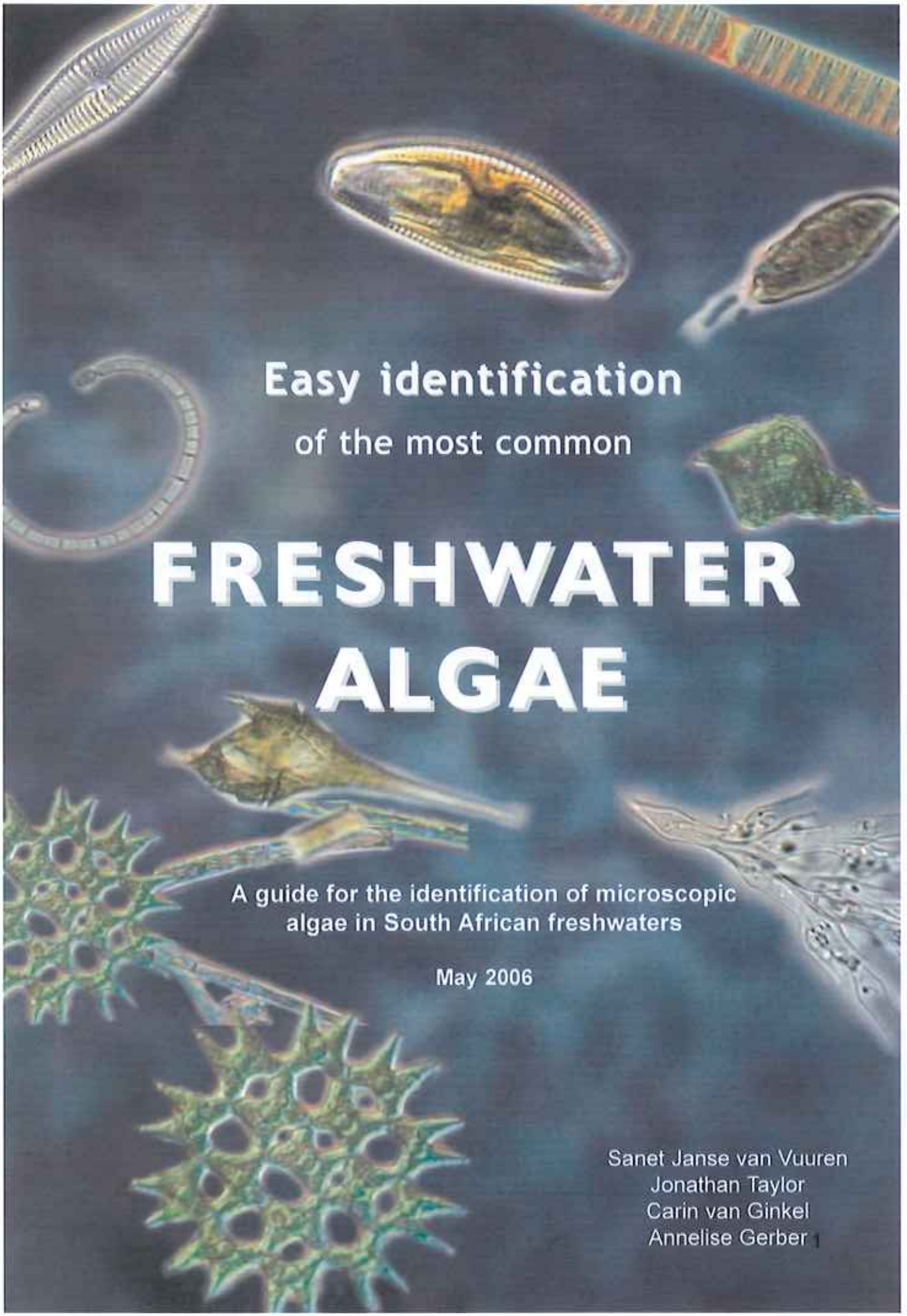

Easy identification

of the most common

FRESHWATER ALGAE

A guide for the identification of microscopic algae in South African freshwaters

May 2006

Sanet Janse van Vuuren
Jonathan Taylor
Carin van Ginkel
Annelise Gerber

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by

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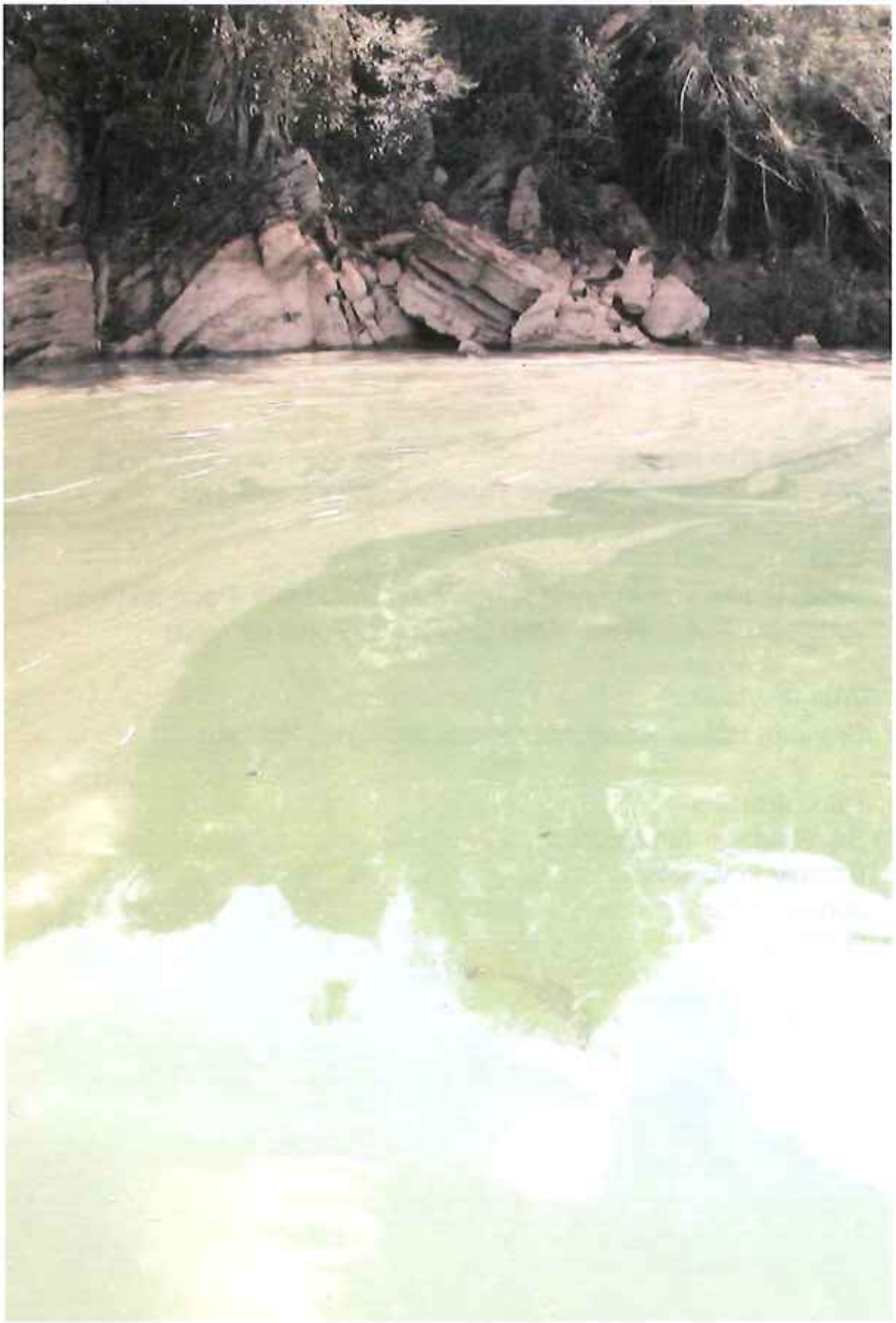

Algal scum on Roodeplaat Dam

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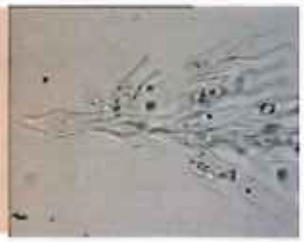

Bacillariophyta
Diatoms

Cryptophyta
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Chlorophyta
Green algae

May be in the form of single cells, colonial or filamentous. Organisms mostly blue-green or olive-green or brown in colour, but very seldom bright green. Organisms motile or perform gliding movements.

Mostly single cells or colonies that are yellow or golden-brown in colour. Cells motile by means of two unequal flagella.

Mostly unicellular organisms or adjacent cells may be attached to each other to form of chains. Colour of chloroplasts varies from yellow to yellow-brown. Cells immotile or perform gliding movements. The cell wall is hard and resistant and comprise of two halves fitting into each other.

Organisms are always unicellular. Cells may vary in colour from red, blue-green, olive-green to olive-brown. Cells swim by means of two slightly unequal flagella.

Unicellular organisms that are usually brown to yellow-brown in colour. Cells are motile by means of two flagella located inside grooves on the cell surface. In some species, the cell covering consists of conspicuous plates.

Cells are single and mostly bright green in colour, sometimes with a bright red eyespot. Cells swim by means of one emergent flagellum and some species are able of changing their shape.

Cells may occur single, in the form of colonies or in the form of filaments (branched or unbranched). They are usually grass green in colour, hence the name "green algae". Cells may be immotile, motile by means of two to four flagella, or gliding movements are performed.

Cyanophyta

Cyanophyta

Cyanophyta

Cyanophyta

Cyanophyta

Cyanophyta

Cyanophyta

Cyanophyta

Blue-green algae

Cyano is derived from Greek, meaning "blue" and *phyta* meaning "plant". *Cyanophyta* are often referred to as cyanobacteria, blue-green algae or blue-green bacteria. Because they are prokaryotic (no membrane-bounded organelles), blue-green algae are considered to be more closely related to bacteria than to other algae. Representatives may be in the form of single cells, colonies or filaments and are usually blue-green (most common), grey, brownish, blackish or even purple in colour, but never bright green. The blue-green colour is the result of photosynthetic pigments such as chlorophyll-*a* (green pigment) and phycocyanin (blue pigment). Some also contain phycoerythrin (a red pigment). When all three pigments are present, the cells may appear purplish. No flagellated stages are present, but some filaments can perform gliding movements. A characteristic feature of many blue-green algae is the presence of gas vacuoles in the cells, which provide buoyancy to the organism. Cells are covered with a thick, layered cell wall that is often surrounded by mucous. Sexual reproduction is absent. The group include marine as well as freshwater, brackish water and terrestrial species. Under conditions of excessive nutrient (primarily phosphorus) availability, slow moving or stagnant water, and warmth, cyanobacteria may proliferate, producing a variety of problems such as surface scums, tastes and odour problems, skin irritations and the release of toxic substances. When these blooms decompose, severe oxygen depletion may occur, resulting in fish kills.

Anabaena Bory *ex* Bornet *et* Flahault

Origin: From Greek *anabaino,* "to rise" or "to go up".

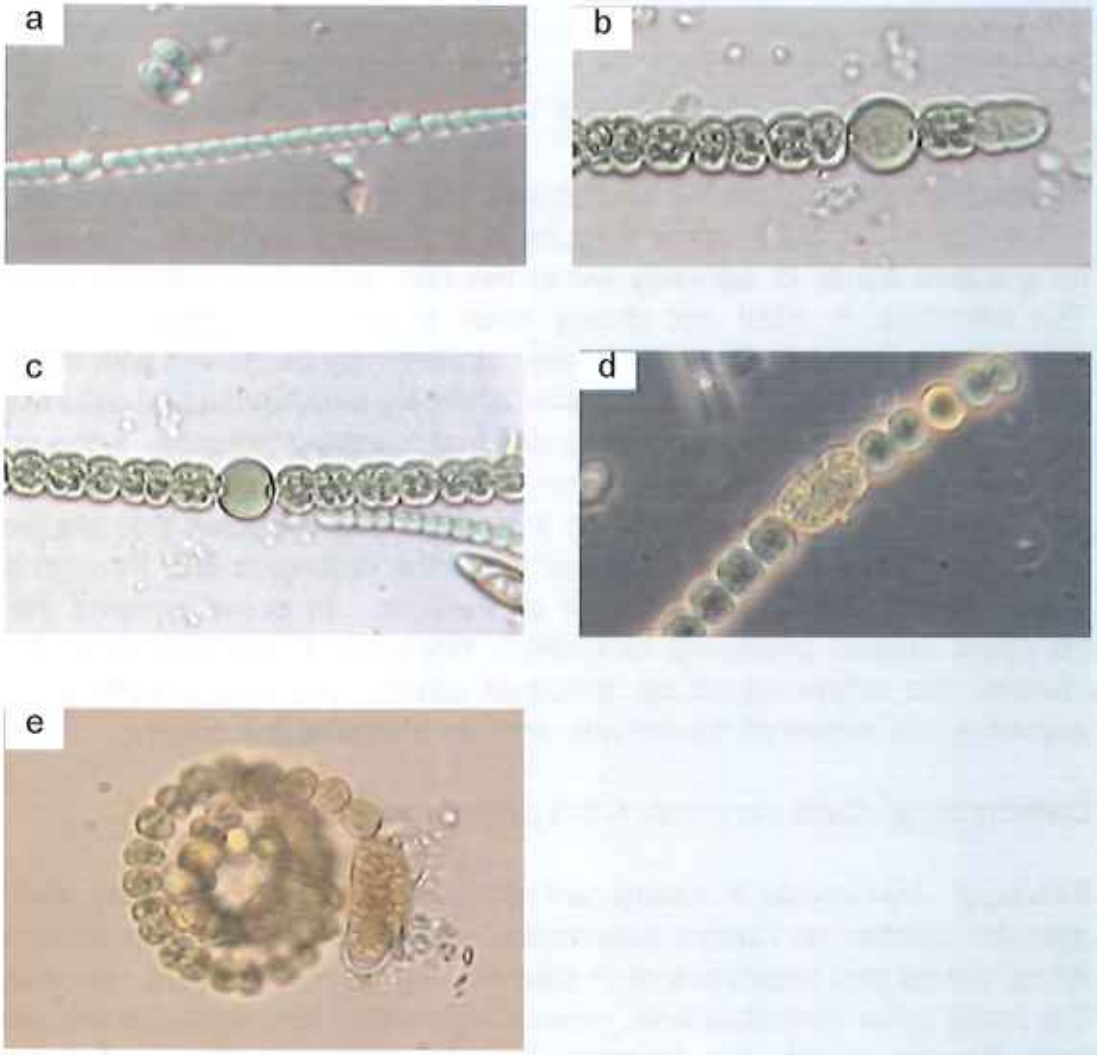
Characteristics: *Anabaena* has unbranched filaments (trichomes) that can be straight, curved, or coiled. Filaments may be solitary or clustered, forming a gelatinous mass. The filaments are uniformly broad and consist of spherical, ellipsoidal or cylindrical cells, often giving the filaments the appearance of a string of beads. Although the filaments lack a distinct sheath (hence the term trichomes is used to describe them), some species have soft and colourless mucilage enveloping them. Heterocysts (used for nitrogen fixation) are rounded or spherical, solitary and generally intercalary. Within the trichome there are akinetes that are larger than vegetative cells, spherical, ellipsoidal, cylindrical, or curved in shape, solitary or in groups of 2 to 5, intercalary and they can be found distant or adjacent to heterocysts. Gas vacuoles in the cells provide buoyancy for planktonic species.

Dimensions: Cells are 7-12 μm in diameter.

Ecology: *Anabaena* is common, widespread and seasonally abundant (highest concentrations usually occur during the summer months) and it often grows in association with *Microcystis* Kützing *ex* Lemmermann. It occurs in freshwater and marine habitats. Some species are planktonic (common in lakes and ponds, but also occur in slow-flowing waters), others are epiphytic, living in damp soil, or forming gelatinous masses on submersed substrates. Certain species are symbionts in higher plants, e.g. *Anabaena azollae* Strasburger in species of the water fern (*Azolla* Lam.). When nutrients are abundant, some planktonic species are responsible for blooms (visible as surface scums) that result in odours, smells and tastes associated with the water. *Anabaena* is also capable of producing lethal toxins (anatoxin-a), which is a neuromuscular blocking agent causing respiratory arrest, liver and gastro-intestinal damage, and is possibly carcinogenic. Animals and birds may die soon after drinking the infested water. Blooms of *Anabaena* can also cause contact irritations, leading to severe dermatitis.

Notes: *Anabaena* is comparable in morphology with *Nostoc* Vaucher *ex* Bornet *et* Flahault. When clumped, or colonial in soft mucilage, the colony is, however, soft and formless, whereas *Nostoc* colonies are firm and keep a definite shape. *Anabaena* also has less constricted trichomes, akinetes are in different locations, it has more motile hormogonia, and a different habitat.

Problems: Blooms, toxicity, tastes, odours and smells, dermatitis



Caption: *Anabaena* filaments consisting of rows of bead-like cells. Heterocysts (visible in photos a to c) are slightly larger than vegetative cells and are responsible for nitrogen fixation. In photos d and e the large oval cells are an akinetes that can survive long periods of unfavourable conditions. The granular appearance of the akinetes is due to the stored food reserves.

Microcystis Kützing *ex* Lemmermann

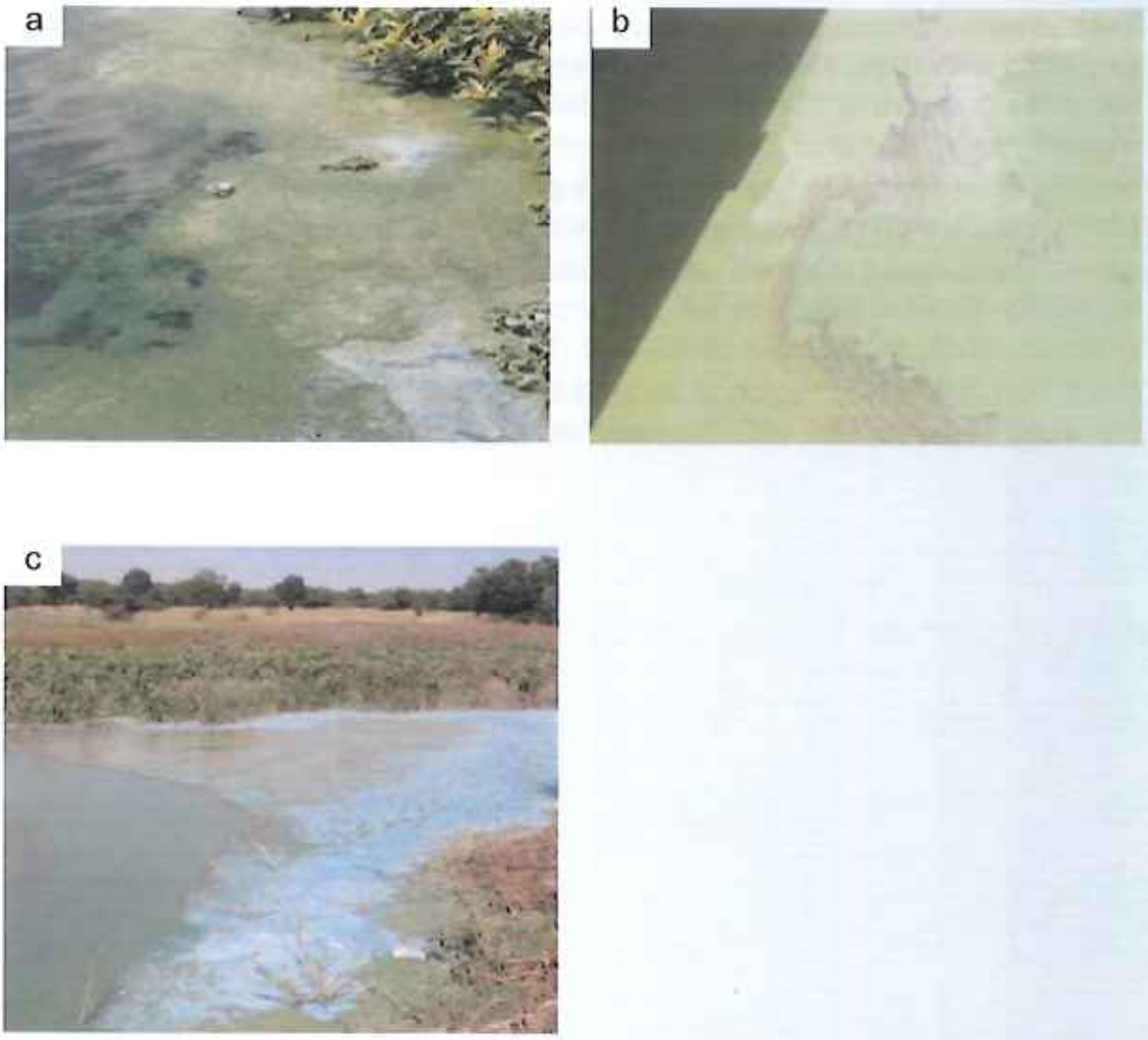
Origin: From Greek *mikros,* "small" + *kystis,* "sac" or "bladder".

Characteristics: Cells of *Microcystis* are arranged in colonies that are initially spherical, but become irregular or perforated over time. The cells may be grouped tightly or sparsely within the fine, colourless colonial mucilage. The mucilage is often not clearly seen in preserved material. Smaller colonies are microscopic, while larger colonies may be viewed with the naked eye. Each colony consists of thousands of very small individual cells that are spherical to sub-spherical without individual mucilage sheaths. Although the protoplast is a pale blue-green colour, the cells, when viewed through the light microscope, often appear black as a result of gas vacuoles that are located within the cells. The gas vacuoles allow the colony to drift through water layers to find the optimal amount of sunlight. In some species the gas vacuoles appear glistening or reddish because of the reflection of light. Species are differentiated by, amongst others, cell-size, presence of gas vacuoles, the nature of the sheath, and the shape of the colony.

Dimensions: Cells vary from 0.5-9 μm in diameter.

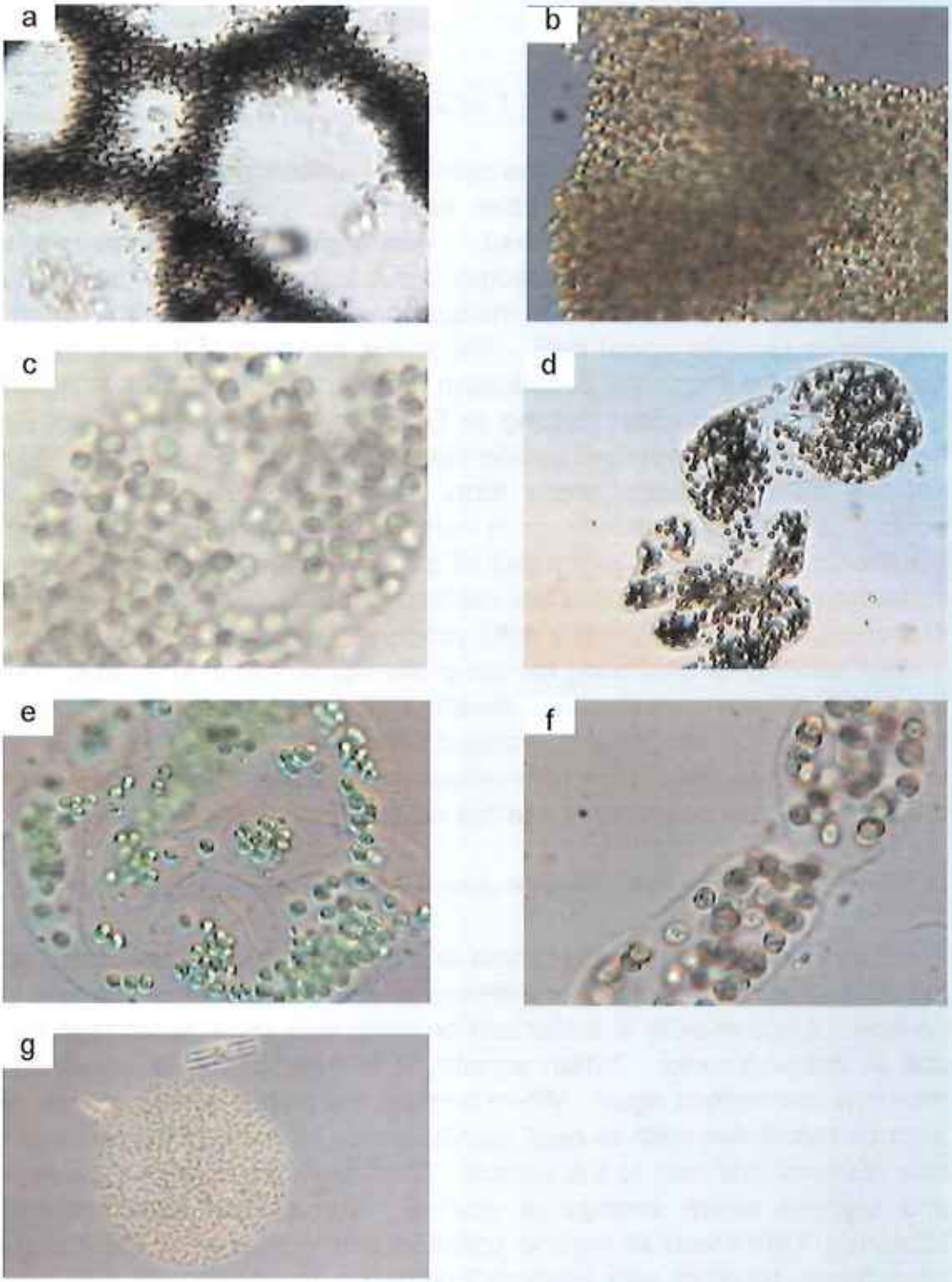
Ecology: *Microcystis* is usually part of the phytoplankton, but may also form granular clumps on bottom substrates. Colonies are common in enriched lakes, ponds and reservoirs or in slow-flowing eutrophic rivers. *Microcystis,* like many other cyanobacteria, prefers high water temperatures and usually form blooms during the summer periods under conditions of adequate nutrient supply. When environmental conditions are favourable, large numbers (blooms) can sometimes be seen floating on the surface of the water, giving a blue-green tinge to the water. It is interesting that, where blooms of some species (e.g. *M. aeruginosa* (Kützing) Kützing) occur, the habitat is completely dominated by this species to the exclusion of almost all other forms of cyanobacteria.

Notes: In contrast to *M. aeruginosa* colonies, which are highly irregular and clathrate when mature, *M. flos-aquae* (Wittrock) Kirchner occurs in nearly globular colonies. *M. wesenbergii* (Komárek) Komárek also has intensely lobed colonies, but it can be distinguished from *M. flos-aquae* and *M. aeruginosa* by a smooth, very firm and colourless mucilage with the outer margin of the colony clearly delimited and extending 3-6 μm beyond the cell aggregations. The presence of gas vacuoles (which appear black or dark brown under the light microscope) easily distinguishes *Microcystis* from *Aphanocapsa* Nägeli (which lacks gas vacuoles).



Caption: *Microcystis* blooms in Roodeplaat Dam

Problems: *Microcystis* is a common cause of algal blooms, sometimes secreting chemicals that inhibit other algae. Because of the presence of gas vacuoles that render them buoyant, they produce surface scums and cause a great deal of disturbance in lakes and reservoirs. Dense growths may lead directly or indirectly to the death of fish through suffocation (as a result of oxygen depletion) or by poisoning. *Microcystis* can produce a polypeptide, called microcystin (named after *Microcystis*), which is toxic to animals ingesting contaminated water. It has also been implicated in human illnesses, such as necrosis of the liver (from ingestion) and severe dermatitis (from skin contact). Blooms of *Microcystis* can also impart taste and odour to the water and interfere with recreational activities.



Caption: Colonies of *Microcystis*, an extremely toxic blue-green bacterium. *M. aeruginosa* is a very common, well-known species in which the colonies are irregular and perforated with holes (photo a). Colonies of *M. wesenbergii* have a characteristic sac-like appearance with the outer margin of the colony clearly delimited by the smooth, firm and colourless mucilage (photos d, e and f). Colonies of *M. flos-aquae* are globose with densely packed cells (photo g).

Oscillatoria Vaucher *ex* Gomont

Origin: From Latin *oscillare,* "to swing".

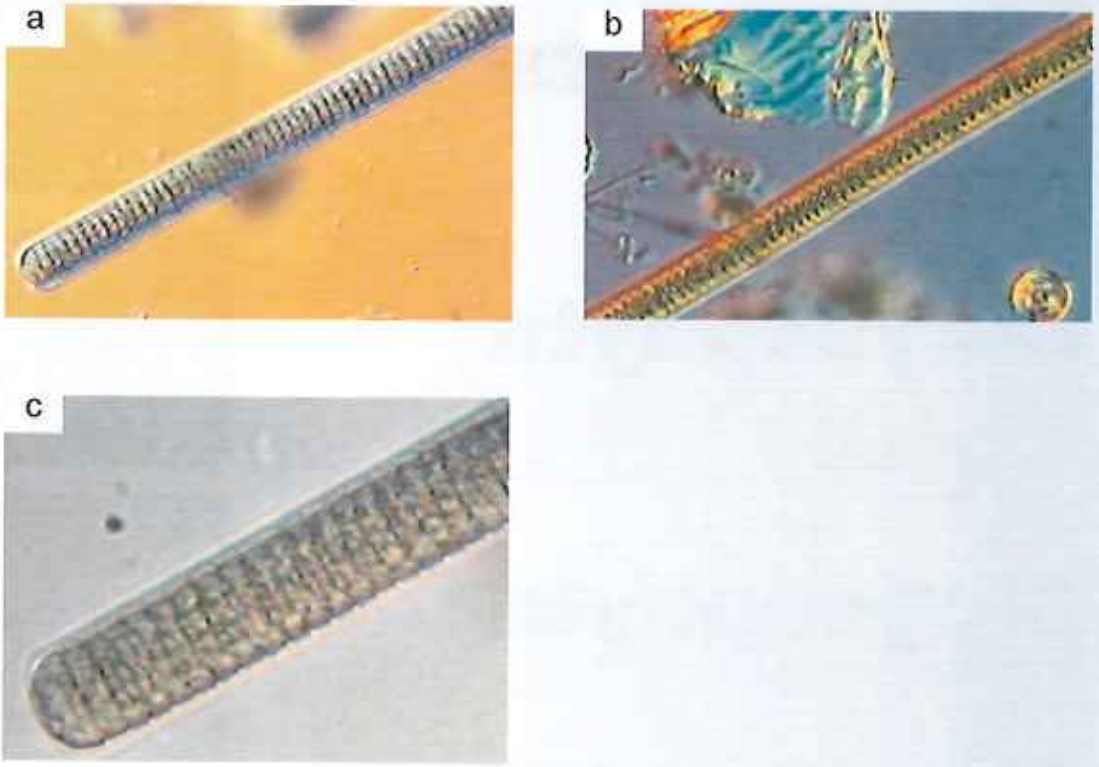
Characteristics: *Oscillatoria* has cylindrical, unbranched trichomes that are straight or slightly wavy, and often very long. Cells of the trichome are discoid and shorter than broad. Although some species do show constrictions at cross walls, the edges of the trichome usually form unbroken parallel lines. Sometimes the trichomes are slightly tapering, often with rounded or capitate apical cells. The shape and size of the end cell of the filament can be important identification features. Unlike *Lyngbya* Agardh *ex* Gomont and *Phormidium* Kützing *ex* Gomont, *Oscillatoria* does not usually have a true sheath, although parallel filaments may form a thin film. Mucilage sheaths may also occasionally form under stressful conditions, such as desiccation or hyper salinity, or in culture. Gas vacuoles are common in planktonic forms. Besides the lack of a definite, firm sheath, the other main characteristic of this genus is the oscillating movement performed when the trichomes are in contact with a solid substrate - the genus is named after the gliding, rotating, or oscillating motion of the filament around its axis. Despite the fact that there is no mucilage sheath, trichomes leave a thin mucilaginous trail as they glide. Mucilage is secreted through pores in the cell walls. There are numerous species (subject to various interpretations) differentiated on the basis of size, cell proportions and the morphology of the apical region.

Dimensions: Trichome diameter usually varies from 8-30 μm or more.

Ecology: *Oscillatoria* is widespread and common in a variety of habitats. It occurs in a diverse range of conditions in freshwater, in the sea and in hot springs. It occurs both in water and on moist sub-aerial substrates such as soil or dripping rocks. When aquatic, it is free-floating or entwined with attached filamentous algae. When benthic, the filaments form dense, slimy, mats on substrates such as mud, plants, stones, or sand. Parts of large mats may dislodge and float to the surface. *Oscillatoria* is common in farm ponds and lagoons where sewage is treated. Some *Oscillatoria* species are tolerant to high levels of organic pollution and trichomes of *Oscillatoria* are often found, together with *Euglena* Ehrenberg, in waters with high nitrogen levels. Some species are shade-tolerant and can adjust their levels of chlorophyll-*a* and use accessory pigments to compensate for low light levels - this enables them to survive in water below blooms of green algae. *Oscillatoria* sometimes uses buoyancy control mechanisms to regulate its position in the water column.

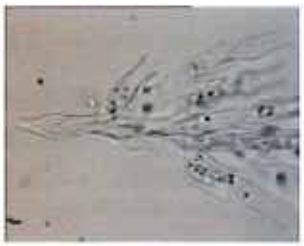
Notes: *Oscillatoria, Lyngbya* and *Phormidium* are three genera difficult to distinguish from one another, even by specialists (see page 28 for differences). *Oscillatoria* is also closely related to genera such as *Planktothrix* Anagnostidis and Komárek, *Limnothrix* Meffert and *Pseudanabaena* Lauterborn. Several former species of *Oscillatoria* with thinner filaments and differences in morphology are now classified as species of *Planktothrix, Pseudanabaena,* or *Limnothrix.* One interpretation of the genus disregards the sheath characteristic and unites *Lyngbya* and *Oscillatoria.*

Problems: Some species of *Oscillatoria* are known to produce toxins. These include both neurotoxins (anatoxins) and hepatotoxins (microcystins). Anatoxins block the transmission of signals from neuron to neuron and neuron to muscle, while microcystins cause liver bleeding. The toxins pose a greater threat to livestock than to humans. *Oscillatoria* is implicated in irritation of the skin (leading to severe dermatitis) and mucous membranes of people swimming in water containing high *Oscillatoria* concentrations.

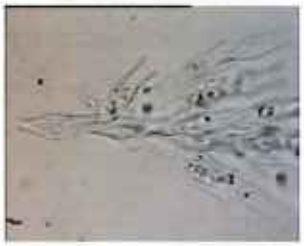


Caption: Unbranched trichomes of *Oscillatoria*, a potential problematic blue-green bacterium. Note, that, unlike *Lyngbya*, there is no clear mucous sheath. The dark spots inside the cells are the gas vacuoles that render the filament buoyant.

Chrysophyta



Chrysophyta



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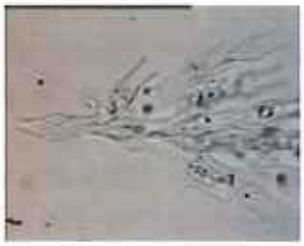

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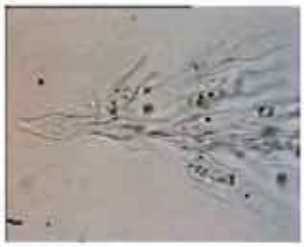

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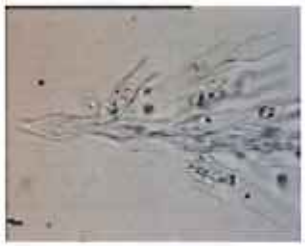

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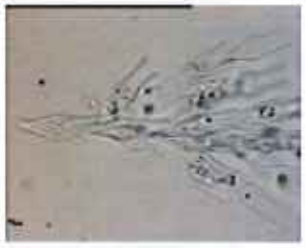
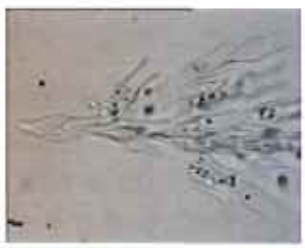


Chrysophyta



Chrysophyta

Golden-brown algae

Chrysophyta is derived from the Greek words *chryso*, which means "golden" and *phyta* that means "plant". Chrysophyta representatives are, therefore, commonly referred to as the golden-brown algae. Organisms belonging to this group are mostly unicellular or colonial, but filaments may also occur. Chrysophytes are both photosynthetic and heterotrophic, in which case they may be phagotrophic (engulfing particulate matter) or osmotrophic (absorbing organic molecules). Photosynthetic genera usually have yellow to golden-brown chloroplasts as a result of the presence of the pigment fucoxanthin, that masks the green colour of chlorophylls *a* and *c*. Food (chrysolaminarin) is stored outside the chloroplast in the form of a large vesicle. Chrysophyta consists mainly of motile forms, with two anterior implanted flagella of unequal length. One flagellum is long, and protrudes outwards from the cell away from the anterior end, while the other is short, and directed laterally (perpendicular to the long flagellum) or posterior. The long flagellum is used as a feeding apparatus in some species by directing the water current and food particles towards the cell. The flagella and cell surface may be covered by siliceous scales. The scales vary in form, and the scale design is unique to a particular species and important in identification. Like the siliceous remains of diatom cells, scales persist in sediments and are valuable tools for paleolimnologists and ecologists interested in changes in ecological conditions over time. Some chrysophytes are excellent bio-indicators, as they inhabit particular environmental niches in fresh- and marine waters. They are usually most abundant and diverse in freshwaters of neutral or slightly acidic pH with low conductivity, alkalinity and nutrient levels and colder temperatures. Sexual and asexual reproduction can produce cysts, often in response to changes in environmental conditions or population density. Although common, they are often hard to examine as the cells tend to be fragile and they break up readily when mounted. It is, therefore, possible to underestimate or even completely overlook members of this group in a sample.

Synura Ehrenberg

Origin: From Greek *syn,* "together" + *oura,* "tail".

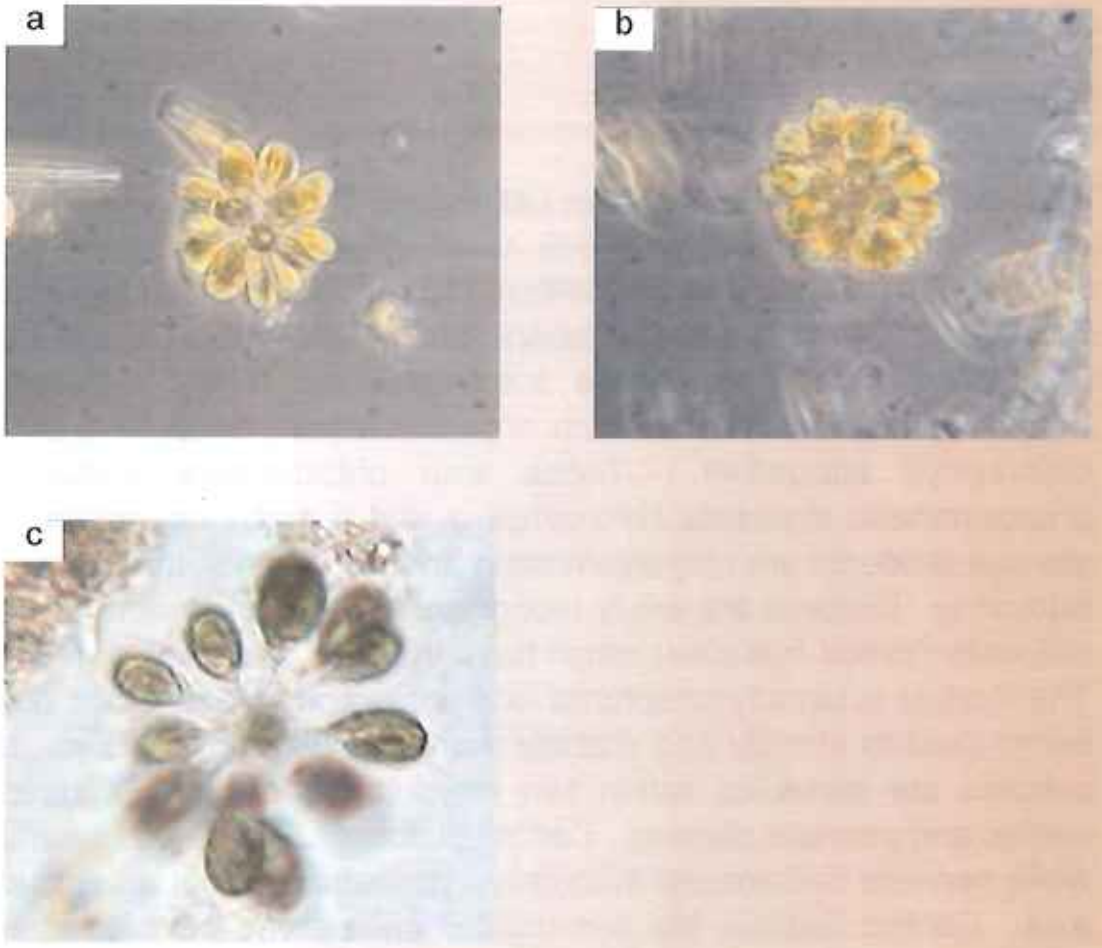
Characteristics: Colonies of *Synura* are spherical to ellipsoidal. Colonies consist of up to 50 closely packed cells which are pear-shaped (broader at anterior end), stalked and radiating from a common centre. Individual cells have two yellow to golden-brown chloroplasts lying along the longitudinal axis of the cell. A large food granule is sometimes visible at the posterior end. No eyespots are present. Each cell has two flagella of almost equal length that protrude along the edge of the colony to permit a rolling, tumbling, swimming motion. The cell membrane is covered with fine silica scales. Most of the anterior scales have spines. If silica is unavailable, synurophytes can survive without scales.

Dimensions: Cells are 30-45 μm long and 7-17 μm broad. Colonies may be 30-500 μm across.

Ecology: *Synura* is widespread and sometimes abundant. Representatives are found in the plankton of freshwater lakes, ponds, and slow moving rivers or streams. This genus is very common in hard water lakes.

Notes: Electron microscopy may be necessary to identify some of the species, but *S. petersenii* Korshikov is by far the most common species observed in rivers. Colonies often break up into separate cells after collection. Like the siliceous remains of diatom cells, the siliceous scales of *Synura* persist in the environment and remain intact within sediments after the cell has died. These preserved scales provide an important tool that helps ecologists to reconstruct environmental changes over time or to better understand the ecology of a particular system.

Problems: *Synura* sometimes forms blooms that are often associated with taste and odour problems. *S. petersenii* is especially known to release ketones and aldehydes from the cells that can give the water an unpleasant fish-like odour or taste.



Caption: Golden-brown colonies of *Synura* consisting of pear-shaped cells that are covered by small scales. The stalks of the individual cells are attached to one another in the middle of the colony (photo c).

Bacillariophyta

Diatoms

Bacillariophyta comes from the Latin word *bacillus* that means "little stick" or "rod" and the Greek word *phyta* that means "plant". *Bacillariophyta* are commonly referred to as diatoms. The single cells, colonies or filaments are microscopic and usually yellow to light brown in colour. Most diatoms are autotrophic but a few are obligate heterotrophs (they must absorb organic carbon) because they lack chlorophyll altogether. Those with chloroplasts contain the photosynthetic pigments chlorophyll *a* and *c* and fucoxanthin. The storage products are chrysolaminarin and oil droplets, the latter aid in buoyancy. Diatoms are easily recognised by their distinctive siliceous cell walls (called frustules) which have the form of a petri-dish or box. The frustule is usually sculptured with pores and striations, the pattern being used to identify and classify the many different species. Most diatoms are classified within two major morphological groups, the centric and pennate diatoms. Centric diatoms exhibit radial symmetry, while pennate diatoms are bilaterally symmetrical about a longitudinal axis. Centric diatoms are non-motile, while some pennate diatoms possess a slit-like structure, called a raphe, along the surface of one or both valves. Through the secretion of polysaccharides, the raphe allows the cell to perform gliding movements when in contact with a substrate. Except for male gametes, diatoms lack flagella. The primary means of reproduction is asexual, by cell division. A wide variety of diatoms are common in freshwater and marine habitats where they live free-floating or attached to a substrate. Diatoms are extremely important components of phytoplankton. Besides being the largest contributors to global primary production and forming the base of aquatic food webs, they are used as powerful ecological tools to investigate past conditions (fossils) and monitor environmental changes over time. Diatomaceous earth (almost pure deposits of diatom frustules) has a variety of uses, such as filtration and insulation. Diatoms also have many industrial and commercial applications in products such as foods, filters, paints, and cosmetics.

Navicula Bory

Origin: From Latin *navicula,* "small ship or boat".

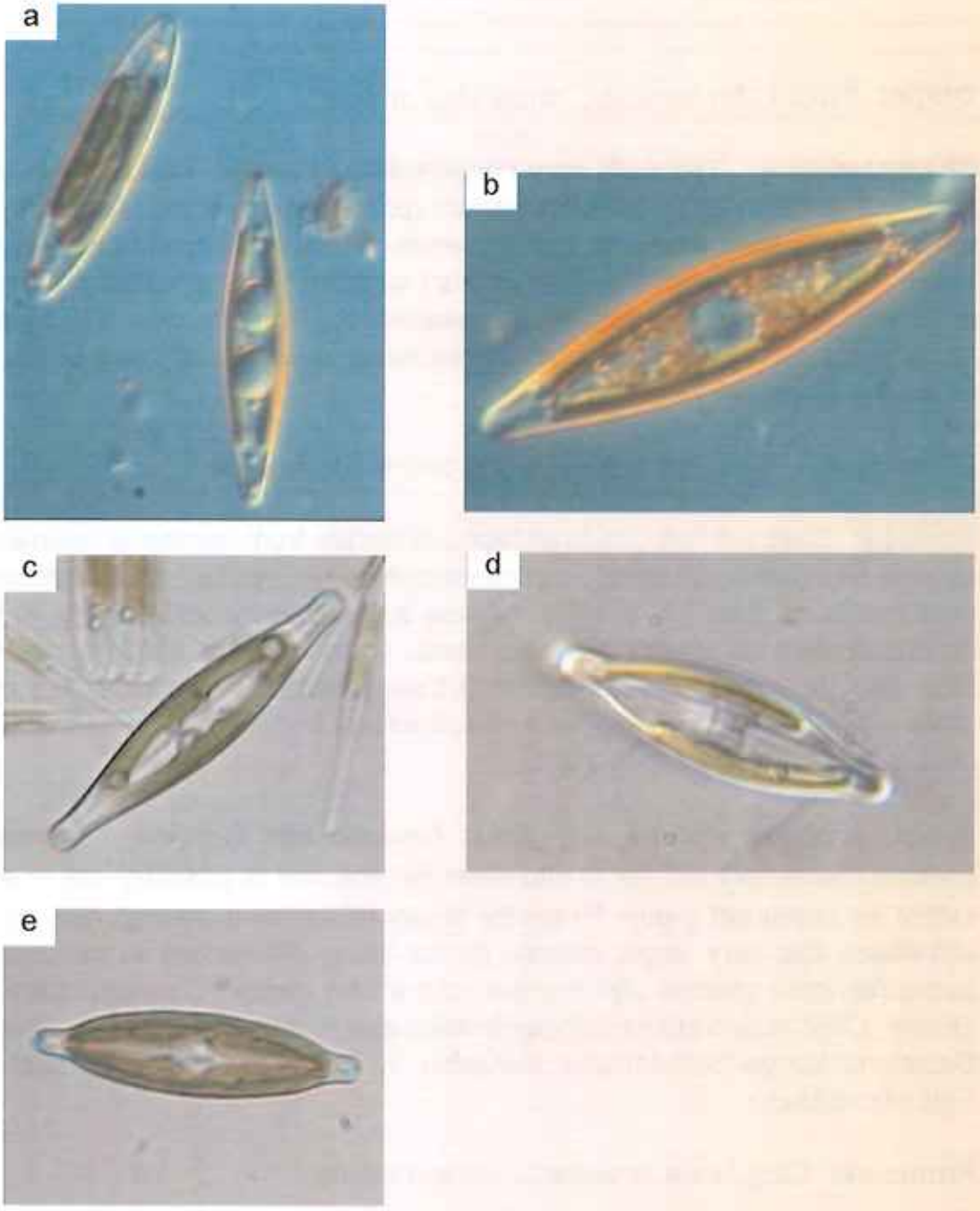
Characteristics: The cells vary considerably in shape, especially in valve view, but in the main they are naviculoid (boat-shaped) or cigar-shaped, and may have rounded, acute, or capitate ends. There is a raphe in both valves. Striae are composed of elongate (linear) punctae. These striae are usually not visible when live specimens are examined. In girdle view the cells are rectangular. All species have two chloroplasts, one on each side of the cell, when seen in valve view.

Dimensions: Cells are 6-42 μm long and 4-12 μm wide.

Ecology: *Navicula* is found in all types of waters from marine to freshwaters as well as in waters ranging from oligotrophic to eutrophic. Cells inhabit the plankton or benthos. In benthic habitats the cells may occur singly, in films on submersed substrates and sediments, or as colonies within a mucilage tube (e.g. *N. recens* (Lange-Bertalot) Lange-Bertalot). *Navicula,* like many other raphe-bearing diatoms, secretes mucilage from the raphe to enable the cells to glide along a substratum.

Notes: For many years, the genus *Navicula* has included a number of species that simply did not fit into other genera and is probably still to some extent an unnatural group. Recently, taxonomists have created new taxa to sub-divide this very large, diverse genus using differences in morphology. Some *Navicula* species are now part of the new genera *Cavinula* Mann and Stickle, *Chamaepinnularia* Lange-Bertalot and Krammer, *Craticula* Grunow, *Geissleria* Lange-Bertalot and Metzeltin, *Kobayasiella* Lange-Bertalot and *Sellophora* Mann.

Problems: Clog filters at water treatment plants.



Caption: *Navicula* spp. (photos a-e) with boat-shaped cells. Note the two distinctive chloroplasts, one on each side of the cell.

Synedra Ehrenberg

Origin: From Greek *synedria,* "a sitting together".

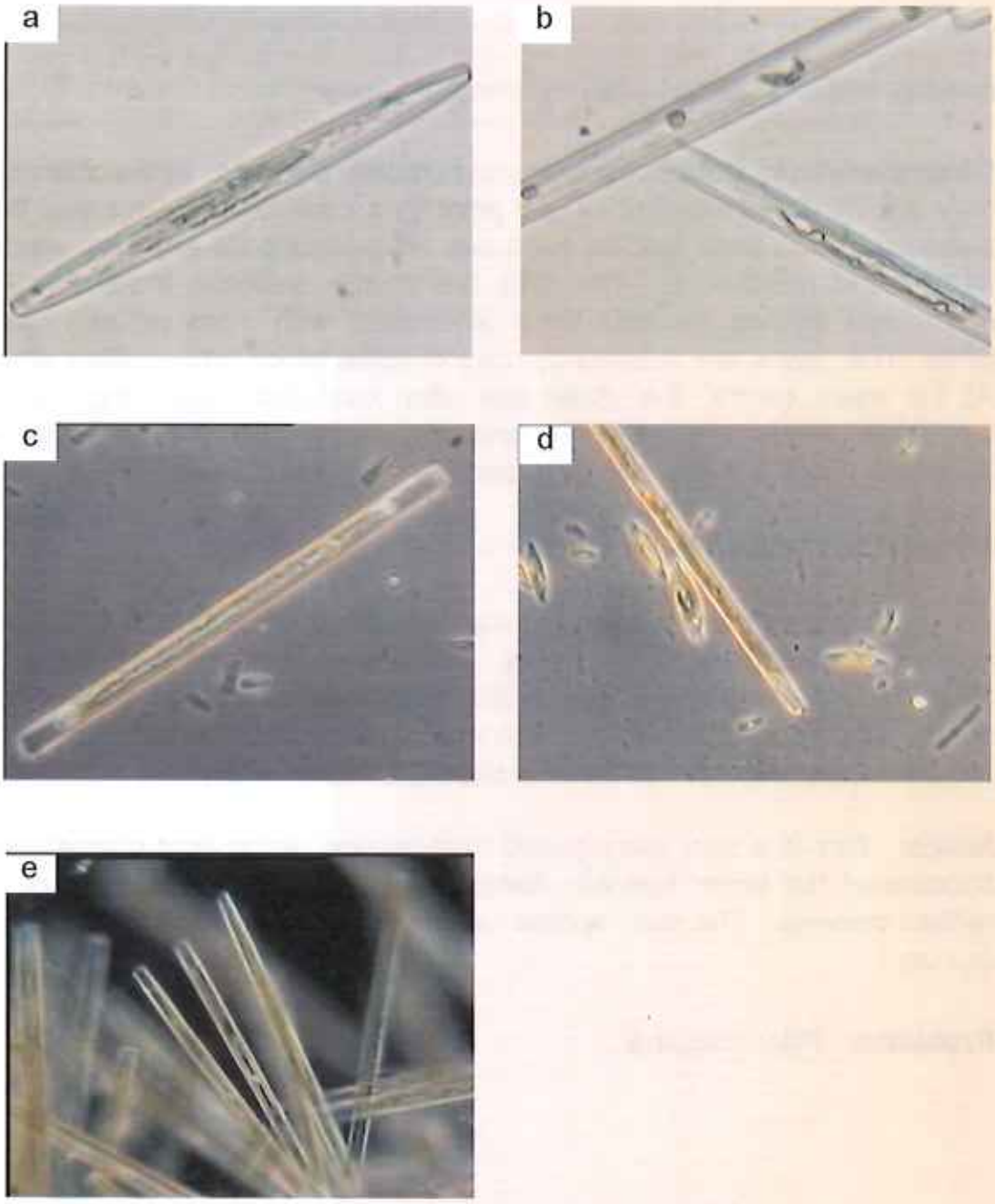
Characteristics: Cells occur singly or in radiate colonies. In the colonies the cells are clustered together at one point by a common mucilage pad that is secreted from a pore field on each cell. Individual cells are long, relatively narrow and needle-like. The cells are usually distinctly linear in outline, sometimes tending towards linear-lanceolate, with more or less capitate ends. The valves are covered by rows of striae which have distinct areolae. At the valve centre, the striae are often occluded, appearing as ghost structures. An apical pore field is present through which the mucilage pad is secreted. Each cell has two long, plate-like plastids.

Dimensions: Cells are 60-500 μm long and 5-9 μm wide.

Ecology: *Synedra* species may occur free-living, inhabiting the plankton of freshwater lakes, dams and rivers. Species of *Synedra* such as *S. ulna* (Nitzsch) Ehrenberg and *S. acus* Kützing may tolerate a broad range of water quality conditions, including eutrophy and organic enrichment. However, they are principally restricted to fresh or slightly brackish waters.

Notes: This is a very easy genus to recognise under light microscopy on account of the large, typically linear cells that usually occur singly or in radiate colonies. The cells appear rectangular when viewed from the girdle or side.

Problems: Filter clogging.



Caption: *Synedra ulna* occurring as single cells (photos a-d) or radiate colonies (photo e) Individual cells are easily recognisable by their needle-like shape in valve view (photo a) or rectangular appearance in girdle view (photos b, c and d).

Dinophyta

Dinoflagellates

Dinophyta comes from the Greek word *dineo,* which means "to whirl" and *phyta* that means "plant". Representatives of Dinophyta are commonly referred to as dinoflagellates. In systematics, dinoflagellates have been claimed by both botanists and zoologists because they share features common to both plants and animals (they can swim, many have cell walls, and both photosynthetic and non-photosynthetic species are known). Representatives are eukaryotic and unicellular and exhibit a wide variety in morphology and size. Autotrophic species are usually golden-brown in color and possess the green pigments chlorophylls *a* and *c*, and golden-brown pigments such as peridinin. About half of the dinoflagellates are, however, colourless and their nutrition varies from heterotrophy (absorption of organic matter) to mixotrophy (cells engulf other organisms). The name "dinoflagellate" refers to the forward whirling and spiraling swimming motion of these organisms. The movement is accomplished by two flagella implanted in grooves on the cell surface. One flagellum is directed backwards and the other stretches around the center of the cell. Dinoflagellates are often covered with armour-like cellulose plates within the cell membrane. The presence of these thecal plates differentiates dinoflagellates from other algal groups and the arrangement of the plates is used in distinguishing genera and species within the group. The cell covering of unarmoured (naked) species is comprised of a membrane complex. Dinoflagellates primarily exhibit asexual cell division, but some species reproduce sexually, while others have unusual life cycles. Dinoflagellates are important members of the phytoplankton in marine and freshwater ecosystems (majority of species are found in sea water). They are usually free-swimming, but some may be benthic, living attached to sediments, sand, corals, macroalgal surfaces or to aquatic plants. Some species live symbiotically with, or parasitic on, other organisms. Blooms of dinoflagellates can cause sea water to turn a reddish-brown colour (known as "red tide") during which certain species produce neurotoxins. These toxins are carried up the food chain, ultimately to humans and can, sometimes result in permanent neurological damage or even death. In general, the species are hard to identify and need specialist keys.

Peridinium Ehrenberg

Origin: From Greek *peridineo,* "to whirl around".

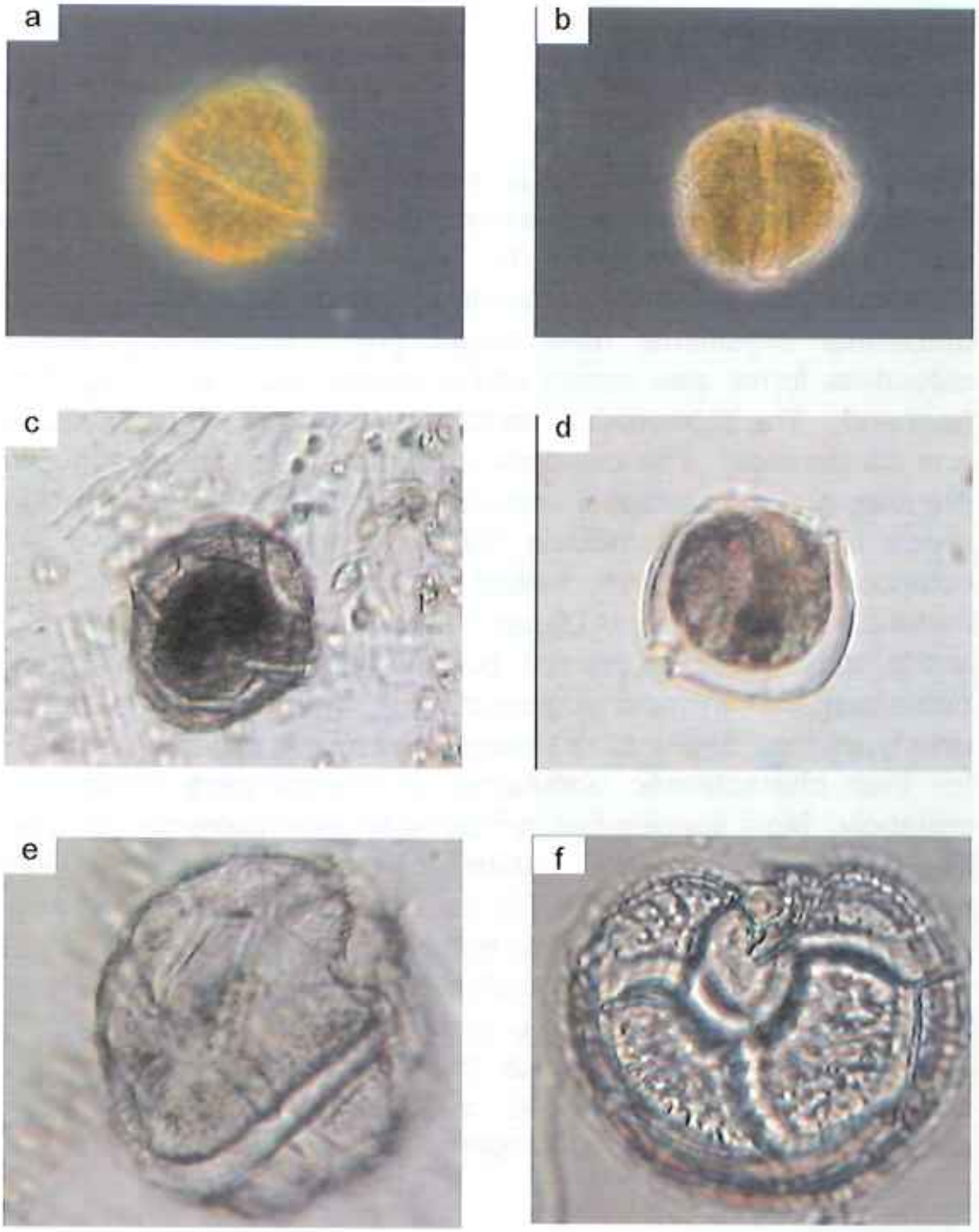
Characteristics: *Peridinium* is a medium to large sized dinoflagellate. The cells are more or less round to oval-shaped, and slightly flattened when seen from the side (convex dorsal surface and a concave ventral surface). Most cells are without horns, although a few species may possess dorsal flanges and distinctive horns. Grooves on the cell surface are quite noticeable, and the cingulum groove (encircling the cell) is deep and nearly at the cell median. Most representatives are photosynthetic with numerous yellowish-brown chloroplasts. Flagella are implanted in the cingulum and sulcus grooves. The cells are enclosed in a number of thick, angular thecal plates. The thecal plates are generally smooth or reticulated and sometimes small groups of spines may be present. Often the apical view shows a terminal pore. Species are differentiated by shape and size of the cell, and by the number, shape and arrangement of the thecal plates.

Dimensions: 10-100 μm long, 15-90 μm wide.

Ecology: *Peridinium* is a free-swimming, widespread and common dinoflagellate which may be abundant in the plankton of ponds, lakes and rivers. Most species are found in fresh or brackish waters, and cannot tolerate high salinity levels. The genus is nearly cosmopolitan in hard waters rich in calcium, but can also be found in waters of low pH and low nutrients.

Notes: Most researchers agree that *Peridinium* should be separated into two genera. The first group would include large cells (as much as 65 μm in diameter) with three intercalary plates. The second group would have significantly smaller cells less than half that size, with only two intercalary plates. For the proper identification of *Peridinium* species, it is essential to be able to observe the number and arrangement of the thecal plates on the surface. Similarly shaped but unarmoured (naked) cells are likely to belong to the genus *Gymnodinium* Stein. Resting cysts may be produced.

Problems: Some species may form large, conspicuous blooms. It can be responsible for taste and odour problems.



Caption: Cells of *Peridinium* may be fairly large or medium-sized, depending on the species. When cells are dead and the inner contents released, the prominent thecal plates are clearly visible (photos e and f). Living cells are usually yellow-brown in colour. The position of the cingulum groove is clearly visible.

Euglenophyta

Euglenoids

The phylum Euglenophyta is named after the common genus *Euglena*, which, in turn, comes from Greek, *eu* meaning "well, good or true" and *glene,* referring to "eye". Representatives of the Euglenophyta are also sometimes called the euglenoids. The unicellular organisms have bright green chloroplasts (although colourless forms also occur) and a conspicuous red eyespot at the front end. The chloroplasts contain the pigments chlorophyll *a* and *b* and carotenoids. The cytoplasm contains many paramylon storage granules and a contractile vacuole (in freshwater members). On the inside of the cell membrane, the cells are covered by a pellicle composed of ribbon-like, helical arranged strips of proteinaceous material. The motile cells usually have two flagella inserted in a gullet at the anterior end of the cell, but one flagellum is short and mostly non-emergent. In most euglenoids only one flagellum is, therefore, clearly visible. *Euglena,* and some other euglenoids, are best known for their characteristic undulating, shape-changing motion, called metaboly. Most species live in freshwater environments. Euglenoids live in hard or soft water habitats of varied pH and light levels - mainly marshes, swamps, bogs and other wetlands with an abundance of decaying organic matter. Populations thrive under high nutrient levels and are, therefore, useful bio-indicators of such conditions. Euglenophyta may also be found in marine or brackish sand and mud flats, farm ponds, the digestive tracks of small aquatic creatures, and the interfaces of air and water, and water and sediment. Euglenoids usually reproduce asexually.

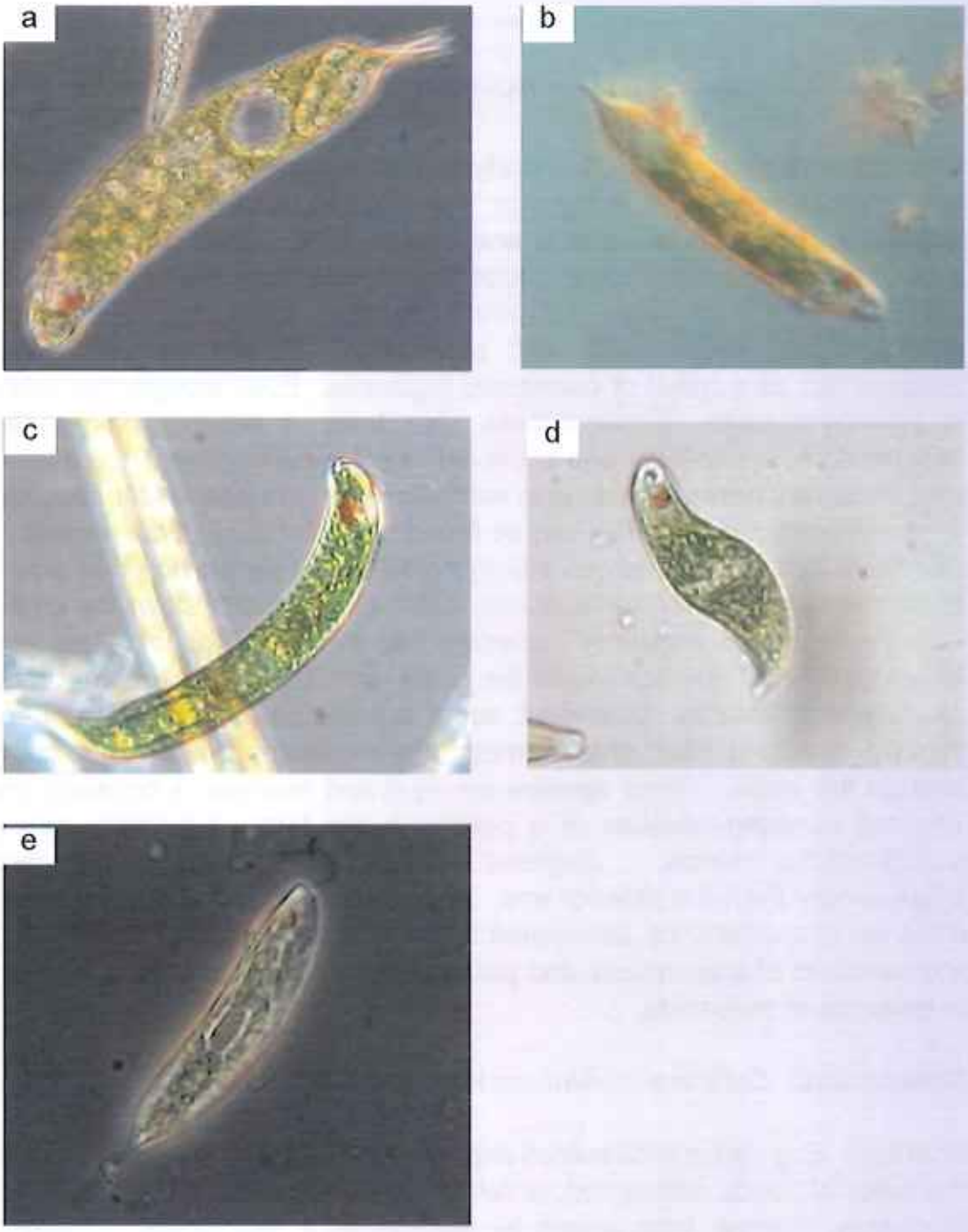
Euglena Ehrenberg

Origin: From Greek, *eu,* "well, good or true" + *glene,* "eye".

Characteristics: *Euglena* is unicellular with a spindle-shaped, cylindrical or oval body, consisting of a more or less pointed posterior end (opposite to flagella) and a rounded anterior end with a gullet. Cells are usually bright green due to numerous conspicuous chloroplasts that are often discoidal in shape, but it can also be ovate, lobate, elongate, U-shaped, or ribbon-shaped, occasionally with pyrenoids. Sometimes cells may be coloured red as a result of carotenoid pigments. Even though they are able to photosynthesize, *Euglena* cells also have a phagotrophic ingestion apparatus. At the anterior end of the cell, a prominent eyespot, used to sense light, is usually present (lacking in some species). In freshwater species one or more contractile vacuoles can be found near the base of the flagella. The cytoplasm contains numerous storage granules of paramylon that may vary in shape (they are often rod-shaped). Cells usually swim slowly by means of a single emergent flagellum implanted into the apical gullet. The second flagellum is short, located inside the gullet, and it does not emerge from the cell. Besides flagellar movement, some species are capable of contraction, thereby changing their shape (metabolic movement) and, thus creeping through the water. Other species are rigid and maintain a constant shape. The cell covering consists of a pellicle in the form of helically arranged, proteinaceous strips. *Euglena* reproduces asexually by splitting longitudinally from the anterior end. Identification of species is not easy and relies on characteristics associated with cell shape, pellicle markings, form and numbers of chloroplasts and paramylon bodies, as well as the presence or absence of pyrenoids.

Dimensions: Cells are 20-540 μm long and 5-50 μm wide.

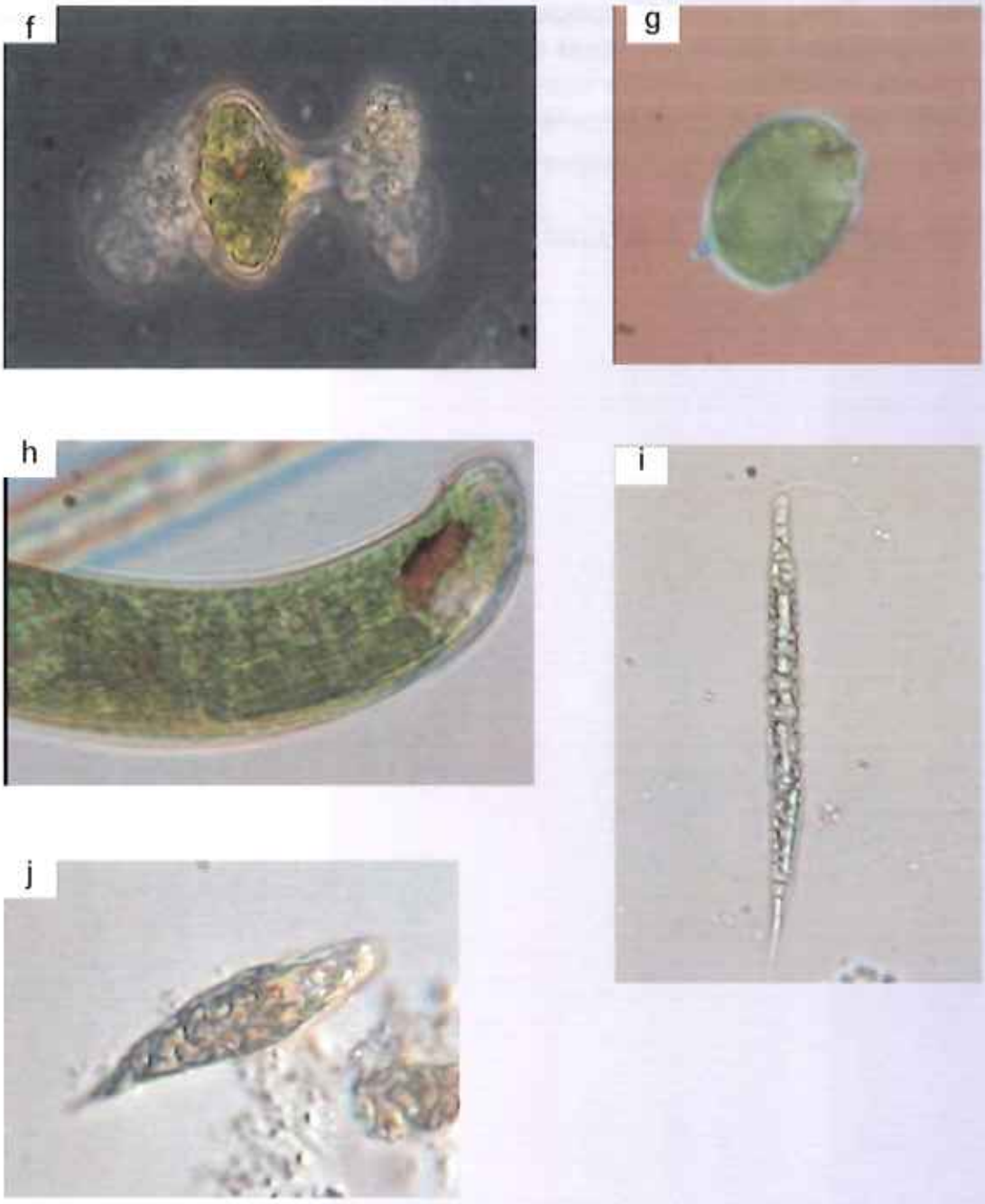
Ecology: *Euglena* is widespread and often abundant, occasionally colouring the water of ponds dark-green, or forming green films on the surface. These films may change from green to reddish in a few hours. *Euglena* is free-swimming in a wide variety of habitats - it can be found in almost any location where there is fresh or brackish water, e.g. ponds, lakes, streams, rivers. It thrives best in polluted or enriched environments, especially where there is an abundance of rich organic waste (from animal wastes or aquatic plants). Cells also live on organic-rich sediments. *Euglena* usually prefers high water temperatures.



Caption: The general shape of the cell (rounded anterior end, pointed posterior end, numerous discoid chloroplasts and bright red eyespot) is illustrated best in photos a and c. Note the single, emergent flagellum and rod-shaped paramylon granule in photo c.

Notes: There are some species of *Euglena* that are bright red in colour (*E. sanguinea* Ehrenberg) and this is due to the presence of a carotenoid pigment, which can also be found in *Haematococcus* Agardh. *Euglena* can live as autotrophs or mesotrophs, when placed in darkness. As soon as they are re-introduced to light, however, the cells regain their chlorophyll.

Problems: Blooms (usually not harmful).



Caption: Cells of *Euglena,* a common genus in organic polluted waterbodies. Note the flagellum and paramylon granules in photo i. Metabolic movement (contraction) is performed by the cell in photo g.

Chlorophyta

Green algae

Chlorophyta comes from the Greek words *chloros* that means "green" and *phyta* that means "plant", and therefore representatives of Chlorophyta are commonly referred to as green algae. Representatives may be unicellular, colonial, filamentous or more complexly structured. The most conspicuous organelle in the cell is the chloroplast, which is mostly bright green in colour due to the presence of chlorophylls *a* and *b*. Certain species may appear yellow-green or blackish-green due to the presence of carotenoid pigments or high concentrations of chlorophyll. The chloroplast morphology varies greatly and is useful for taxonomic purposes. The chloroplast usually contains one or more pyrenoids that store starch as a food reserve. A stigma or red eyespot may be present. The protoplast is surrounded by a more or less firm cell wall (composed of cellulose, along with other polysaccharides and proteins) just outside the plasmalemma. Cells can be non-motile or they swim actively by means of two or four anterior flagella that are mostly smooth and equal in length. The Chlorophyta comprises one of the major groups of algae when considering the abundance of genera and species, and the frequency of occurrence. They grow in waters of a great range of salinity, varying from oligotrophic freshwaters to those that are marine and supersaturated with solutes. A number grow in brackish waters and some are exclusively marine. Both benthic and planktonic species occur. A number grow in sub-aerial habitats.

Ankistrodesmus Corda

Origin: From Greek *ankistron*, "fishhook"+ *desmos*, "bond".

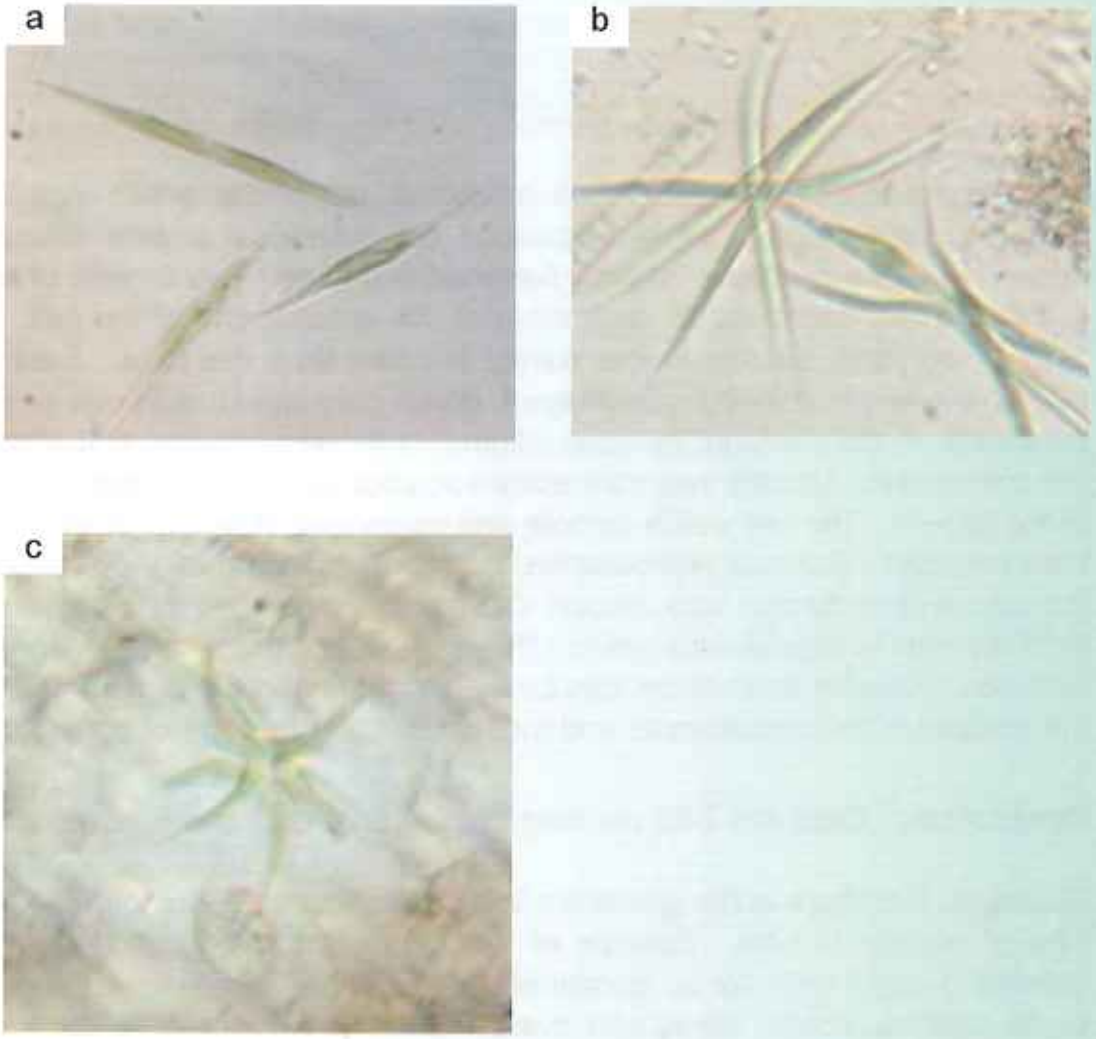
Characteristics: *Ankistrodesmus* is a large genus consisting of thin-walled cells that may be solitary, loosely clustered or twisted around each other in small bundles of 4-32 cells. The young cells are often found in crossed arrangement, while older cells are usually solitary. When in colonial form, the cells are attached to each other at the centre of the body and cells may lie parallel to one another or may be radially arranged. Individual cells are needle-like, tapering at both ends, and may be straight, curved or spirally twisted. Each cell is uninucleate and has a plate-like chloroplast with or without a pyrenoid. No gelatinous sheath is present. Asexual reproduction takes place by autospore formation. Flagellated stages and sexual reproduction are unknown. Species are distinguished from one another mostly by cell shape and size.

Dimensions: Cells are 25-60 μm long and 1-6 μm wide.

Ecology: *Ankistrodesmus* is widespread and common in all types of waterbodies (especially abundant in eutrophic waters). The genus is usually free-floating within the plankton of freshwater ponds and lakes, sometimes forming blooms. They can also grow on soil.

Notes: *Selenastrum* Reinsch and *Ankistrodesmus* are closely related, with some authors considering them synonymous; the key difference being the degree of cell curvature with *Ankistrodesmus* being more or less straight or slightly curved and *Selenastrum* being strongly curved. Cells of *Ankistrodesmus* are also very similar to those of *Monoraphidium* Komárková-Legnerová, except that *Ankistrodesmus* cells more often occur in groups. *Ankistrodesmus* has a high tolerance for copper treatments (usually copper sulfate) that are commonly used to control algal growth in water supplies, reservoirs, and recreational areas.

Problems: None known of, although it may form blooms.



Caption: *Ankistrodesmus* spp., consisting of needle-like cells that are sometimes solitary (photo a), sometimes loosely clustered, lying over one another (photo b) or twisted around each other (photo c). Cells may be straight (photo a) or curved (photo c).

Chlamydomonas Ehrenberg

Origin: From Greek *chlamys*, "mantle" + *monas,* "single" or "unit".

Characteristics: *Chlamydomonas* is a small, unicellular, green alga. The cells may be spherical, ovoid, ellipsoidal, sub-cylindrical or pear-shaped in lateral view, and circular or slightly flattened in outline. Two flagella of equal length are inserted close to each other at the anterior end of the cell. The flagella are long, usually longer (rarely shorter) than the cells. Each cell contains a single, parietal, cup-shaped, green chloroplast, with one or more pyrenoids. A red coloured eyespot (stigma) is located anterior, embedded in the chloroplast. Usually two contractile vacuoles are present near the base of the flagella. The cell wall is smooth and composed of glycoproteins, rather than cellulose. Asexual reproduction, by cell division, produces zoospores, but sexual reproduction also occurs. Cells sometimes shed their flagella and form colonies in a gelatinous matrix - these palmelloid (non-motile) stages are common. Species distinctions can be quite difficult and are based mainly on the position of the chloroplasts and the number and position of pyrenoids.

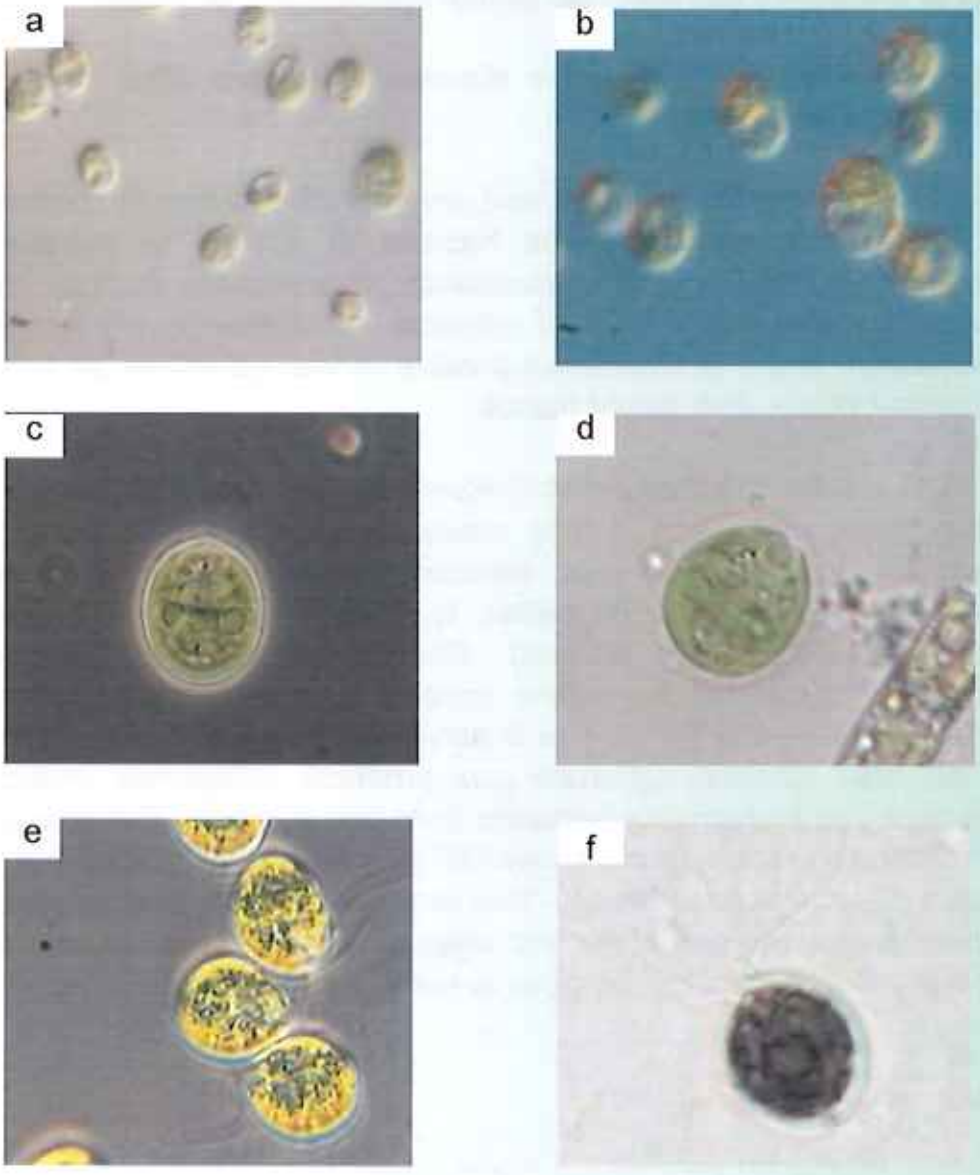
Dimensions: Cells are 2-50 μm long (mostly 5-20 μm) and 8-22 μm wide.

Ecology: Members of the genus are widely distributed, being found in every kind of aquatic habitat. Species of this genus are the most likely green swimming algal cells to be encountered. Habitats range from temporary pools, ditches, ponds, lakes and rivers. *Chlamydomonas* cells are mostly free-swimming in freshwater (where they sometimes form blooms, especially in extremely nutrient-rich waters), but are also found on soil and terrestrial surfaces, snow and ice (where they may appear red due to the presence of carotenoid pigments), and in arctic or antarctic pools. *Chlamydomonas* is phototactic - the cells are attracted to moderate, but not intense, light levels due to a photoreceptor near the eyespot.

Notes: *Chlamydomonas* is a vast genus, with a very large number of species described, but many are probably not true species. Species are difficult to identify. *Carteria* is similar to *Chlamydomonas*, but possesses four flagella instead of two. *Dunaliella* Teodoresco is also similar to *Chlamydomonas*, but it lacks a firm outer wall and it usually causes the pinkish or reddish colour of saline lakes. *Haematococcus* Agardh also resembles *Chlamydomonas* as it also has two flagella, however, the cell contents are contained within a central body connected to the outer wall with fine protoplasmic threads.

Haematococcus cells are normally green, but as growth conditions become unfavourable, red pigmentation increases and these cells often cause a red discolouration of bird baths and garden ponds. Species without a pyrenoid is placed into a separate genus, *Chloromonas* Gobi *emend* Wille, by some specialists. *Chlamydomonas* is widely used as a laboratory genetic model system for researching cell structure and function since it grows rapidly, is easily cultivated, and has a haploid life cycle in which sexual reproduction can be induced easily.

Problems: None known of, although it may form very dense blooms.



Caption: *Chlamydomonas* cells, each with a cup-shaped chloroplast (photos b and c) containing one (photo f) or more (photo c) pyrenoids, a red eyespot (photo b)and two equal flagella at the anterior end (photo f).

Chlorella Beijerinck

Origin: From Greek *chloros*, "green".

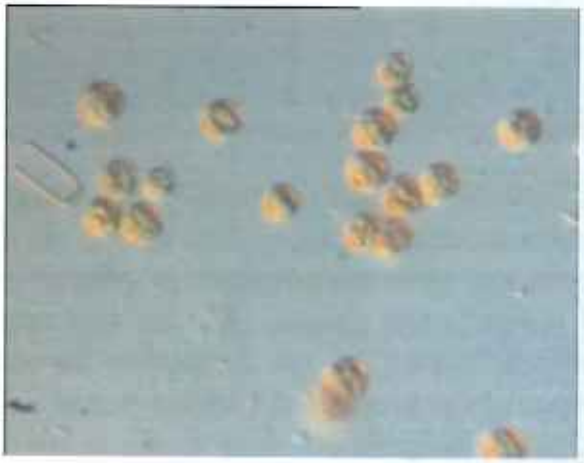
Characteristics: *Chlorella* consists of small, non-motile unicells (rarely aggregated into small groups). The cells are spherical or ellipsoidal with a single, parietal, cup-shaped (sometimes plate-like) chloroplast with or without a pyrenoid. The cell wall is generally thin and smooth. The only method of reproduction is asexual by means of 4 or 8 (rarely 16 or more) autospores which are formed internally through cell division. Autospores are liberated by rupturing of the parent cell wall. No sexual reproduction is known.

Dimensions: Cells are 2-15 μm in diameter (cells are often overlooked because of their small size).

Ecology: *Chlorella* is widespread and common, free-living in freshwater, marine waters, soil and sub-aerial habitats or it may be present as endosymbionts within the cells of freshwater invertebrates such as *Hydra viridis*, sponges, and many kinds of protozoa. *Chlorella* usually occurs in eutrophic waters and it is sometimes present in vast quantities as a green soup in cattle-troughs and similar places.

Notes: The cellular morphology of *Chlorella* is very similar to many other unicellular green algae and it may easily be confused with motionless zoospores of some genera. It is, therefore, necessary to study a large number of individuals, or even better, to culture them for identification purposes (*Chlorella* is easily cultured). *Chorella* can only be differentiated from some *Chlorococcum* Meneghini species by a study of reproductive habits. *Chlorella* usually forms 4 or 8 non-motile daughter cells within the mother cell wall, whereas *Chlorococcum* produces biflagellate zoospores which escape and immediately separate from one another. The species or forms of *Chlorella* that are found in invertebrates have been placed in a separate genus, *Zoochlorella* K. Brandt - they are often referred to as zoochlorellae. *Chlorella* was also one of the first algae grown as a possible food additive and it is still grown for this purpose to some extent, notably in Japan and Taiwan.

Problems: None known of.



Caption: Small, non-motile cells of *Chlorella*, distinguishable from *Chlamydomonas* and *Carteria* by the lack of flagella.

Closterium Nitzsch *ex* Ralfs

Origin: From Greek *klosterion*, "small spindle".

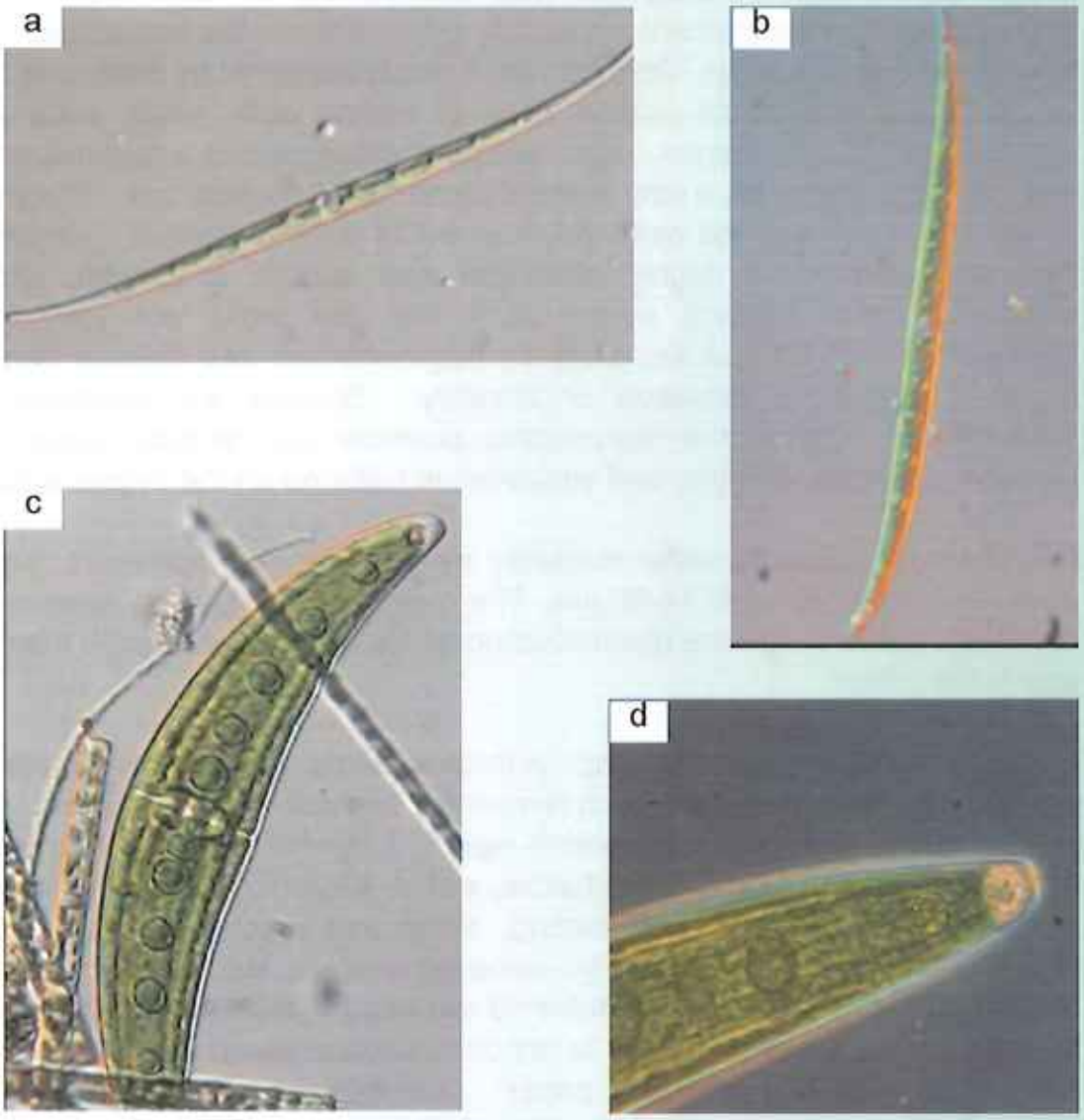
Characteristics: Cells of this unicellular genus are usually elongated and crescent-, sickle- or bow-shaped, with varying degrees of curvature. In cross section, the cells appear circular and the cells are sometimes inflated in the mid-region. The ends of the cell (apices) are usually tapered and may be acutely pointed, rounded or truncate (used as an important taxonomic character). The cells are always longer than broad and divided into two equal semi-cells. The median constriction is insignificant and there is no clear incision or sinus. Each semi-cell contains a single chloroplast. Chloroplasts of narrow species are mostly simple and ribbon-like, while those of larger species often appear like a central axial core, having radiating, longitudinal ridges with one to several pyrenoids arranged in an axial row or scattered throughout the chloroplast. The prominent, central nucleus lies between the two plastids at the equator of the cell. At each end of the cell there is a conspicuous vacuole in which one or more erratically vibrating crystals of barium or calcium sulphate may be observed performing Brownian movement. The function of these vacuoles is unknown. The cell wall of *Closterium* is colourless, or may appear yellowish or brown, due to iron staining. The wall may be smooth or striate and contains pores through which mucilaginous material is secreted. Secretions of mucilage from alternating ends of the cell are responsible for the somersaulting motion of *Closterium*. *Closterium* reproduces asexually by cell division or sexually by conjugation.

Dimensions: Cells are 70-1200 μm long and 4-50 μm wide. At least two species attain lengths of more than 1 mm.

Ecology: *Closterium* is cosmopolitan, widespread (oligotrophic to eutrophic) and often abundant. Because they can attach firmly by one end, they are common in rivers on macrophytes or other surfaces, even where there may be a strong current. They may, however, be dislodged by wave action and then occur free-floating in the open water of ponds, lakes and slow rivers. *Closterium* is very common in acidic, oligotrophic lakes and ponds, while it occurs more rarely in alkaline, eutrophic environments. *Closterium* can also grow in soils. Polymers in the cell wall may help protect the cell from drying out and allow them to survive for months in environments such as dried mud at the edges of lakes.

Notes: The genus is easily identifiable. Some of the species have large and conspicuous cells reaching nearly 1 mm in length, while others, particularly the planktonic ones, may be much more slender and almost straight.

Problems: Creates filter-clogging problems.



Caption: *Closterium*, a desmid common in acidic, clean water bodies. Cells may range from small (photos a and b) to large (photo c). Note the numerous pyrenoids in the chloroplast and the transparent area in the middle of the cell in which the nucleus is located (photos a, b and c). Photo d illustrates a vacuole at the tip of the cell containing barium or calcium sulphate crystals performing Brownian movement.

Oedogonium Link

Origin: From Greek *oidos,* "swelling" + *gonos,* "offspring".

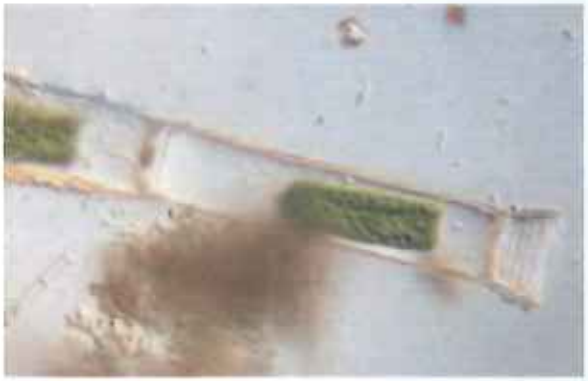
Characteristics: *Oedogonium* is an unbranched, filamentous green alga, consisting of a single layer of cells. The filaments are often attached by a basal holdfast cell, but they can also occasionally be found free-floating. Individual cells of the filament are usually cylindrical and are sometimes wider at one end than the other. *Oedogonium* is easily identified by distinctive rings (up to 20) at the apical (wider) ends of certain cells, which arise as a consequence of cell division - each cellular division creates a new ring on the cell. In some filaments, a long spike is carried on the apical cell. The shape of the apical cell and the basal holdfast cell is often distinctive. Vegetative cells are uninucleate, highly vacuolate and contain a parietal, net-like chloroplast with several pyrenoids. The cell walls are very hard. *Oedogonium* reproduces asexually by fragmentation, cell division (forming rings) or zoospore formation or sexually. Species are identified and differentiated when in the reproductive condition by the size, shape, and location of the gametangia, and variations in patterns on the zygote wall.

Dimensions: Species differ markedly in cell size with diameters ranging from 4-54 μm, commonly 14-30 μm. The mean cell diameter is, however, an unreliable guide to species discrimination as filaments vary in width from one end to the other.

Ecology: *Oedogonium* is common in freshwater habitats worldwide, with the greatest abundance of species in temperate and sub-tropical regions. Only a few species are found in brackish water. Filaments are attached by the basal holdfast cell to rocks in shallow, still or slow-moving water, wood or aquatic plants or they are free-floating. When free-floating, they form dense pale-green, yellow-green or cream-coloured masses near or on the surface of the water (especially when nutrients are readily available). Often these masses are so dense that, if left to dry by the evaporation of water, they may form what is known as "algal paper". *Oedogonium* filaments are often covered with epiphytic diatoms or other microalgae as a result of the hard cell walls that make them an ideal substrate.

Notes: *Oedogonium* is easy to distinguish from other unbranched, filamentous algae by the rings left after cell division. Sometimes a number of cells must be observed to find these rings and they can be seen by careful focussing under favourable lighting. Species identification is only possible with fertile organisms present (not always common).

Problems: *Oedogonium* may form blooms (floating mats) under high nutrient concentrations and clog irrigation canals when growth on the concrete surfaces becomes excessive. However, *Oedogonium* is much more easily controlled by copper treatments than other mat-forming green algae.



Caption: An unbranched filament of *Oedogonium*. Note the rings (a result of cell division) on the right hand side of the filament - they are very important characteristics used in the identification of this genus.

Pandorina Bory de Saint-Vincent

Origin: From Greek "*Pandora*", a mythological women.

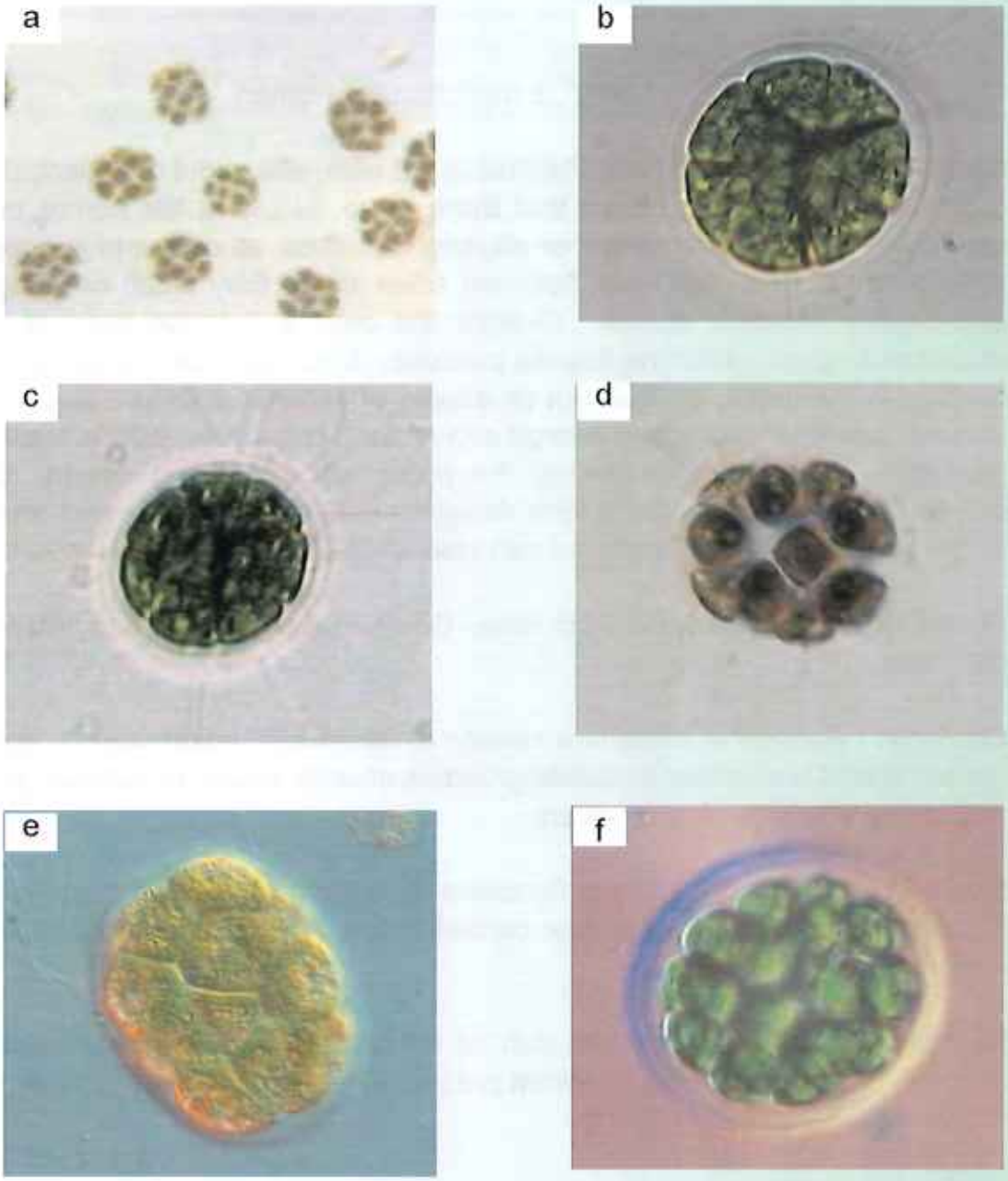
Characteristics: Colonies of *Pandorina* are oval, ellipsoidal or spherical with 8-32 densely packed cells so that there is no hollow at the centre of the colony. The cells are ovoid or slightly narrowed at one end to appear pear-shaped. The cells have flattened sides where they touch one another and slightly flattened apices. Outside the cells is a broad zone of clear mucilage through which the flagella protrude. Each cell has two flagella, two contractile vacuoles, an eyespot (eyespots of anterior cells are larger than those of posterior cells), and a large cup-shaped chloroplast with at least one pyrenoid. Colonies move through the water with a tumbling motion. Each cell can undergo cleavage to form daughter colonies that are exact replicas of the mother colony. *Pandorina* can also undergo sexual reproduction.

Dimensions: Cells are 8-20 μm long. Colonies are usually up to 100 μm in diameter.

Ecology: *Pandorina* inhabits a variety of freshwater environments around the world and is common in standing bodies of water (such as puddles, ponds and lakes) and slow-flowing rivers.

Notes: *Pandorina* differs from *Eudorina* Ehrenberg *ex* Ralfs in that the cells fit closely together without a large central space. The most common species is *P. morum* (Muller) Bory.

Problems: *Pandorina* growths can be difficult to control and are relatively tolerant to copper treatments. When present in large numbers, this alga gives the water a fishy odour.



Caption: Colonies of *Pandorina*, consisting of triangular, tightly-compressed cells kept together by mucous (clearly visible in photo f). Note the two flagella arising from each cell (photo c).

Pediastrum Meyen

Origin: From Greek *pedion,* "flat or plain" + *astron,* "star".

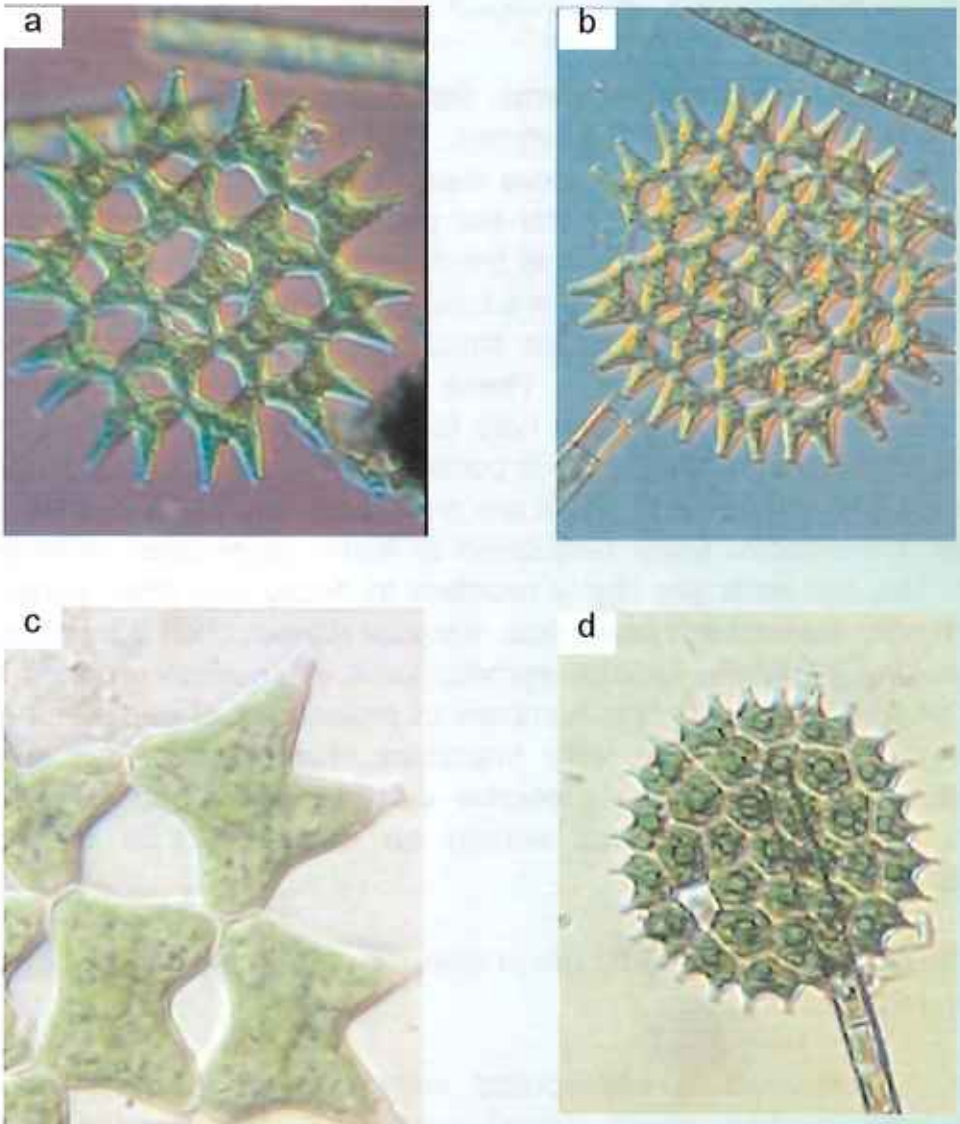
Characteristics: *Pediastrum* forms flat disc-shaped, oval to circular colonies, consisting of 4-64 (sometimes 128) cells. The colony is one cell-layer thick and if there are more than 16 cells, the cells tend to be arranged in concentric rings in a star-like pattern. Cells of *Pediastrum* are highly variable in shape - the cells at the margin differ in shape from those within the colony. The interior cells are typically polyhedral with four to many sides, while the peripheral cells are similar or with 1, 2 or sometimes 4 horn-like lobes or projections. These horn-like projections improve buoyancy in the water column and help to prevent predation. Cells of the colony are contiguous or the colony is perforate. The cells contain a parietal chloroplast with one pyrenoid. Cells are non-motile and multinucleate. The cells walls are smooth, finely reticulated or highly granulated, wrinkled or notched. The cell walls are highly resistant to decay and often persist for some time after the contents have died. Asexual reproduction is by zoospore and autocolony formation. Sexual reproduction is infrequently reported. Cell size and shape (particularly the numbers of projections of peripheral cells) and colony morphology are very important characteristics for species identification. In addition, the presence or absence of perforations and ornamentation of the cell wall should be considered for taxonomic contemplation.

Dimensions: The cells are 8-32 μm in diameter. Colonies can be large (up to 200 μm in diameter).

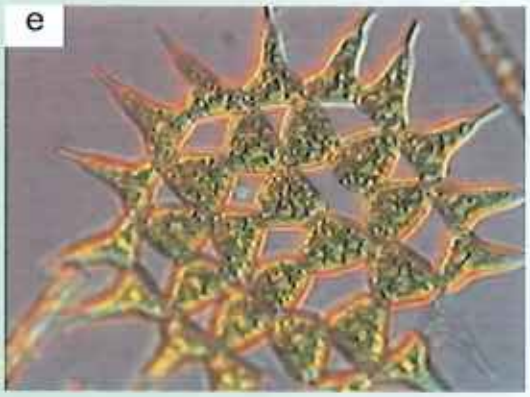
Ecology: *Pediastrum* is widespread and common in most standing (swamps, bogs, ditches, ponds, lakes) and slow-flowing freshwaters, and occasionally forms blooms especially in nutrient-rich environments. Colonies are free-floating, often among plants or other algae.

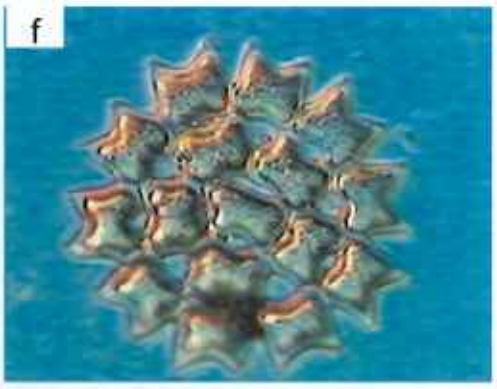
Notes: Common species include *P. simplex* Meyen (marginal cells are single lobed), *P. duplex* Meyen (marginal cells are bilobed with distinct gaps between the inner cells), *P. boryanum* Menegh. (marginal cells are bilobed without gaps between individual cells) and *P. tetras* Ralfs (small colonies with only 2, 4 or 8 angular cells per colony, each cell divided into two lobes by a narrow central incision). All the above species are common and widely distributed. *Euastropsis* Lagerheim is similar to *Pediastrum,* but its colonies consist of only 2 cells.

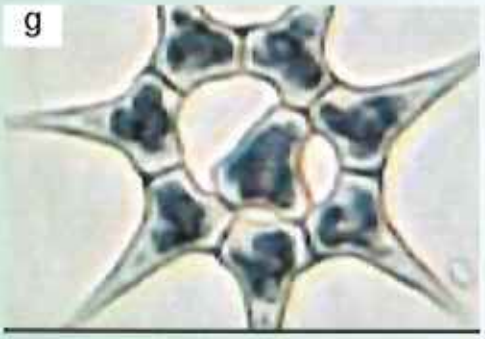
Problems: May form blooms.

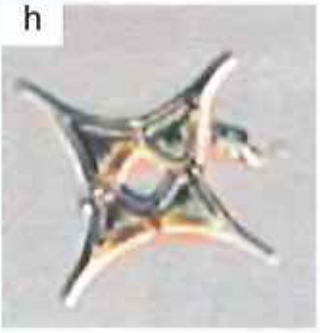


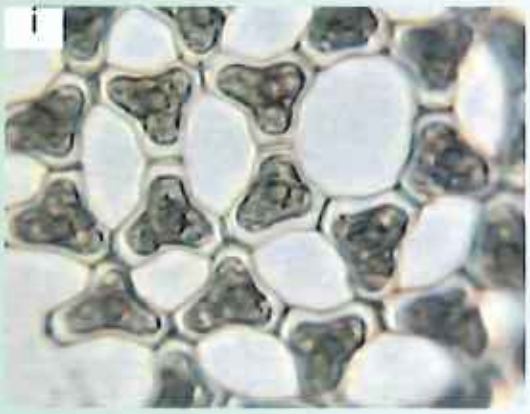
Caption: *Pediastrum* colonies belonging to *P. simplex* (photos a - d)

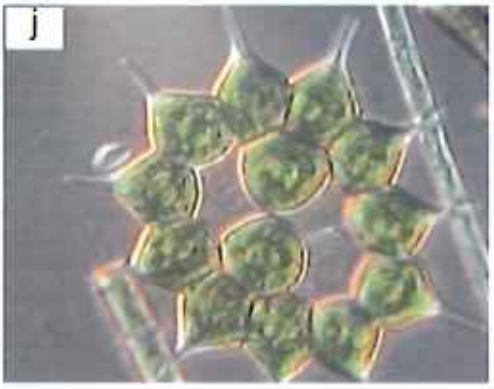






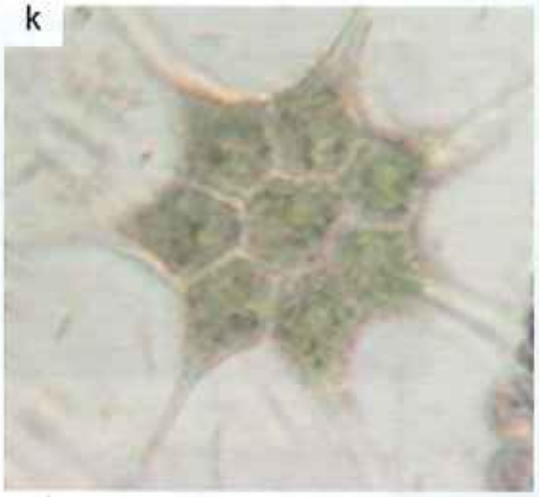






Caption: *Pediastrum* colonies belonging to *P. simplex* (photos e-j)

k



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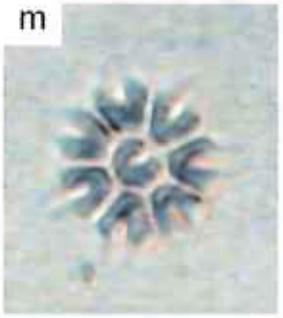
m



Caption: Pediastrum colonies belonging to several species, e.g. *P. simplex* (photos k and l) and *P. tetras* (photo m).

Scenedesmus Meyen

Origin: From Latin *skene,* "tent or awning" + *desmos,* "bond".

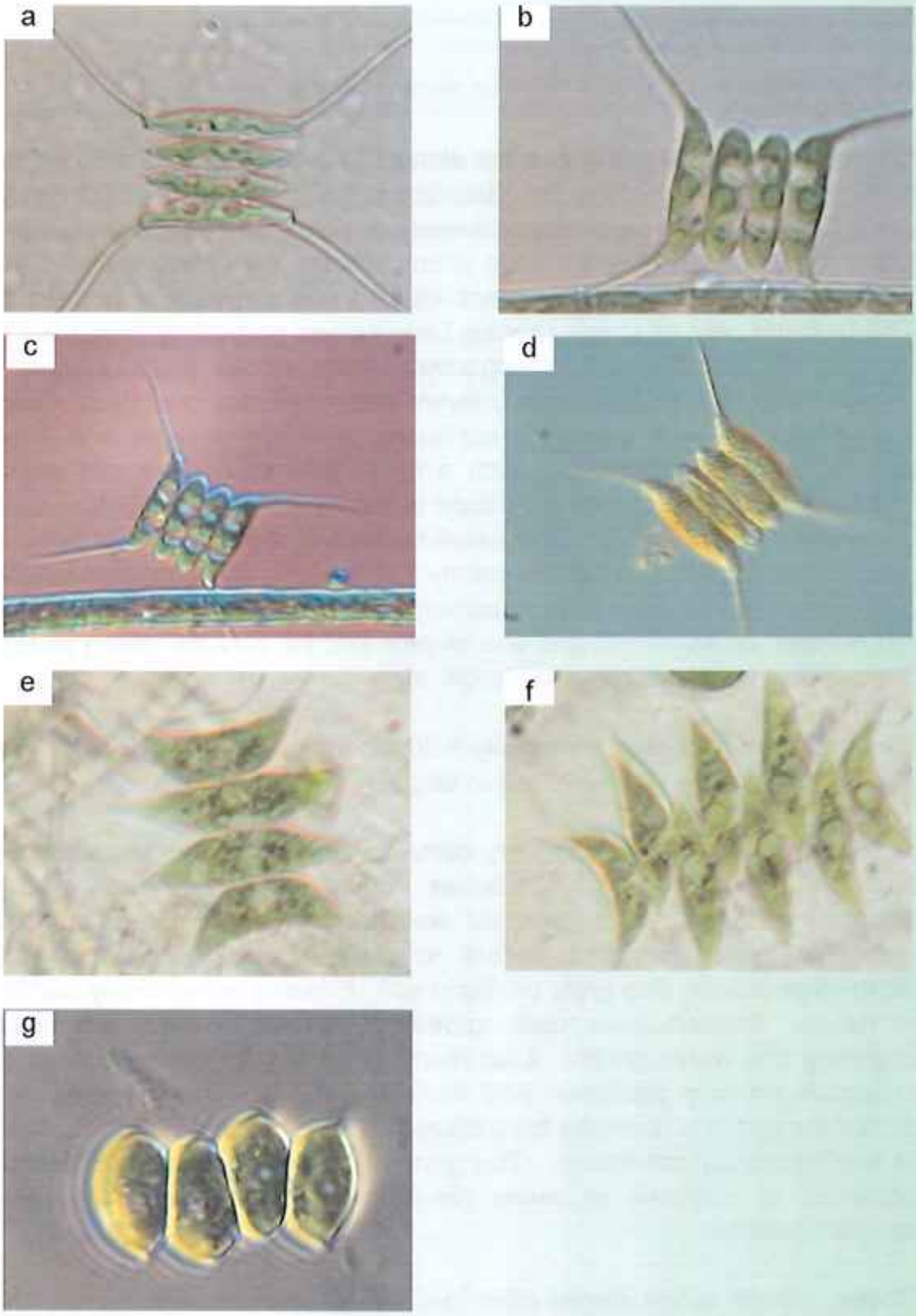
Characteristics: In this genus the elongated cylindrical cells are joined side by side to form flat, rectangular, plate-like colonies of 2, 4, 8, 16 (or rarely 32) cells. The cells may be arranged linearly or zigzag in a single or double row. Occasionally *Scenedesmus* cells occur solitary, especially when cultured. Cells are oval, fusiform or crescent-shaped with rounded or pointed ends. The terminal cells of many species have spines protruding from their outer corners, with the other cells having smooth walls, spines, teeth or ridges. The spines make the colonies more buoyant and may deter predation. Colonies are non-motile, with each cell containing a single nucleus and a single parietal, plate-like chloroplast with a single pyrenoid. The cell walls are resistant to decay and thus contribute to the formation of fossil fuel deposits and visible fossil records. The usual method of reproduction is asexual by autospores, forming a daughter colony inside each cell. Sexual reproduction is reported, but is apparently extremely rare. Species are distinguished by the number, arrangement and size of cells and the ornamentation pattern on the cell wall (spines, ribs, granulation, etc.).

Dimensions: The cells are mostly 5-30 μm long and 2-10 μm wide. Spines (if present) may be up to 200 μm in length.

Ecology: *Scenedesmus* is a very common and sometimes abundant genus found in the plankton of freshwater ponds, lakes and rivers (rarely in brackish habitats). It is reported worldwide in all climates, but prefers eutrophic to hypertrophic waters with slight acidity and low salinity. *Scenedesmus* can also grow on damp soil. Besides being widely distributed in nature, *Scenedesmus* cells appear frequently in laboratory aquaria, colouring the water green. Like many other algae, *Scenedesmus* is an important primary producer and food source for higher trophic levels. *Scenedesmus* is a common bio-indicator of physical and chemical changes in environmental conditions. The genus is commonly used to detect the presence of nutrients or toxins resulting from anthropogenic inputs to aquatic systems.

Notes: Single celled stages often look like species of *Lagerheimia* Chodat (*Chodatella*) and can cause much nomenclatural confusion.

Problems: Although growth may be dense in nutrient-rich waters, it is not typically considered a nuisance.



Caption: *Scenedesmus* colonies consisting of four or eight cells. Different species are distinguished by the number, arrangement, size and shape of the cells. Note the clearly visible pyrenoids in photos b, e and f.

Spirogyra Link

Origin: From Greek *speira,* "coil" + *gyros,* "twisted".

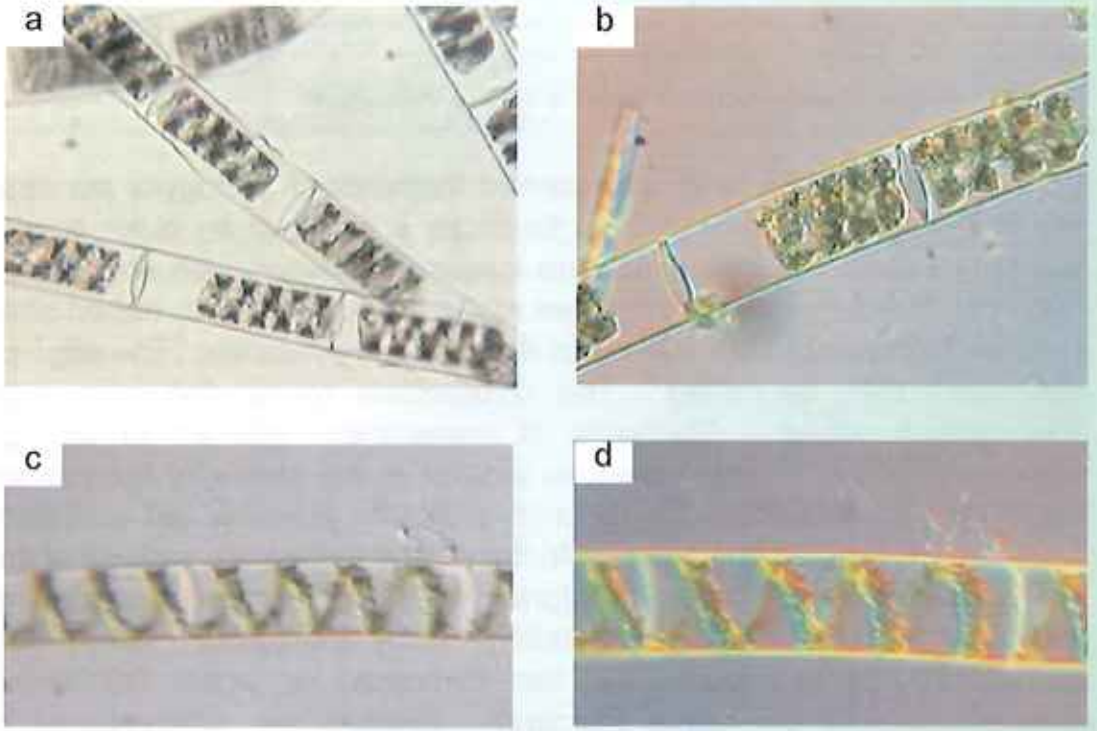
Characteristics: The long, unbranched filaments of *Spirogyra* are straight, one cell-layer thick, and slimy to touch as a result of an outer coating of mucilage. Cells are cylindrical and longer than broad with firm cell walls. Each cell contains one or more (as many as 16) spiralled, ribbon-shaped, parietal chloroplasts, with numerous disc-shaped pyrenoids. The edge of the chloroplast may be ruffled. The chloroplasts render the cells a bright grass-green colour - *Spirogyra* is sometimes referred to as "green silky-strand algae". The nucleus is located in the centre of the cell and is suspended from strands of cytoplasm stretching from the cell periphery. A large central vacuole is present. No flagellated stages are present in the life cycle. Asexual reproduction by fragmentation and the formation of akinetes and aplanospores. Sexual reproduction is by conjugation, which may be scalariform (ladder-like between two filaments) or lateral (between two adjacent cells in the same filament). Species are differentiated by a combination of vegetative characters (size and shape of cells, number of chloroplasts, etc.) and reproductive details, mostly in reference to the morphology of the zygospore and its wall markings. Identification of species can be difficult.

Dimensions: Cells are up to 200 μm long and 10-150 μm wide, depending upon the species.

Ecology: *Spirogyra* is widespread in all freshwater habitats. It is most common in standing water (e.g. shallow ponds, ditches and amongst vegetation at the edges of large lakes), but also frequently occurs in running streams of neutral or low pH. The filaments are usually found as free-floating masses and it often forms extensive blooms in freshwater ponds. The filaments are also frequently attached to a substrate.

Notes: Under favourable conditions *Spirogyra* forms green clouds of filaments below the surface of the water and it usually appears as floating yellowish-brown mats when entering the reproductive state.

Problems: Blooms can impart a grassy odour to the water, block canals and clog filters, especially at water treatment facilities.



Caption: Unbranched filaments of *Spirogyra*. Note the spirally twisted chloroplast and the nucleus in the centre of the cell (photo d).

Staurastrum Meyen *ex* Ralfs

Origin: From Greek *stauron,* "cross" + *astron,* "star".

Characteristics: There is a great variation in size, shape and ornamentation within this genus. Each cell is divided into two semi-cells by a deep incision, the sinus. In front view semi-cells may be elliptical to semi-circular, triangular, quadrangular to polygonal. In apical view the cells are usually triangular with the angles produced into multiple hollow projections (usually 2-12). Projections may be absent (cell angles rounded or truncate) or range from short and stumpy (giving the cell a polygonal appearance) to long, arm-like structures often covered in warts or spines. The cells with longer projections can achieve greater buoyancy in the water column and are often planktonic. In some species the arm-like projections are in one plane only (horizontal extensions of the semi-cell), in others they may occur in different planes. Cell walls have pores and extrusion from pores (especially in planktonic species) results in cells enclosed within a wide mucilage envelope. Each semi-cell usually has a large, lobed chloroplast with a single large pyrenoid in its centre, but this can vary among species. The nucleus is located in the isthmus between the two semi-cells. The cell walls may be smooth or ornamented, and contain compounds that make them resistant to decay (remains have been found in lake sediments thousands of years old). Asexual reproduction occurs by cell division and new semi-cell formation. Sexual reproduction, by conjugation, is known for many species. Species of *Staurastrum* are mainly distinguished by differences in the cell wall patterns and the number, size and arrangement of projections.

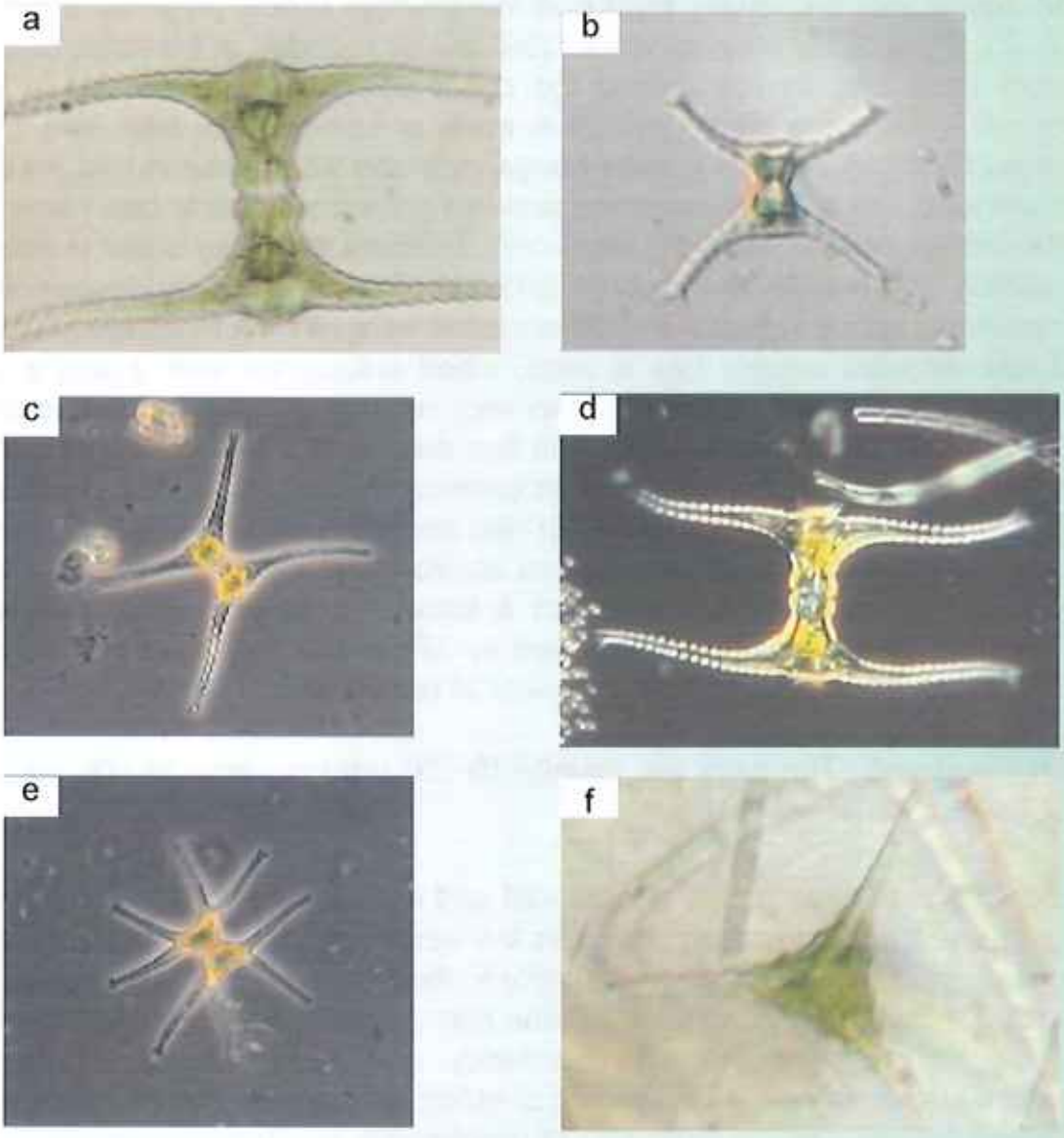
Dimensions: The cells are usually 15-120 μm long and 10-100 μm wide (excluding processes).

Ecology: *Staurastrum* is widespread and extremely diverse. Although the genus is most commonly found in the sediments or periphyton of acidic, oligotrophic lakes, ponds and swamps, they can occur in all freshwaters, including eutrophic conditions. Some species are planktonic and they often have long processes that aid in buoyancy. At least two *Staurastrum* species are regarded as reliable indicators of eutrophic, alkaline waters, while many others are used as bio-indicators of oligotrophic, mildly acidic waters.

Notes: *Staurastrum* is the desmid genus with the greatest range of morphologies. Because of this and the complexity of form within the genus, several attempts have been made to divide it into several genera.

So far only smooth walled species with a single spine (or thickened cell wall) at each angle have been assigned to the genus *Staurodesmus* Teiling. Many species appear like *Cosmarium* Corda *ex* Ralfs when seen in front view and one must focus carefully to see the arms or lobes of the semi-cell extending towards or away from the observer.

Problems: Blooms of *Staurastrum* have created odour problems in drinking water supplies. The odour is described as grassy.



Caption: Different views of *Staurastrum* spp. Photo f shows an apical view, in which the semi-cells look triangular. The spike-like projections (often with forked ends; photo b) increase the surface area and improve the algae's ability to float. Note the single pyrenoid in each semi-cell (photo a).

Stigeoclonium Kützing

Origin: From Latin *stigeus,* "tattooer" + from Greek *klonion,* "small twig".

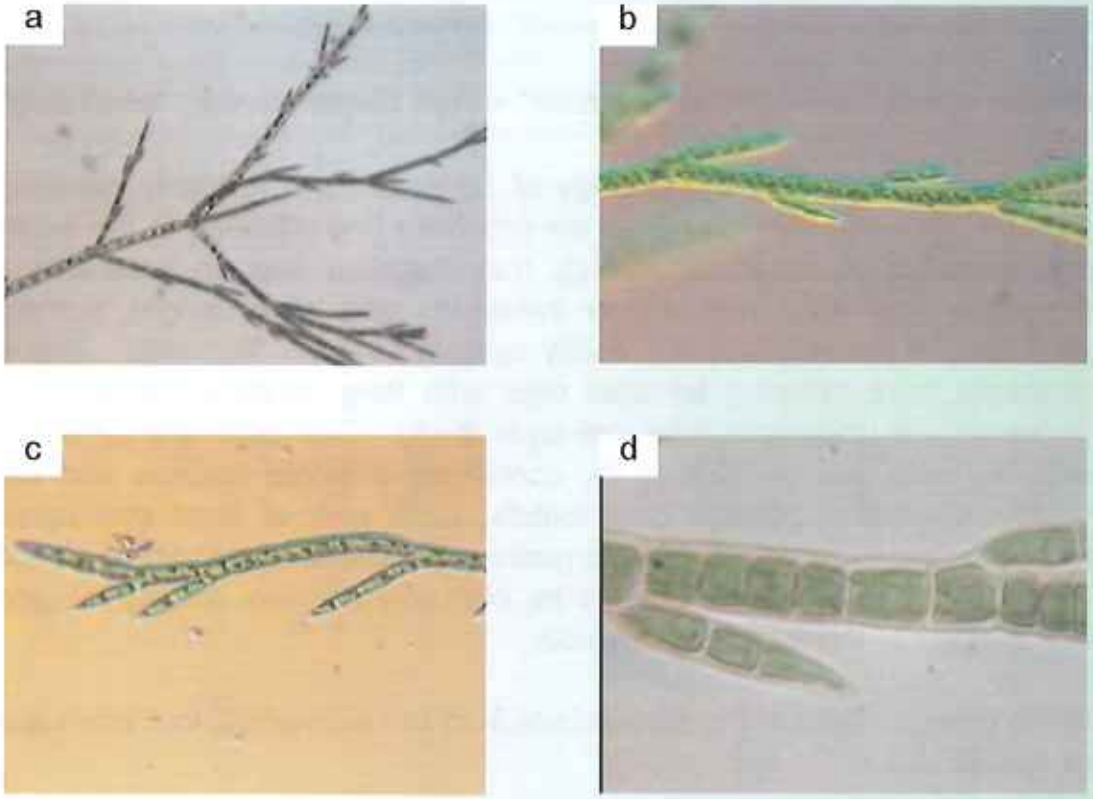
Characteristics: The morphology of *Stigeoclonium* is highly variable. In general, *Stigeoclonium* filaments are prostrate and attached to the substrate by means of a basal cell, which may develop into an extensive disc. Branches may arise regularly or irregularly and grow upright, sometimes producing a macroscopically visibly system of erect filaments. The erect filaments have tapering terminal cells with long, multicellular hairs. The filaments are uniseriate (one cell-layer thick). The cells are cylindrical or rounded with thin or thick walls, containing a single nucleus and one to several plate-like, parietal chloroplasts, each with at least one pyrenoid. Reproduction is asexual by the formation of zoospores, or sexual. There are several species differentiated by size, plan of branching, and by the general morphology of the thallus as a whole.

Dimensions: Cells of the filament are 8-25 μm wide and 2 to 5 times as long as broad.

Ecology: *Stigeoclonium* is a common freshwater genus growing on a wide range of different surfaces. It is usually found as attached tufts or mats on submerged rocks or aquatic plants, mostly in fast-moving rivers and streams (it can, however, also be found in standing waters). It is sometimes abundant in polluted waters such as the outflow of sewage treatment plants, and it is tolerant of heavy metals. The genus typically forms mats in colder waters and is part of the periphytic community.

Notes: *Stigeoclonium* is a common weed species in urban creeks, and although capable of clogging irrigation canals, it is usually less problematic than *Cladophora* Kützing. The filaments are more slimy to touch than *Cladophora* but less so than *Spirogyra* Link.

Problems: *Stigeoclonium* is known to clog irrigation canals by growing abundantly on the concrete linings.



Caption: Branched filaments of *Stigeoclonium* consisting of a single cell layer. These filaments often produce a macroscopically visible system of erect filaments. Note the tapering terminal cell in photo d.

Volvox Linnaeus

Origin: From Latin *volvo*, "to roll".

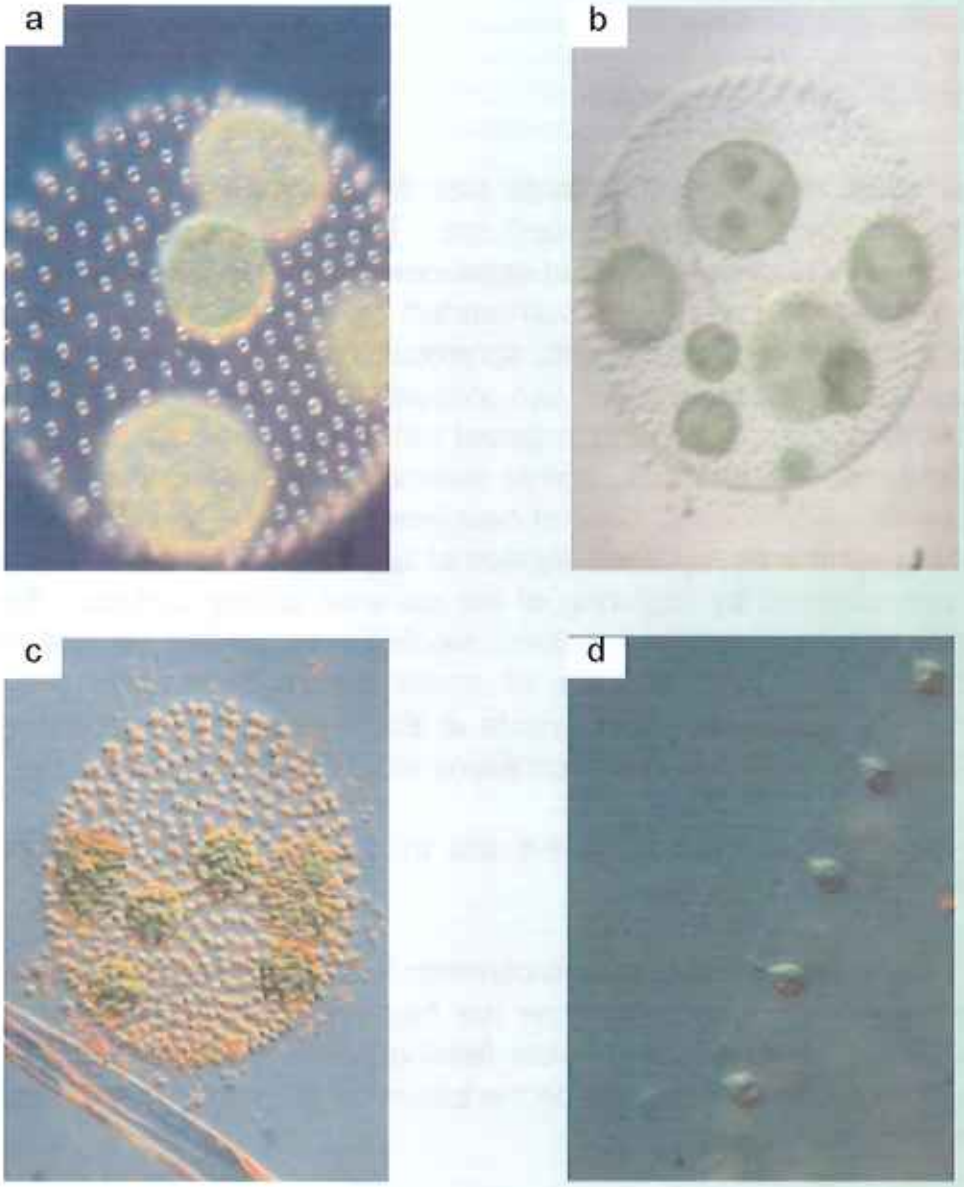
Characteristics: Because of its large size, free-swimming *Volvox* colonies can usually be seen with the unaided eye. The hollow, spherical to ovoid colonies contain a peripheral layer of approximately 500 to 50 000 biflagellate *Chlamydomonas*-like cells, each surrounded by a mucilaginous envelope. Cells are approximately equidistant, spherical, ovoid or star-shaped, each with two equal flagella, an eyespot, two contractile vacuoles at the base of the two flagella, and a cup-shaped chloroplast with single pyrenoid. Cytoplasmic strands between cells are thick, thin or absent (species dependent). During asexual reproduction, one to several daughter colonies is formed within the interior of the sphere by repeated division of special gonidial cells. Daughter colonies are released by rupturing of the parental colony surface. Sexual reproduction is oogamous and mature colonies may contain several, much enlarged egg cells and packets of motile sperm. Species may be monoecious or dioecious. The zygote is thick-walled - the wall may be smooth, or it may bear external decorations such as spines and warts.

Dimensions: Cells are mostly 4-8 μm in diameter while colonies are usually 0.5-1.5 mm in diameter.

Ecology: *Volvox* is widespread and common in freshwater, especially those rich in nitrogenous matter. Colonies are free-swimming in ditches, lakes, ponds or other bodies of still or slow flowing water, especially during late summer. *Volvox* often over winter on the bottom of the waterbody in the form of zygotes.

Notes: *Volvox* is the largest free-swimming, colonial Chlorophyte and it is frequently accompanied by *Eudorina* and *Pleodorina* Shaw in water bodies. Because *Volvox* colonies are a millimetre or more in diameter, their movements can be followed when large populations are present - in a dish it can be seen that they move towards the light, provided it is not too bright.

Problems: An excess of nitrogen encourages the growth of *Volvox* and may cause "blooms" during the summer months. When this occurs in the shallow ponds at fish hatcheries, large numbers of *Volvox* cause damage to the gills of young fish. When present in large numbers *Volvox* gives water a fishy odour.



Caption: Large colonies of *Volvox*, with daughter colonies visible on the inside of the mother colonies (photos a, b and c). Photo d shows higher magnification of the individual cells each having two flagella.

GLOSSARY

Accessory pigment: A pigment capable of capturing radiant energy and transferring it to chlorophyll-*a*.

Acid water: Water with a pH value below 7.

Adnate: Tightly joined or affixed to a particular substratum.

Akinete: Thick-walled non-motile resting spore formed by transformation of a vegetative cell; in blue-green algae, with a thick wall and usually considerably larger than the vegetative cells. Considered to be storage structures that can survive in sediments for many years.

Alga (pl. algae): A commonly used term for primitive chlorophyll-containing, mainly aquatic eukaryotic organisms, lacking true roots, stems and leaves.

Alkaline: Having a pH greater than 7.

Alkalinity: A measure of the acid-neutralising capacity of water, and as such, it is also an indication of the base content. Ions which commonly contribute to the alkalinity of water are bicarbonate (HCO_3^-) and carbonate (CO_3^{-2}), and at higher pH values, hydroxide (OH^-).

Alveolus (pl. alveoli): Elongate chambers in the surface of the valve. The top surface of these is composed of punctae or similar structures, which may only be resolvable under the electron microscope.

Amorphous: Having no definite form or distinct shape.

Anterior: The forward end, toward the top or the front plane of the body.

Anthropogenic: Caused by human activities, often referring to disturbances to ecological systems, such as acidic precipitation.

Apex (pl. apices): End or tip of the cell.

Apical: Situated at the apex (tip) of any cell, structure or organ.

Aplanospore: An ontogenetically potential zoospore that has omitted the motile period.

Araphid: Diatom valve with no true raphe slit, valve may however be ornamented with a pseudoraphe

Arcuate: Arched-, bow- or crescent shaped; strongly curved (2-dimensional term).

Areola (pl. areolae): Chamber-forming perforations, rounded to angular in cross-section, in the valve wall of diatoms. They are closed either on the outside, or inside, by a velum.

Asexual reproduction: Reproduction which does not involve formation and fusion of gametes, and which may be by binary fission, budding, asexual spore formation or vegetative propagation, resulting in progeny with an identical genetic constitution to the parent and to each other.

Autocolony: A colony, that is a miniature of the parental colony, formed during asexual reproduction of coenobia.

Autospore: A non-motile spore resembling the parent cell

Autotrophic: "Self-feeding"; able to synthesise, by the process of photosynthesis, organic compounds from inorganic substrates, using either sunlight or chemical energy sources.

Axial area: In pennate diatoms this is an areolae-free zone on either side of the apical axis.

Basal: Located at the base or point of origin of a thallus or filament.

Basionym: Original name of a taxon, now used in a new combination.

Benthos, benthic: Bottom-dwelling; non-planktonic; attached to, or resting on, the substrate.

Bilateral symmetry: Having two sides symmetrical about one median axis only, so that one side is a mirror image of the other.

Binary fission: A form of asexual reproduction whereby a cell divides into two daughter cells after DNA replication nuclear division.

Bio-indicator: Organisms or groups of organisms, which relate to biochemical, cytological, physiological, ethological or ecological variables, and enable the characterisation of the state of an ecosystem or ecocomplex. Subsequently they enable the observations of changes in time and/or space of these characteristics and facilitate the differentiation between human and/or natural causes of these changes.

Biraphid: Diatom frustule ornamented by a true raphe on each of the two valves.

Bloom: Massive or conspicuous growth of algae which visibly discolours the water, typically planktonic and often forming surface scums; often a large percentage of the total cells are one of a few species.

Bog: Wet spongy ground of decomposing vegetation; has poorer drainage than a swamp.

Bow-shaped: Curved.

Brackish: Water that contains an increased and usually variable dissolved salt (sodium chloride) content, that is, however, less than that in seawater.

Brownian movement/motion: Random motion of small (about 1 μm) solid particles suspended in a colloidal solution, due to their bombardment by molecules of the solution.

Budding: Method of asexual reproduction in which new individuals develop as outgrowths of the parent organism and may eventually be set free.

Calcareous: Composed of or containing calcium carbonate or calcite.

Capitate: Enlarged or swollen at the tip.

Carcinogenic: Causing, or tending to cause, cancer in humans or animals.

Carotenoid: A group of widely distributed orange, yellow, red or brown fat-soluble pigments.

Cell: The basic structural and functional unit of all organisms; Cells may exist as independent units of life or may form colonies or tissues as in higher plants and animals.

Cell division: The process by which a cell divides to form daughter cells

Cell membrane: A thin membrane around the cytoplasm of a cell that controls passage of substances in and out of the cell. Also known as the plasma membrane or plasmalemma.

Cell wall: Typical rigid external structure enclosing the cell membrane (not in animal cells though); may consist of cellulose, silica, pectin, or other materials in algae.

Cellulose: A linear polysaccharide made up of glucose residues joined by ß-1,4-linkages, the most abundant organic compound in the biosphere, comprising the bulk of algal cell walls, where it occurs as cellulose microfibrils.

Chelate: A heterocyclic compound having a metal ion attached by coordinate bonds to at least two non-metal ions.

Chlorophyll-*a*: A primary photosynthetic pigment and light receptor in algae and higher plants.

Chlorophyll-*b*: A secondary photosynthetic pigment present in higher plants, green algae, prochlorophytes, and euglenophytes.

Chlorophyll-*c*: A secondary class of photosynthetic pigment which occurs in chrysophytes, synurophytes, diatoms, cryptophytes, tribophytes, dinoflagellates and brown algae; includes two components (both forms not found in all algal groups) termed c_1 and c_2, each of which has several different absorption peaks.

Chloroplast: Double-membrane bounded organelle in eukaryotic algae containing chlorophyll and other pigments; if the green colour is masked by chlorophyll, the older literature sometimes used the term chromatophore.

Chrysolaminarin: A polysaccharide storage product,ß -1,3-linked glucan; occurs in several algal groups, including chrysophytes and diatoms. Also termed leucosin.

Cigar-shaped: Shaped like a cigar, i.e. rod-like, but tapering at each end.

Cingulum: In dinoflagellates, a transverse groove that encircles the cell (usually) and holds the transverse flagellum in place. In diatoms, the girdle region of the frustule, connecting the epivalve and hypovalve.

Circumneutral: Having a pH of approximately 7.

Clathrate: Lattice-like with irregular perforations or openings.

Clavate: Club-shaped, growing gradually thicker toward the top (3-dimensional term).

Cleavage: Mitotic divisions resulting in the splitting of a single cell.

Coenobium (pl. coenobia): Colony in which the cell number is fixed at the time of formation and not augmented subsequently; a colony has a definite form and organisation, behaves as an individual and reproduces to form daughter coenobia.

Collar: A narrow neck around the flagellum opening in a lorica.

Colonial: Living in colonies.

Colony (pl. colonies): Group of individual cells enclosed within a common mucilaginous sheath or joined together by cytoplasmic strands or parent cell walls.

Conductivity: A measure of the resistance of a solution to electric flow.

Conical: Relating to, or resembling a cone i.e. tapering to a fine point.

Conjugation: Sexual reproduction between cells that connect together, with the entire cytoplasm from one cell fusing with that of the other, resulting in a zygospore.

Contiguous: Touching each other at the edges, but not actually united.

Contractile vacuole: Small vesicle found in the cytoplasm of many freshwater algae, which expels surplus fluid.

Cosmopolitan: World-wide distribution.

Costa (pl. costae): Longitudinal (transapical) thickening of the valve.

Costate: Possessig transapical ribs.

Creek: A natural stream of water smaller than a river (and often a tributary of a river).

Crescent-shaped: In the form of an arc, resembling the curved shape of the moon in its first or last quarters (a narrow, curved shape tapering at the ends to form a wider or cylindrical mid-region).

Cross wall: See septum.

Culture: Algae grown in a laboratory in a solution which is made of the basic nutrients required for growth.

Cup-shaped: A nearly complete folded plate (as a chloroplast) open at one position to form a cup.

Cylindrical: Elongate with parallel lateral margins when viewed from any direction, as in a cylinder or tube (3-dimensional term).

Cyst: Resting spore, usually thick-walled.

Daughter cells: Cells derived from a parent by a mitotic division.

Daughter colony: Small colony within a mother cell or mother colony.

Debris: The remains of something that has been destroyed or broken up.

Dermatitis: Inflammation of the surface of the skin.

Desmid: Unicellular or filamentous freshwater green alga whose cells are typically almost divided in two by a constriction of the cell wall.

Diatom: A yellow-brown algae belonging to the division Bacillariophyta; most are unicellular and have a cell wall consisting of two halves (valves) composed of silica.

Diatomaceous earth: A light soil consisting of deposits of siliceous diatom remains and often used as a filtering material.

Discoid: Having a flat, circular shape; disc-shaped.

Ditch: Any small natural waterway.

Dorsiventrally flattened: In dinoflagellates, flattened in cross section of the cell, equivalent to laterally flattened or flattened in side view in other flagellate groups (e.g. chrysophytes).

Ecology: The interrelationships between organisms and their environment and each other; the study of these interrelationships.

Ecosystem: All the plants and living creatures in a particular area considered together with their physical environment.

Ejectisome: Projectile-like structure that is discharged from the cell; may serve as an escape mechanism or direct defence against other organisms.

Ellipsoidal: A three-dimensional term for a structure appearing elliptical in side view, i.e. an elongated structure with convex lateral margins and rounded, narrowed ends; watermelon-shaped.

Elliptical: Rounded, like an egg (2-dimensionale term).

Endosymbiont, endosymbiotic: Symbiosis in which one partner (the endosymbiont) lives inside the cells of the other, e.g. photosynthetic cyanobacteria living in the cells of non-photosynthetic dinoflagellates (i.e. they live endosymbiotic).

Endosymbiosis: A symbiotic relationship between two organisms in which one of the two organisms (the endosymbiont) lives inside the body of the other one (the host).

Enriched: Loaded with nutrients, particular nitrogen and phosphorus.

Epipelon: Algal community living in or on the surface of sediments in shallow waters where light penetrates.

Epiphyte, epiphytic: Growing on another plant (including another alga), but does not parasitise on it.

Epitheca: In dinoflagellates, the portion of the cell anterior to the cingulum; in diatoms, the larger and older half of the frustule, also known as the epivalve.

Equator: Imaginary line halfway between the opposite poles of the cell.

Eukaryotic: Organisms with distinct membrane-bounded organelles, such as the nucleus, mitochondria and/or chloroplasts.

Eutrophic: Literally, well nourished; water bodies that have high levels of dissolved nutrients (especially N and P) and high levels of organic production.

Eutrophication: Process of becoming eutrophic by an increase in nutrients in a body of water. Natural eutrophication is a gradual process, but human activities may greatly accelerate the process.

Eyespot: Granular organelle, or a cluster of granules, usually red or orange, frequently present in flagellated cells; it functions in different ways in different groups of algae, but either directly or indirectly permits the cell to perceive the direction of light.

Fascicles: Stria bundled together in sectors on the valve surface.

Fertile: Capable of reproducing.

Fibulae (carinal dots): Support in the form of a silica strut, bridging the raphe-bearing keel on the inner side of the valve in many diatom species with a canal raphe. The fibulae can end in one or more transapical striae, and be either solid, tubular or be flattened.

Filament: Cells united or arranged in one or more rows to form a chain or thread; in blue-green bacteria often used interchangeably with the term "trichome" in forms which do not have a sheath; in those forms with a sheath, it refers to the trichome and its investing sheath.

Film: Thin layer of cells or filaments on surfaces such as rocks or sediments.

Fission: A mode of division in which cells cleave, thereby dividing into 2 equal daughter cells.

Flagellate: Non-phyletic term for protists that possess one or more flagella.

Flagellated: The condition of possessing one or more flagella.

Flagellum (pl. flagella): A long whip-like or feathery structure, used for locomotion through a liquid medium. Borne either singly or in groups by the cells of many bacteria and unicellular eukaryotic cells and by the motile male gametes of many eukarotic organisms. Bacterial and eukaryotic flagella differ in internal structure and mechanism of action.

Fragmentation: Formation of new individuals from segments arising by the break-up of parental ones.

Freshwater: Water lacking a significant salt content.

Frustule: The complete silicified cell-wall of a diatom, consisting of the epi- and hypotheca plus assossiated girdle bands.

Fucoxanthin: Brown-coloured carotenoid pigment produced by members of the golden-pigmented algae (e.g. chrysophytes, dinoflagellates and diatoms); acts as an accessory pigment in photosynthesis.

Fultoportula: Hollow processes on the outside of the valve (Thalassiosiraceae), normally as a marginal ring.; tubuli (tubes) with 2-5 closely associated structures ("satellite pores") that penetrate the valve wall. They can be arranged in a marginal ring and/or otherwise arranged on the valve surface. Their organisation and number (including their presence and absence) are held as important taxonomic characters.

Fusiform: Spindle-shaped, elongate, broad in middle and tapering gradually to acute or broadly rounded apices (3-dimensional term).

Gametangium (pl. gametangia): Structure producing gametes.

Gamete: A cell with a haploid chromosome complement, potentially capable of fusing with or fertilising a compatible cell to form a zygote in the process of sexual reproduction.

Gas vacuole: In blue-green bacteria, a grouping of gas vesicles in the cell which are visible under the light microscope.

Gas vesicle: In blue-green bacteria, the minute hollow, cylindrical, gas-filled structure in the gas vacuole. It confers ability for gas vacuoles to float; only visible with the electron microscope.

Gelatinous: Jelly-like.

Genus (pl. genera): Taxonomic group of closely related species, similar and related genera being grouped into families.

Girdle: A band or belt, usually median; part of the structure just within the wall, and lateral in the cell, which holds the valves of diatoms together.

Girdle-view: A lateral or side view of a diatom, showing the overlapping of the two sections of the frustule.

Gliding: Type of movement shown by various microorganisms which requires contact with a surface, but not involving flagella or cilia; it occurs in many blue-green bacteria, diatoms, desmids and also some green algal filaments.

Globose, globular: Having the shape of a sphere or ball.

Glycoprotein: Protein with attached carbohydrates, often in wall or external gelatinous coatings.

Granular, granulated: As if composed of minute grains.

Gullet: A depression in the anterior region of some euglenoids, chrysophytes, cryptomonads, and other flagellates in the area where the flagellum(-a) emerges.

Habitat: The type of environment in which an organism or group normally lives or occurs.

Haploid: Having one set of chromosomes representing the basic genetic complement of the species, usually desinated n.

Hard water: Water containing large concentrations of alkaline earth elements, such as calcium and usually also magnesium ions, usually derived from drainage of calcareous deposits.

Heavy metal: Metal with a high relative atomic mass, such as lead and mercury.

Hepatotoxin: Poison acting on the liver.

Heterocyst: In blue-green bacteria, a rounded, thick-walled, seemingly empty cell in which nitrogen fixation takes place; found at intervals in filaments.

Heteropolar: Asymmetric polarity.

Heterotroph: An organism utilising organic sources of carbon, nitrogen, etc. using either sunlight or a chemical energy source.

Heterotrophic: Requiring organic compounds of carbon and nitrogen for nourishment.

Heterotrophy: Mode of heterotrophic nutrition.

Heterovalvar: One valve differing from the other valve, usually with respect to the raphe slit, i.e. one valve will possess a true valve and the other no raphe or a pseudoraphe.

Holdfast cell: Cell modified to attach or hold something in place.

Hormogonium (pl. hormogonia): In filamentous blue-green bacteria, a means of vegetative reproduction (and dispersal) formed via fragmentation of the trichome, forming distinct segments that are often motile (gliding).

Humus: Black organic material of complex composition which is the end product of the microbial breakdown of plant or animal residues in the soil.

Hyaline: Description of un-perforated parts of the diatom valve, i.e. those parts lacking puncta (opposite: perforated).

Hypertrophic: Waters grossly enriched with plant nutrients.

Hypotheca: In dinoflagellates, the portion of the cell posterior to the cingulum; in diatoms the smaller and younger half of the frustule, also known as the hypovalve.

Intercalary: Inserted between cells of a filament or trichome, rather than at the ends or laterally.

Interfascicular costa: The areolate and alveolate area between the transapical costae.

Isobilateral: A form of bilateral symmetry where a structure is devisable in two planes at right angles.

Isopolar: With similar poles.

Isthmus: In some desmids narrow equatorial part between two semi-cells.

Kidney-shaped: Bean-shape resembling the shape of kidney.

Labiate process (rimoportulae): A tube or similarly shaped perforation in the cell wall. Its inner opening is formed into an elongated slit, often surrounded by lip-shaped structures (centric and araphid diatoms).

Lake: A body of (usually fresh) water surrounded by land.

Lanceolate: Lance-shaped; long and narrow, with almost parallel margins but tapering towards the apex (2-dimensional term).

Lateral: Towards the side.

Lemon-shaped: Oval, with both ends slightly pointed.

Life cycle: The various phases that an individual passes through from origin to maturity and reproduction.

Linear: Narrow and several times longer than wide, with parallel sides.

Lobate: Having or resembling a lobe or lobes.

Lorica: In euglenophytes, chrysophytes and some green algae, a shell-like structure in which the organism lies. The shape varies, but there is always an opening at one end. Sometimes there is a collar through which a flagellum passes.

Macroalga: Multicellular alga, visible without magnification.

Macrophyte: Term used for all plants visible to the naked eye, not just macroalgae.

Macroscopic: Visible to the unaided eye; discernible without magnification.

Marine: Relating to the sea (ocean).

Marsh: An area of low land that is wet because water cannot drain away from it.

Mats: Thicker and firmer than films; they usually include distinctly sheathed organisms and are formed especially by significant growths of blue-green bacteria or some filamentous green algae.

Mesotrophic: Intermediate nutrient status, between oligotrophic and nutrient-rich, eutrophic water.

Metaboly, metabolic: In euglenoids, motility and flexibility in the pellicle (outer cell covering) without the aid of a flagellum.

Microalga: Small, unicellular alga, visible only under a microscope.

Micron, micrometer (μm): Unit of measurement (= 0.001 mm); microscopy measurements are usually expressed in micrometers.

Microscopic: Discernible only with magnification by a microscope.

Morphology: The form or shape of a cell or organism.

Mother cell: Cell which divides to form daughter cells.

Motile: Capable of movement.

Mucilage: General term for colloidal material consisting of complex polysaccharides and frequently forming a protective coat, enveloping individual algal cells and especially groups of cells; the limitation of desiccation in aerial or sub-aerial environments is one of various important roles.

Mucilaginous: Containing or composed of mucilage.

Mucous: Slimy material consisting of water, the glycoprotein "mucin" and salts.

Multicellular: Many-celled.

Multinucleate: With several or many nuclei.

Naked: Cell not covered by a cell wall, only a cell membrane.

Naviculoid: Boat shaped.

Needle-like: Tapering at both ends.

Neurotoxin: Poison acting on the nervous system.

Niche: The conditions in which a species can live successfully.

Nitrogen fixation: The process whereby atmospheric, elemental nitrogen is reduced to ammonia by some blue-green bacteria and bacteria.

Non-motile: Not capable of movement.

Oligotrophic: Used to describe a waterbody low in nutrients, especially nitrogen and phosphorus.

Ontogenetically: Relating to the origin and development of individual organisms.

Organelle: A specialized part of a cell; analogous to an organ.

Oscillating: To move repeatedly and regularly from one position to the other and back again.

Osmotrophic: Any heterotrophic organism that absorbs organic substances in solution.

Oval, Ovate: Slightly elongate egg-shaped figure, with one pole broader than the other (2-dimensional terms).

Ovoid: Egg-shaped, rounded with one pole broader than the other (3-dimensional term).

Palmelloid stages: Stage in the life history of flagellated algae where cells become non-motile and divide to form a mass of cells embedded in an amorphous mucilage.

Papilla (pl. papillae): A small conical projection or protuberance on the cell wall.

Paramylon: Storage compound in euglenoids and other algae; a polymer of many b-1, 3-linked glucans organised in a membrane-bound crystalline structure; appears as distinct rods or disks under the light microscope.

Parasitic: The process whereby an organism derives its food from a living organism of another species (the host).

Parietal: Adjacent to or lying just inside the cell wall, usually used with reference to the position of the chloroplast.

Peat: Type of soil formed by partly decomposed plant material in anaerobic waterlogged conditions.

Pellicle: In euglenophytes, the flexible proteinaceous outer layer of the cytoplasm consisting of overlapping strips immediately internal to the cytoplasmic membrane. In Cryptophyta, a cell covering of proteinaceous plates internal to the cell membrane.

Periphery, peripheral: A position along the edge or boundary.

Periphyton, periphytic: Algae and other organisms growing attached to any submerged surface.

Phagotroph: Any heterotrophic organism that ingests live or dead food particles.

Photoactic: Attracted to moderate, but not intense light levels.

Photosynthesis: The synthesis of carbohydrate from carbon dioxide as a carbon source and water as a hydrogen donor with the release of oxygen as a waste product, using light energy trapped by the green pigment, chlorophyll inside chloroplasts.

Photosynthetic: Capable of performing photosynthesis.

Phycobilin; phycobiliproteins: Pigment found in blue-green bacteria, rhodophytes, a few cryptomonads and organisms containing cyanelles.

Phycobilisome: One of a number of small particles present on the thylacoids of cyanobacteria.

Phycocyanin: Blue phycobiliprotein pigment of all blue-green bacteria (other than prochlorophytes), cyanelles, some rhodophytes and some cryptophytes.

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