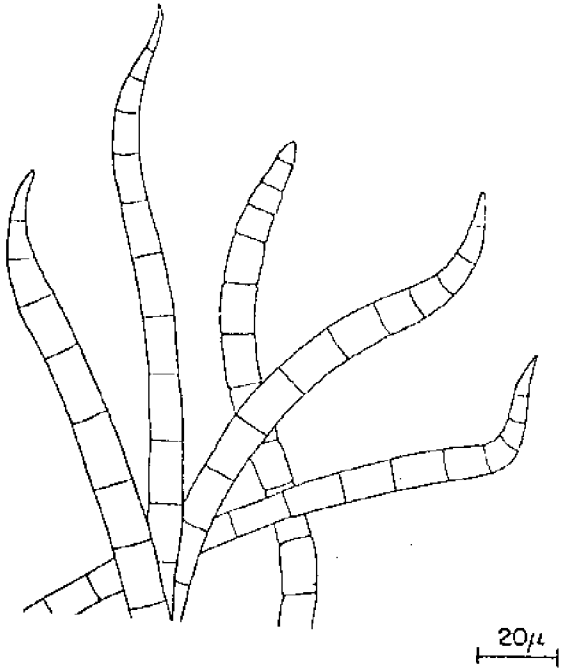


Figure XXXIV. *Porphyrosiphon Notarisii*

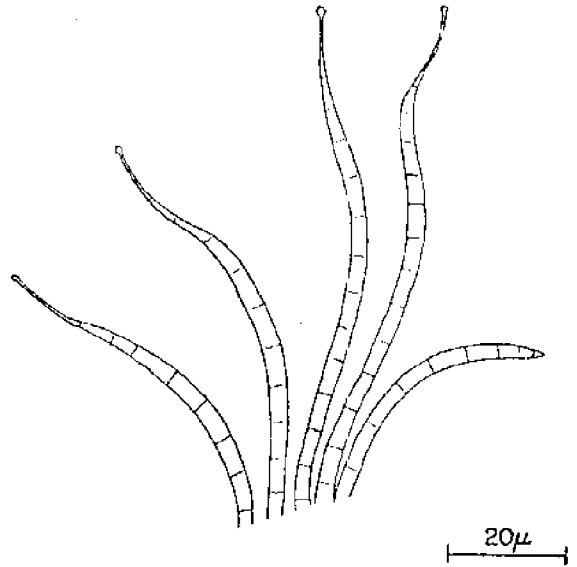


Figure XXXV. *Porphyrosiphon splendidus*

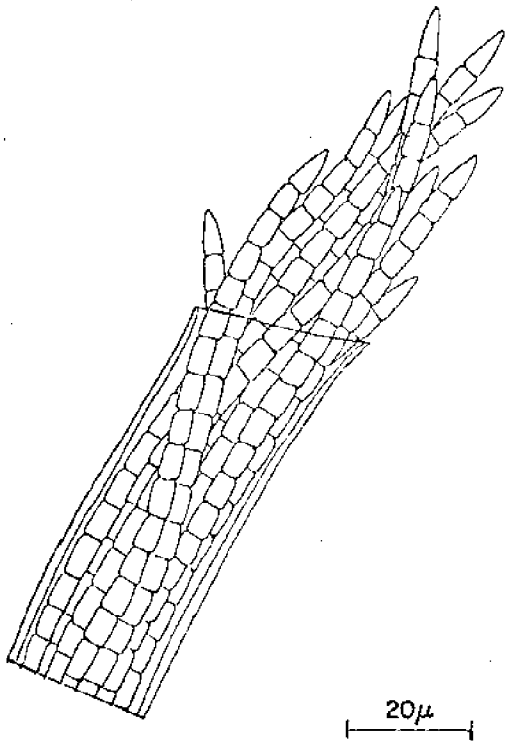


Figure XXXVI. *Schizothrix arenaria*

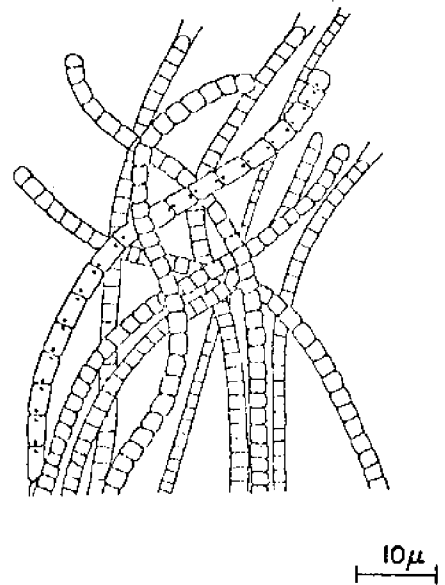


Figure XXXVII. *Schizothrix calcicola*

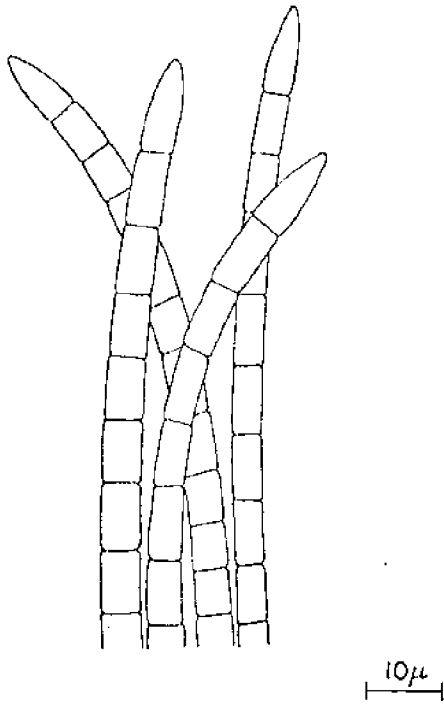


Figure XXXVIII. *Schizothrix Friesii*

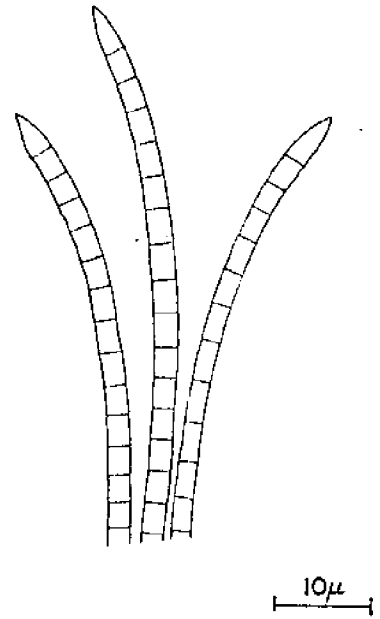


Figure XXXIX. *Schizothrix rubella*

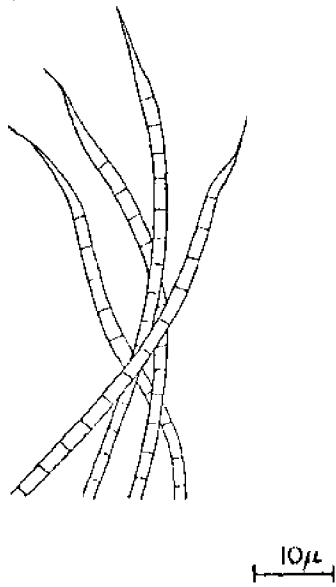


Figure XL. *Schizothrix tenerrima*

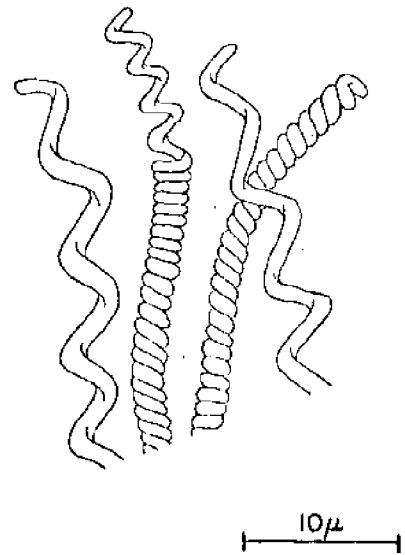


Figure XLI. *Spirulina subsalsa*

GLOSSARY

- Akinete - a spore.
- Amorphous - without definite form, shapeless.
- Attenuate - gradually tapering or very much drawn out at the ends.
- Bloom - a sudden and dramatic efflorescence of aquatic plants often producing a thick scum or slurry in still surface waters.
- Capitate - with a distinct cap or protuberance.
- Catenate - joined together as in a chain or string of beads.
- Clathrate - riddled with holes; like a lattice.
- Cocoid - more or less spherical, globe-shaped.
- Cordiform - shaped like a heart.
- Coriaceous - leathery.
- Diffluent - dissolving away or dissipating.
- Discoid - shaped like a platter.
- Ecophene - a stable, strictly morphological variant produced in response to environmental conditions.
- Endophytic - growing within, but not necessarily parasitic on a plant.
- Endospore - one of many spores produced within a cell by repeated divisions of the protoplast.
- Epiphytic - growing on, but not necessarily parasitic on a plant.
- Equidiametric - of the same breadth.
- Eucapsoid - arranged in a discrete cube.
- Filament - the trichome surrounded by the sheath, if present.
- Filiform - threadlike.
- Granulose - grainy, or as if filled with small grains.

- Heterocyst - a specialized nitrogen-fixing cell with homogeneous contents, thick walls and large pores in each wall contiguous with another cell.
- Hormogone - a fragment of a trichome.
- Hyaline - colorless and transparent.
- Indurate - having become hardened.
- Invaginate - with one or more deep clefts or cavities.
- Intercalary - disposed between cells of the trichome rather than at the ends.
- Laciniate - with a lacy margin or surface.
- lamellate or -lose - composed of layers.
- Laminate or -nose - arranged in or composed of layers.
- Lenticular - shaped like a convex lens.
- Mamillose - covered with small knobs or nipple-like projections.
- Membranaceous - thin and sheet-like.
- Mucous - mucilaginous, slimy.
- Multiseriate - composed of more than one row of cells or trichomes.
- Nostocaceous - belonging to the family Nostocaceae.
- Oscillatoriaceous - belonging to the family Oscillatoriaceae.
- Ovoid - shaped like an egg.
- Pseudovacuate - with gas vacuoles in the protoplast.
- Pyriform - shaped like a pear.
- Quadrate - roughly rectangular.
- Septate - with cross walls.
- Seriate - arranged in a row.
- Terete - cylindrical.
- Thallus - the body of a plant in which there is little internal organization.



Torulose - with obvious constrictions at the cross walls.

Trichome - one or more chains of cells constituting the living portion of the filament.

Tuberculose - having a warty surface.

Undulate - with a wavy appearance or with sinuous margins.

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