Identification of Algae in Water Supplies

Table of Contents

Continue **Credits**

Identification of Algae in Water Supplies

Section I

Back to Table of Contents

George Izaguirre

The algae are a large and very diverse group of organisms that rangefrom minute single-celled forms to the giant marine kelps. They occupy a wide variety of habitats, including fresh water (lakes, reservoirs, and rivers), oceans, estuaries, moist soils, coastal spray zones, hot springs, snow fields and stone or concrete surfaces. In water, they can be planktonic, meaning suspended in the water and carried passively by the currents, or attached to rocks, sediment, reservoir walls, or other plants. They all have in common the ability to photosynthesize with the evolution of oxygen (i.e., they are oxygenic phototrophs). In this process, they use light energy to convert carbon dioxide and water to sugars, and from these to cell matter. The algae include manydifferent taxonomic groups, but the major and most important distinction is between the blue-green algae, or cyanophyta, and the eukaryotic algae, which encompass all the other divisions. The former have an essentially bacterial cell structure, hence the modern designation of cyanobacteria.

The identification of algae is important not only for correctly determining the source of problems and the “target” of corrective measures, but also to enable people in different places and at different times to communicate. There is much disagreement in terms of algal taxonomy, but further confusion has arisen from investigators either incorrectly identifying an organism, or calling the same organisms by different names. It is important to establish some continuity and consistency in the naming of algae.

The significance of algae in drinking water arises from their often abundant presence in the aquatic environment. They are foremost among the organisms that can affect water supplies, either adversely or beneficially, and most reports of biogenic water quality problems in surface waters involve algae. However, there are also beneficial effects

Continue

American Water Works Association

Identification of Algae in Water Supplies

Section I

of algae that are often overlooked. First, the cyanobacteria are believed to have been the first oxygen-producing photosynthetic organisms on earth, and responsible for the development of an oxygen atmosphere that made possible all the higher forms of life. Because all algae release oxygen as part of their metabolism, they contribute to the oxygenation of water supplies and are considered desirable in this regard. Algae also play an important part of the aquatic food chain, as they are the main food source for zooplankton, which in turn serve as food for small fish and other aquatic organisms. This is important from a general ecological point of view, but is also significant in lakes and reservoirs that serve as fisheries in addition to drinking water sources. Algae have also been used as food or food additives in many countries, especially the marine kelps and commercially grown *Spirulina*. Some algae are also potential sources of pharmaceuticals and other bioactive substances. Algae have also been utilized in the treatment of wastewater and other liquid waste.

The adverse effects of algae include taste and odor, filter clogging, oxygen depletion, toxin production, the formation of disinfection byproducts, undesirable pH changes, and scum formation in lakes and reservoirs. The production of objectionable taste-and-odor substances is one of the most common deleterious effects of algae in water supplies, resulting in higher treatment costs and affecting the acceptability of the water to the consumers. This problem can also lead to the erosion of public confidence in the water supply. The usual odors or off-flavors are earth-musty, moldy, fishy, grassy or "septic." The most difficult odors to deal with are those involving the earthy-musty compounds geosmin or 2-methylisoborneol (MIB), which can be detected by many people at extremely low concentrations (<15 ng/L). They are very difficult to remove by conventional treatment, although they can be removed by ozone or granular activated carbon. These compounds are produced by bacteria called actinomycetes, and by some cyanobacteria. Many of the cyanobacteria able to produce these compounds have been isolated

Continue

Identification of Algae in Water Supplies

Section I

only in the last twenty years. Some algae can lead to clogging of filters in treatment plants, thereby drastically reducing the length of filter runs and necessitating frequent backwashings. In extreme cases, clogging may require more water to backwash than the amount of filtered water produced, severely diminishing the efficiency and cost-effectiveness of the process. This problem is usually caused by certain diatoms, but other algae can also be responsible, especially those that form colonies or that have sticky surfaces. A related problem is the clogging of

screens and trash racks in reservoirs, that can result from accumulations of filamentous algae.

A common adverse effect is the depletion of oxygen following the death and decay of an algal bloom. The end result is often a massive fish kill. This problem is usually associated with blooms of certain colonial or filamentous bluegreens that form surface scums. The floating algae not only exert an oxygen demand as they decay, but can also act as a physical barrier to the exchange of oxygen between the atmosphere and the water. These scums are unsightly and can lead to accumulations on the shore, an undesirable development in a recreational water body.

Some cyanobacteria can produce a variety of toxins, which have caused deaths of cattle, horses, swine, sheep, dogs and other animals. Reports of algal poisonings have come from many parts of the world, including Australia, the United States, Canada, South Africa, and New Zealand. These toxins are of four general classes: the cyclic peptide hepatotoxins exemplified by the microcystins and nodularin, the alkaloid neurotoxins such as anatoxin-a and saxitoxins, the cyclic alkaloids such as cylindrospermopsin, and the dermatotoxins, such as aplysiatoxins and lyngbyatoxin. There is mounting evidence that humans are susceptible to these toxins as well. One recent incident involved the cyanotoxin contamination of the water in a hemodialysis facility in Brazil, resulting in fifty deaths. Interest in algal toxins by the drinking water industry has accelerated in recent years, especially in light of this and other incidents.

Continue

Identification of Algae in Water Supplies

Section I

It has been recognized since at least 1980 that algae or their extracellular metabolites can react with chlorine to form trihalomethanes and other disinfection byproducts. Treating an algal bloom with chlorine will generally lead to an elevation of these compounds in the water, in the near term. This can be a difficult problem to avoid in open treated water reservoirs subject to algal blooms. Since there is no filtration capability downstream of the impoundment, the only recourse to the utility is to use some chemical means of control, usually copper sulfate or chlorine.

Algae can lead to undesirable pH shifts in the course of their growth in a lake or reservoir, usually toward the alkaline side. In some cases pH's as high as 9.5 have been observed in the upper levels of a reservoir with abundant algae, and this can interfere with water treatment processes. Since some treatment processes are very pH-sensitive, it is undesirable to have pH fluctuations in the source water.

Continue

Identification of Algae in Water Supplies

BIBLIOGRAPHY

(* indicates most useful reference)

*American Public Health Association, American Waterworks Association, Water Environment Federation. 1995. **Standard Methods for the Examination of Water and Wastewater**. Section 10200 F. Phytoplankton Counting Techniques and color plates. 19th Edition, A.P.H.A., Washington, D.C.

AWWA. 1995. **Problem Organisms in Water: Identification and Treatment**. M7 Manual of Water Supply Practices.

Belehery, Hillary. 1979. **An Illustrated Guide to Phytoplankton**. H.M. Stationery Office, London.

Bold, H.C., and M.J. Wynne. 1985. **Introduction to the Algae: Structure and Reproduction**. 2nd Edition. Prentice-Hall, Inc., NJ.

Canter-Lund, H. and J.W.G. Lund. 1995. **Freshwater Algae: Their Microscopic World Explored**. Biopress Ltd., Bristol, England.

*Cox, E.J. 1996. **Identification of Freshwater Diatoms from Live Material**. Chapman & Hall, London.

*Dillard, Gary E. 1999. **Common Freshwater Algae of the United States**, **An Illustrated Key to the Genera (Excluding Diatoms).** J.Cramer, Stuttgart.

Dillard, Gary E. 1989. **Freshwater Algae of the Southeastern United States. Part 1. Chlorophyceae: Volvocales, Tetrasporales and Chlorococcales.** J. Cramer, Stuttgart (Bibliotheca Phycologica, Band 81)

Dillard, Gary E. 1989. **Freshwater Algae of the Southeastern United States. Part 2. Chlorophyceae: Ulotrichales, Microsporales, Cylindrocapsales, Sphaeropleales, Chaetophorales, Cladophorales, Schizogoniales, Siphonales and Oedogoniales.** J. Cramer, Stuttgart (Bibliotheca Phycologica, Band 83)

Dillard, Gary E. 1990. **Freshwater Algae of the Southeastern United States. Part 3. Chlorophyceae: Zygnematales: Zygnemataceae, Mesotaeniaceae and Desmidiaceae (Section 1).** J. Cramer, Stuttgart (Bibliotheca Phycologica, Band 85)

Continue

Identification of Algae in Water Supplies

Section III

Dillard, Gary E. 1991. **Freshwater Algae of the Southeastern United States. Part 4. Chlorophyceae: Zygnematales: Desmidiaceae (Section 2) .** J. Cramer, Stuttgart (Bibliotheca Phycologica, Band 89)

Dillard, Gary E. 1991. **Freshwater Algae of the Southeastern United States. Part 5. Chlorophyceae: Zygnematales: Desmidiaceae (Section 3) .** J. Cramer, Stuttgart (Bibliotheca Phycologica, Band 90)

Dillard, Gary E. 1993. **Freshwater Algae of the Southeastern United States. Part 6. Chlorophyceae: Zygnematales: Desmidiaceae (Section 4) .** J. Cramer, Stuttgart (Bibliotheca Phycologica, Band 93)

Foged, Niels. 1981. **Diatoms in Alaska.**. J. Cramer, Stuttgart. Bibliotheca phycologica Fritsch, F.E. 1961. **The Structure and Reproduction of the Algae, Volume 1**. Cambridge University Press, NY.

Garnett, M.J. 1965. **Freshwater Microscopy in the U.S.** Dover Publishing, Inc., NY. Graham, L.E., and L.W. Wilcox. 2000. **Algae**. Prentice-Hall, Inc., NJ.

Kudo, R.R. 1971. **Protozoology**. 5th Edition. Charles C. Thomas Publisher, IL.

Lee, J.J., Leedale, G.F., Bradsbury, P. editors 2000. **An Illustrated Guide to the Protozoa**. Society of Protozoologists, KS.

Lee, Robert. E. 1999. **Phycology**, 3rd Edition. Cambridge University Press, NY.

Leedale, G.F. 1967. **Euglenoid Flagellates**. Prentice-Hall, Inc. NJ.

*Palmer, C. Mervin. 1962. **Algae in Water Supplies**. U.S. Department of Health, Education and Welfare, Public Health Publication No. 657, Washington, D.C.

Patterson, D.J. and S. Hedley. 1992. **Free-living Freshwater Protozoa; A Color Guide**. CRC Press, Inc., FL.

Pennak, R.W. 1989. **Freshwater Invertebrates of the United States-Protozoa to Mollusca**. 3rd Edition. John Wiley & Sons, Inc., NY.

Pentecost, A. 1984. **Introduction to Freshwater Algae**. Richmond Publishing Co.Ltd., Richmond, England.

Pesez, Gaston. 1977. **Altas de Microscopie des Eaux Douces**. 19 rue Augereau, Paris.

*Prescott, G.W. 1962. **Algae of the Western Great Lakes Area**. Wm.C. Brown Co. Publishers.

Continue

Identification of Algae in Water Supplies

Section III

*Prescott, G.W. 1954. **How to Know the Freshwater Algae**. In: Pictured Key Nature series, University of Montana Press, Montana.

Round,F.E., R.M. Crawford and D.G. Mann. **The Diatoms** . Cambridge University Press, Cambridge.

Smith, G.M. 1938. **Cryptogamic Botany, Volume 1, Algae and Fungi**. McGraw Hill Gook Company, Inc. NY.

Smith, G.M. 1950. **Freshwater Algae of the United States.** 2nd Edition. McGraw Hill Book Co. Inc., NY.

Smith, R.F. 1994. **Microscopy and Photomicrography: A Working Manual.** CRC Press, Inc., FL.

*Taft, C. and Taft, C. 1971. **The Algae of Western Lake Erie.** Bull. Ohio Biol. Surv. N.S. Columbus,OH, 4:1-89.

US Environmental Protection Agency. 1992. **Consensus Method for Determining Groundwaters Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis (MPA)**. #910/9-92-029. USEPA Manchester Environmental Laboratory, Port Orchard, WA.

US Environmental Protection Agency. 1996. **Microscopic Particulate Analysis (MPA) for Filtration Plant Optimization**. EPA 910-R-96-001, USEPA Region 10, Seattle, WA.

Vinyard, W.C. 1979. **Diatoms of North America.** Mad River Press, Inc., CA

*Weber.C.I. 1971. **A Guide to the Common Diatoms at Water Pollution Surveillance System Stations**.

U.S. Environmental Protection Agency, National Environmental Research Center, Cincinnati, OH.

Wetzel, R.G. and G.E. Likens. 1991. **Limnological Analysis**, 2nd Edition. Springer Verlag, NY.

Whitford, L.A. and G.L. Schumacher. 1984. **A Manual of Freshwater Algae** . Sparks Press, Raleigh, NC.

Continue

Identification of Algae in Water Supplies

Key for the Identification of The Most Common Freshwater Algae in Water Supplies

(This key is based on keys given in American Public Health Association (1995). Dillard, (1999) and Weber,1971)

1a Chloroplasts (plastids) absent; generally blue-green; does not stain blue/black with Lugol's iodine solution (no starch present).......Cyanobacteria (blue green algae) .... Go to 4

1b Chloroplast(s) present. Lugol's iodine test positive or negative .... Go to 2

2a Cell wall rigid with regular pattern of fine markings, cells (frustules) formed of two silicon halves (valves), one over the other like a box and lid. Not stain blue with Lugol's iodine solution (no starch present)........Bacillariophyta (diatoms) ....Go to 16

2b Cell wall not as above. Lugol's iodine test positive or negative ....Go to 3

3a Cell or colony motile; flagella present (often not readily visible) .... Go to 40

3b Nonmotile; no flagella present ....Go to 52

Cyanobacteria (blue green algae)

4a Cells in filaments (or much elongated to form a thread)..Go to 5

4b Cells not in filaments ....Go to 12

5a Heterocysts present ....Go to 6

5b Heterocysts absent..Go to 10

Continue

Section IV

Back to Table of Contents

6a Heterocysts located at one end of the filament- filament not gradually narrowed to one end ....*Cylindrospermum*

6b Heterocysts at various locations in the filament..................Go to 7

7a Filament unbranched ....Go to 8

7b Filament with occasional (false) branches (rare in water supplies) ....*Scytonema* (no image available) or *Tolypothrix*

8a Cells cylindric, often in tight parallel clusters. Heterocysts and akinets cylindric to oval in shape ....*Aphanizomenon*

8b Filaments not in tight parallel clusters.Cells, heterocysts and akinets usually round ....Go to 9

9a. Filaments in a common gelatinous mass ....*Nostoc*

9b. Filaments in not in a common gelatinous mass ....*Anabaena*

10a Filaments with spiral form throughout...........................*Spirulina*

10b Filaments not spiral..Go to 11

11a Filaments surrounded by a sheath that may extend beyond the ends of the filaments of cells ....*Lyngbya*

11b Filaments not surrounded by a sheath. Filament may show movement ....*Oscillatoria*

12a Cells in a regular pattern of parallel rows, forming a plate ....*Merismopedia*

12b Cells not as above ....Go to 13

13a Cells regularly arranged near surface of a spherical gelatinous sheath. Cells ovate to heartshaped, connected to the center of the mass by colorless stalks ....*Gomphosphaeria*

Continue

Back

13b Gelatinous sheath, if present, not spherical, or cells not only near surface of mass ....Go to 14

14a Cells cylindric-oval..*Aphanotheca*

14b Cells spherical ....Go to 15

15a Two or more distinct layers of gelatinous sheath around each cell or cell cluster (No photo image available, see Fig. A-3)..*Gloeocapsa*

15b Mucilagenous sheath not distinctly layered, colonies composed of many crowded cells within the sheath, cells often appear purplish-brown in color ....*Microcystis*

15c Cells evenly spaced, sometimes in pairs, within the mucilaginous sheath ....*Aphanocapse*

15d Cells isolated or in colonies of 2-32 cells. Sheath thin or absent..*Chroococcus*

Diatoms

16a Valves without a true raphe or pseudoraphe (raphe is a slit in the valve that allows for diatom mobility); valve view circular in outline, ornamentation radial about a central point (centric diatoms) ....Go to 17

16b Valves with true raphe or pseudoraphe; ornamentation transverse and/or longitudinal (pennate diatoms) ....Go to 21

17a Frustules united into filaments, with valve faces in contact, therefore cells commonly seen in side (girdle) view....................*Melosira, Aulacoseira, or Skeletonema*

17b Frustules usually solitary, but may form short chains ....Go to 18

Identification of Algae in Water Supplies

Back to Table of Contents

18a Valves with two marginal protuberances or horns on opposite sides of the valve; usually seen in girdle view .... *Biddulphia* *(no image available)* *or Pleurosira (view image)*

18b Valves lacking protuberances .... Go to 19

19a Valve margins otherwise; central area not sharply distinct from margin .... Go to 20

20a Marginal spines always present. Radial markings extending from center to margin .... *Stephanodiscus*

20b No marginal spines. Ornamentation of valve uniform often with geometric facets...................... *Coscinodiscus*

21a True raphe absent, pseudoraphe present on both valves .... Go to 22

21b True raphe present on at least one valve; raphe may be very short or rudimentary, or may be concealed in a keel or wing .... Go to 26

22a Frustules with thick longitudinal septae running parallel to the valve faces .... *Tabellaria*

22b Frustules without septae.. Go to 23

23a Valves with thickened internal transverse ribs (costae), extending mostly completely across valve face .... Go to 24

23b Valves without costae .... Go to 25

24a Valves symmetrical about the transapical plane .... *Diatoma*

Continue

Back

Identification of Algae in Water Supplies

Section IV
Back to Table of Contents

24b Valves asymmetrical about the transapical plane, colonies fan-shaped .... *Meridion*

25a Frustules with bulbous ends, the two ends unequal in size. Typically forming stellate colonies .... *Asterionella*

25b Frustule ends equal. Cells attached side by side forming ribbon like chains, or solitary .... *Fragilaria* and *Synedra*

26a Raphe evident on at least one valve .... Go to 27

26b Raphe not readily evident, concealed in a keel or wing .... Go to 35

27a Raphe on one valve only. Opposing valve with pseudoraphe or rudimentary raphe near valve poles .... Go to 28

27b Raphe or rudimentary raphe on both valves .... Go to 30

28a Valves elliptical (round-oval) in valve view. One valve with pseudoraphe .... *Cocconeis*

28b Valves not elliptical, usually linear, usually bent when seen in girdle view .... Go to 29

29a Valves symmetrical about the transapical plane, one valve with pseudoraphe .... *Achnanthes*

29b Valves asymmetrical about the transapical plane, one valve with rudimentary raphe near the poles .... *Rhoicosphenia*

30a Raphe rudimentary, short, near poles only …………..….. *Eunotia*

30b Raphe fully developed, extending the length of the valve .... Go to 31

Continue
Back

Identification of Algae in Water Supplies

31a Valves symmetrical about both the transapical and apical plane ....Go to 32

31b Valves asymmetrical about either the apical or transapical plane..Go to 33

32a Valves with chambered striae, usually with parallel sides and broadly rounded poles ....*Pinnularia*

32b Striae not chambered...*Navicula*
(See also *Frustulia*, *Stauroneis, Mastogloia, Caloneis, Gyrosigma*, etc.)

33a Valves asymmetrical about the transapical plane, symmetrical about the apical plane ....*Gomphonema*

33b Valves symmetrical about the transapical plane, asymmetrical about the apical plane ....Go to 34

34a Valve faces parallel, Raphe located almost through center of valve ....*Cymbella*

34b Valve faces not parallel, both valve faces can be seen in girdle view. Raphe near edge of valves ....*Amphora*

35a Keel elevated into a lateral "wing" or flattened on the valve surface, costae extending across valve ....Go to 36

35b Valves without internal transverse ribs or costae ....Go to 37

36a Raphe with "V" shaped medial extension. Costae alternating with two or more rows of alveoli ....*Epithemia*

36b Raphe without "V" shaped medial extension, Raphe canal without pores..*Rhopalodia*

American Water Works Association

37a Valves with lateral keel (or canal) extending along both margins of each valve ....Go to 38

37b Valves with lateral keel extending along only one margin of each valve ....Go to 39

38a Valve face longitudinally undulate, undulations seen also in girdle view. “Peanut shaped” ....*Cymatopleura*

38b Valve face with no undulations, but with heavy ribs ......*Surirella*

39a Keel eccentric to the median axis (except for *Bacillaria*). Keel with a row of circular pores (carinal dots or keel puncta).Keel diagonally opposite on both valves so it may be seen on each valve by slight change in focus..*Nitzschia*

39b Keel directly opposite on both valves (can’t see change by changing focus). Frustules robust............*Hantzschia*

Flagellated Algae

40a Cells in a loose, rigid conical case (lorica); isolated or in a branching colony...*Dinobryon*

40b Case or lorica if present not conical; colony if present not branching...Go to 41

41a Cells single or in pairs ....Go to 42

41b Cells in colonies of four or more cells ....Go to 49

42a Flagella emerging from a prominent transverse groove that encircles the cell. (Dinoflagellates) ....Go to 43

42b Cells without transverse groove ....Go to 45

American Water Works Association

Identification of Algae in Water Supplies

Section IV

Back to Table of Contents

43a Cells with a long anterior horn and 2 or 3 shorter posterior horns .... *Ceratium*

43b Cells without horn-like projections .... G*o to 44*

44a Cell wall composed of plate-like subunits .... *Peridinium* (see also *Gonyaulax*, *Glenodinium*)

44b Cells "naked", no cell wall.................................... Gymnodinium (See also *Gyrodinium, Massartia*) (No image available)

45a Cells with long bristle-like spines and/or scales .... *Mallomonas* (No photo image available. See Fig. A-1)

45b Cells without bristles or scales .... Go to 46

46a Cells enclosed in a rigid covering, cell wall or lorica .... Go to 47

46b Cells without a rigid lorica.. Go to 48

47a Lorica opaque, brown to red. Surface smooth or with granules or spines .... *Trachelomonas*

47b Lorica transparent, cells with golden-brown chloroplasts, does not stain blue/black with Lugol's iodine .... *Chrysococcus* (No photo image available, see Fig. A-4)

47c Cell was clear, cells with grass-green chloroplasts, two flagella per cell, stains blue/black with Lugol's iodine .... *Chlamydononas*

48a Cell membrane (pellicle) plastic. Cells can change shapes during movement .... *Euglena*

Continue

Back

48b Cell membrane rigid, cell shape fixed, cells flattened .... *Phacus*

49a Chloroplasts golden-brown, cells in contact with one another. Starch test negative .... *Synura*

49b Chloroplasts grass-green, starch test positive (stains blue with Iodine) .... Go to 50

50a Cells within a colony in contact with one another .... *Pandorina*
(No photo image available, see Fig. A-1)

50b Cells within a colony not in contact with one another .... Go to 51

51a Colony composed of several hundred cells .... *Volvox*

51b Colony with less than 75 cells .... *Eudorina*

Green Algae

52a Cells jointed together to form a network .... *Hydrodictyon*

52b Algae not forming a net .... Go to 53

53a Cells elongated, attached side by side with their long axis parallel to one another. Number of cells commonly two, four or eight .... *Scenedesmus*

53b Cells not attached side by side .... Go to 54

54a Cells divided into mirror-image halves (semicells) by a mid-region constriction. If constriction not obvious in the cell wall itself, the chloroplast is so divide **(Desmids)** .... Go to 55

54b Cells not divided at the mid-region ....Go to 59

55a Cells flattened with a deep median constriction; semicells with several lobes, those lobes with secondary lobes and lobules that appear as sharp teeth ....*Micrasterias*
(No photo image available, see Fig. A-4)

55b Cells not flattened...Go to 56

56a Cell margin with rounded lobes, apices with a deep notch or shallow depression; semicells with 1 to several protuberances which are often granulate. (No photo image available, See Fig. A-5).....*Euastrum*

56b Cells not as above ....Go to 57

57a Each half of cell with three or more spinelike or pointed arms, cells pyramidal.................................*Staurastrum*
(No photo image available, see Fig. A-1)

57b Cells with no such extensions, not pyramidal or several-angled in top view ....G*o to 58*

58a. Cells circular or subcircular in top view...................*Cosmarium*

58b. No distinct mid-region constriction in cell wall. Two chloroplasts per cell with unpigmented area across center of cell. Conspicuous vacuole in each apical region. Most species are bowed or crescentshaped. A few have straight cells ....*Closterium*

59a. Cells forming filaments...Go to 11

59b. Cells isolated or in non-filamentous colonies ....Go to 60

Section IV

Back to Table of Contents

60a. Cells elongated ....Go to 61

60b. Cells round to oval or angular ....Go to 63

61a. Cells colonial, radiating from a central point ....*Actinastrum*

61b. Cells isolated or in irregular clusters ....Go to 62

62a. Cells 5 to 10 times as long as broad, crescent shape to almost straight...................................*Ankistrodesmus*

62b. Cells 2 to 4 times as long as broad, semicircular, cell apices pointed...*Selenastrum* (No image available)

63a. Cells in a colony of (2) 4-128 angular cells forming a circular plate, marginal cells usually shaped diffently than those within the colony ....*Pediastrum*

63b. Cells not arranged as above ....Go to 64

64a. Colony at tight sphere of cells, short connecting processes between cells..*Coelastrum*

64b. Colony a loose sphere of cells enclosed by a common membrane...Go to 65

65a. Cells ellipsoid, oval, occasionally one finds a solitary cell (No photo image available, see Fig. A-5).....*Oocystis*

65b. Cells round, connected to center of colony by a branching stalk..*Dictyosphaerium*

Continue

Back

Identification of Algae in Water Supplies

65c. Cells round, chloroplast cup shaped, cellsisolated or in tightly grouped small colony (No photo image available, see Fig. A-2)....*Chlorella*

66a. Filaments branched ....Go to 71

66b. Filaments not branched ....Go to 67

67a. Chloroplast(s) twisted into spiral (helical) form ....*Spirogyra*

67b. Chloroplast not spiral..Go to 68

68a. Chloroplast a flat or twisted axial ribbon with several conspicuous pyrenoids ....*Mougeotia*

68b. Chloroplast not as above...Go to 69

69a. Cells cylindrical, with 2 star-shaped chloroplasts each containing a sigle pyrenoid ....*Zygnema*

69b. Chloroplast not as above...Go to 70

70a. Chloroplast a parietal network, cells cylindrical but slightly narrowed at the posterior ends, some cells with one or more ring-like scars; may have distinctly enlarged oogonia ....*Oedogonium*

70b. Chloroplast a marginal band incompletely encircling the cell wall. Cells quadrangular ....*Ulothrix*

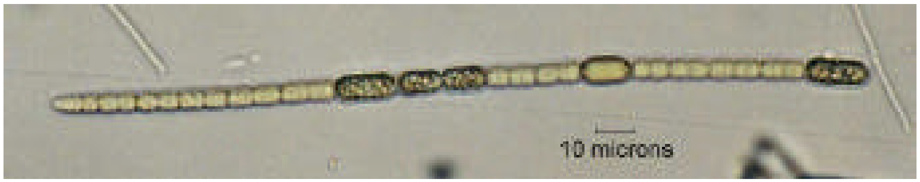
71a. Apices of branches acutely pointed ....*Stigeoclonium*

71b. Apices of banches rounded. Each cell with many pyrenoids...*Cladophora*

Back to Section IV

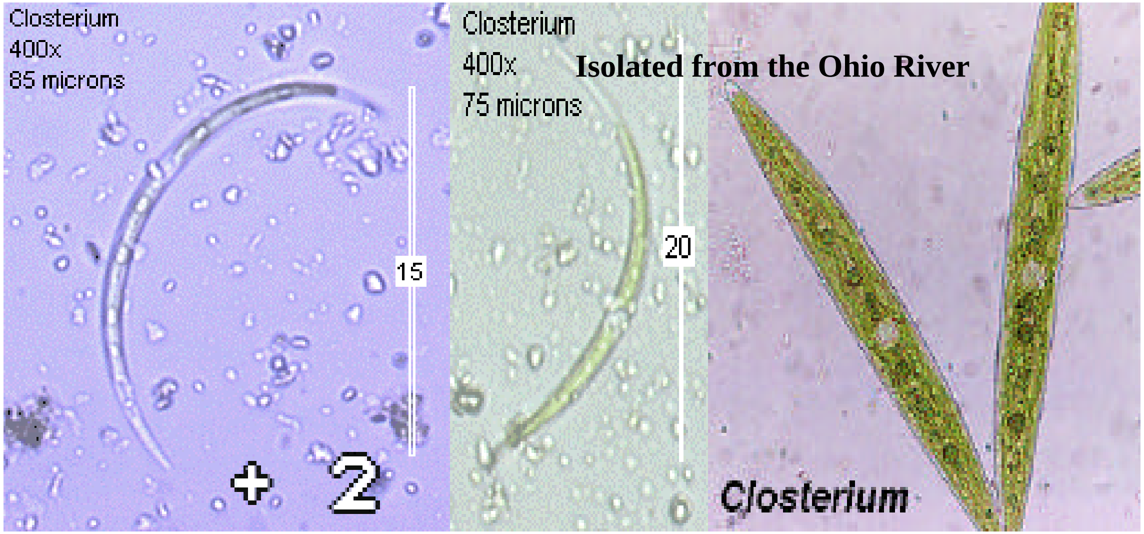
Back to Section V

Isolated from Limoncocha- an eutrophic lake in Ecuador



Isolated from the Ohio River

***Anabaena* sp.** (blue-green/cyanobacteria)-A few species of this genus are planktonic: others are epiphytic, or form gelatinous masses. Among the planktonic forms several are coiled (Prescott 1982). Some of the planktonic species are capable of producing lethal microcystin toxins in large concentrations. Anabaena sp. will produce a grassy, musty, or nasturium odor at moderate concentrations. A rotten, septic, or medicinal odor is possible with large concentrations. Critical concentration for odor production is 530,000 cells/100 ml. (AWWARF 1987)



Back to Section IV

Back to Section V

***Closterium* sp.** (Chlorophyta/Green Algae)- Cells are crescent shaped, variously bowed, but in some species nearly straight, without apical spines There is one axial chloroplast per semi cell, each with longitudinal ridges. Each cell may have few to many pyrenoids, which can be axial or scattered. The cells are either colorless or greenish brown. There is a terminal vacuole at the end of each cell (Prescott 1982). ***Closterium* sp** will produce a grassy odor in large quantities. The critical concentration for odor production is 20,000 cells/100 mls (AWWARF 1982).

Back to Section IV

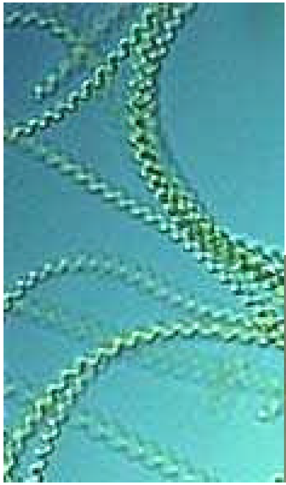
Back to Section V

***Euglena* sp.** (Euglenophyta). Cells often changing shape when swimming. Numerous disc shaped chloroplasts are usually green but one species sometime is colored red because of a pigment (Haematochrome). The red pigment seems to be produced in response to intense light. Ponds may have a bright red film over the surface caused by Euglena blooms. This algae is found in eutrophic waters with high levels of organic material. It is a pollution indicator.

Back to Section IV

Back to Section V

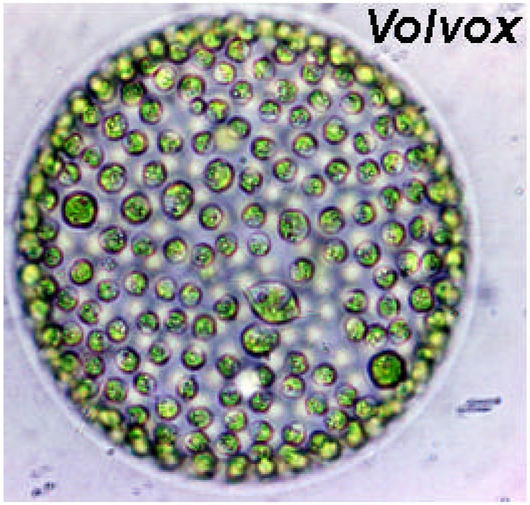
***Nostoc* sp.** (blue-green/cyanobacteria)—*A* membranous, globular, or irregularly lobed colony of uniseriate unbranched trichomes. The individual cells can be globulose and bead like, barrel shaped, or cylindrical. The cells are enclosed in copious thick mucilage, which in many species forms a firm integument that gives the colony a fixed shape. Individual sheaths are confluent with the colonial mucilage. The trichomes are without basal-distal differentiation and are made up of vegetative cells, heterocysts and gonidia when mature. *Nostoc* is very similar to *Anabaena*, but unlike *Anabaena*, retains its shape when taken out of water.



Back to Section IV

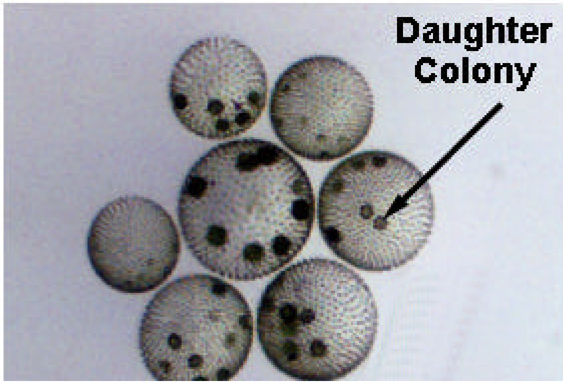
Back to Section V

***Spirulina* sp**. (blue-green/cyanobacteria)—Filamentous and spirally twisted. It consists of a unicellular trichome that is cylindrical throughout and not tapering at the apices. How tight the spiral twists are depend on the species, some being very loose and others being very tight. Trichomes can be free-floating and planktonic or intermingled with other forms of algae. Sometimes it forms layers on soil where water has receded. *Spirulina* is used in human dietary supplements even though it often is found mixed with toxin producers. *Spirulina* is an indicator of estuarine pollution and of sewage pond algae.



Back to Section IV

Back to Section V



***Volvox* sp**. (Chlorophyta/ Green Algae)—An algae that can cause taste and odor problems in water. *Volvox* is colonial and free-swimming. The cells are arranged at the periphery of gelatinous sphere of homogeneous mucilage. The individual cell's sheathes may be seen as well. Each colony may contain anywhere from 500 to several thousand cells. Each cell has two flagella of equal length in some species the cells are connected by protoplasmic strands called 'canals'. The chloroplast is a parietal incomplete cup that covers most of the wall. Daughter colonies form within the interior of the sphere by repeated divisions of special gonidia cells.