

INVESTIGATIONS OF THE MARINE ALGAE OF NOVA SCOTIA: XIII. CYANOPHYCEAE*

C. BIRD and J. MCLACHLAN

Atlantic Regional Laboratory
National Research Council of Canada
Halifax, N.S. B3H 3Z1

Fifty-six taxa of cyanophycean algae, including species now recognized as ecophenes under recent taxonomic revisions, are reported as new to the marine algal flora of Nova Scotia; 43 of these are also first records for the Maritime Provinces. Each taxon is illustrated, and brief accounts of habitat and seasonality are given.

Although the marine algal flora of Nova Scotia is well documented in various published records of Chlorophyceae, Phaeophyceae, and Rhodophyceae (eg, Bell & MacFarlane 1933; Edelstein *et al* 1967; Edelstein & McLachlan 1967a, b; MacFarlane & Milligan 1966), the Cyanophyceae have thus far received only sporadic mention or have been omitted altogether from both provincial surveys and more general regional reviews (South 1976; Taylor 1957). This neglect has stemmed partly from difficulties in identifying an abundance of closely similar taxa, and partly from uncertain taxonomy following recent drastic revisions (Drouet 1968, 1973; Drouet & Daily 1956). Two reports (Hughes 1949; Smith 1938), however, list cyanophycean algae from freshwater habitats in Nova Scotia, and blue-green algae are well represented in one marine and several freshwater studies from other points in the Maritime Provinces (Habeeb & Drouet 1948; Klugh 1917, 1921, 1927; Smith 1946, 1952; Staker 1976). As this group of algae is a widespread and sometimes conspicuous component of our coastal flora, we now extend our knowledge of Nova Scotian algae by reporting on the marine Cyanophyceae.

MATERIAL, NOMENCLATURE and INCLUDED TAXA

Specimens examined were incidental collections of blue-green algae made during the past 12 yr and stored in the marine algal herbarium of the Atlantic Regional Laboratory. Additionally, many records are based on intensive sampling in salt-marsh habitats since 1972, although herbarium specimens were always not secured from these collections. Whenever possible, collections were inspected in the living state, and samples were often maintained in refrigerated, crude seawater culture for this purpose.

Nomenclature follows the revisions of Drouet and Daily (1956) for coccoid taxa, of Drouet (1968) for the Oscillatoriaceae, and of Drouet (1973) for cylindrical Nostocaceae. As these concepts of cyanophycean taxonomy have not been universally accepted, we retain the traditional

*Issued as NRCC No. 16569

nomenclature within these groups to the extent of recognizing 'classical species' separately as ecophenes or environmental variants; this is for comparison with earlier reports of cyanophytes from the Maritime Provinces and other literature using the older taxonomy. For these ecophenes and for catenate Nostocaceae and the Nostochopsidaceae (Stigonematales), nomenclature is used as determined from various sources, notably Geitler (1932). Wherever possible, author citations are adopted from Parke and Dixon (1968, 1976).

Only those taxa which occurred in sufficient quantity to allow identification with reasonable certainty are included. Tentative determinations of isolated cells or filaments are thus omitted because of probable misrepresentation of such classical diagnostic criteria as growth habit and nature of sheath. Also, a number of small taxa is subject to confusion with certain bacteria, and is excluded pending further opportunity to study them in the living state.

Most taxa listed herein represent new records from marine habitats in Nova Scotia; however, some species or ecophenes have been reported previously from freshwater, as indicated in the text. Several previously recorded and relatively abundant taxa in marine habitats are discussed briefly for purposes of comparison. Four recorded species are excluded because further observations are meagre or lacking; these are: Anabaena cylindrica Lemm. (McLachlan & Edelstein 1970-71); Anacystis marina (Hansg.) Dr. & D. (McLachlan & Edelstein 1970-71, as Aphanocapsa marina Hansg. ex Fosl.); A. montana (Lightf.) Dr. & D. f. montana [Stephenson & Stephenson 1954, as Gloeocapsa alpicola (Lyngb.) Born.]; and Nostoc microscopicum Born. & Flah. (Stephenson & Stephenson 1954). Altogether, 31 species are discussed, comprising 56 ecophenes or 'classical species' reported as new to the marine algal flora of Nova Scotia, and 43 as new to the Maritime Provinces.

CHROOCOCCALES

Chroococcaceae

Agmenellum quadruplicatum (Bréb.) Menegh.

Ecophene: Merismopedia punctata Meyen (Fig 1,2)

In salt marsh pans, or mixed with benthic cyanophytes in swards of Spartina patens (Ait.) Muhl.; Pomquet Harbour, Antigonish Co.; Barrachois Harbour, Colchester Co.; Kingsport, Kings Co.; uncommon, July, August.

Previous records in Nova Scotia: Hughes (1949), as Merismopedia glauca (Ehr.) Näg., M. punctata; Smith (1938), as M. glauca; all in freshwater.

Merismopedia punctata is ordinarily a freshwater ecophene, although Geitler (1932) cites a marine record. Typical salinity of one salt marsh pan in which this entity occurred is 25‰.

*Agmenellum thermale (Kütz.) Dr. & Daily

Ecophenes: Merismopedia convoluta Bréb. in Kütz. (Fig 66)
M. glauca (sensu Frémy 1929-33; Geitler 1932) (Fig 3)

Salt marshes; in detritus of pans or mixed with filamentous Chlorophyceae and other blue-green algae in floating mats or benthic turfs;

*New record for Maritime Provinces.

Pomquet Harbour, Antigonish Co.; Barrachois Harbour, Colchester Co.; rare to common, June-August.

Merismopedia convoluta is a freshwater ecophene according to Desikachary (1959) and Geitler (1932), but is recorded from salt marshes by Frémy (1929-33). The present specimens were found in a low-level pan with salinity about 25‰.

Merismopedia glauca is included in Agmenellum quadruplicatum (Drouet & Daily 1956). However, the range of cell diameter given for M. glauca by several authors (Frémy 1929-33; Geitler 1932; Prescott 1951) is comparable with that of A. thermale which characteristically has larger cells than A. quadruplicatum. The ecophene designated herein as M. glauca is a small colony with relatively distant cells 5-5.5 µm wide, corresponding well with various descriptions in the literature. It is thus possible that prior records of M. glauca in Nova Scotia (Hughes 1949; Smith 1938) may have been similar, large-celled forms also assignable to A. thermale.

Anacystis dimidiata (Kütz.) Dr. & D.

Ecophene: Chroococcus turgidus (Kütz.) Näg. (Fig 4, 5)

Salt marshes: in pans or algal turf in swards of Spartina Schreb. and Juncus L.; Pomquet Harbour, Antigonish Co.; Barrachois Harbour, Colchester Co.; Kingsport, Kings Co.; rare to occasional, June-September.

Previous record in Nova Scotia: Smith (1938), as C. turgidus, in freshwater.

Coccochloris stagnina Spreng.

Ecophenes: Aphanothece stagnina Braun in Rabenh. (Fig 6)

*Chroococcus minutus (Kütz.) Näg. (Fig 7, 8)

*Microcystis litoralis (Hansg. in Fosl.) Forti in de Toni (Fig 9)

M. pallida (Kütz.) Lemm. (Fig 10)

On Zostera L., Fucus L., Polysiphonia Grev., Rhizoclonium Kütz., and with other cyanophytes in salt-marsh habitats, at times floating in pans: Crystal Cliffs, Point Town, and Pomquet Harbour, Antigonish Co.; Kingsport, Kings Co.; widespread, occasionally locally dominant, June-October, December.

Previous record in Nova Scotia: Hughes (1949), as A. stagnina, in freshwater.

The most common ecophenes of this species were A. stagnina and M. pallida, with observed maximum development as crowded flocculent colonies in and at the surface of marsh pans.

Gomphosphaeria aponina Kütz.

Ecophene: G. aponina (sensu stricto) (Fig 11)

Among detritus in salt-marsh pans and wet depressions, or associated with filamentous green algae beneath Spartina alterniflora; Pomquet Harbour, Antigonish Co.; Barrachois Harbour, Colchester Co.; Waugh Island, Cumberland Co.; colonies were usually numerous when present, June-August, October, December.

*Johannesbaptistia pellucida (Dickie) W. R. Taylor & Dr.

Ecophene: Cyanothrix willei Gardn. (Fig 12)

Among detritus in a salt-marsh pan; Pomquet Harbour, Antigonish Co.; rare, July.

The width of protoplasts in the Nova Scotian specimens, at 3.5-4.5 μm , is smaller than the dimensions given by Geitler (1932) for C. willei (6-6.5 μm). In this respect, the Nova Scotian specimens are closer to Cyanothrix cavanillesii Gonz.-Guerr., with cells 4-4.5 μm broad (Desikachary 1959), but this entity characteristically is much shorter than the Pomquet 'filaments', which frequently exceed 500 μm in length. While this length is also greater than that reported for both C. willei and C. primaria Gardn. (Geitler 1932), both width and length of the Pomquet plants are well within the limits described for J. pellucida (Desikachary 1959; Drouet & Daily 1956).

*Microcrocis geminata (Lagerh.) Geitl.

Ecophene: Holopedia sabulicola (Lagerh.) Kirchn. (Fig 13,14)

On mud flats below the zone of Spartina alterniflora Loisel.; Kingsport, Kings Co.; rare, September.

CHAMAESIPHONALES

Chamaesiphonaceae

Entophysalis conferta (Kütz.) Dr. & Daily

Ecophenes: *Dermocarpa olivacea (Reinsch) Tilden (Fig 15)

*D. rosea Batt. (Fig 16)

*Xenococcus cladophorae (Tilden) S. & G. (Fig 17)

Supralittoral to sublittoral zones, on various algae and Ruppia L., in sheltered bays, marsh pans and tidepools, and on exposed coasts; Pomquet Harbour, Antigonish Co.; Barrachois Harbour, Colchester Co.; Gulliver Cove, Digby Co.; Herring Cove, Ketch Harbour, Sandy Cove, and Shag Bay, Halifax Co.; November-March, June, July, September.

Previous records in Nova Scotia: Collins (1904), as D. prasina (Reinsch) Born. & Flah.; Drouet and Daily (1956), ecophenes not specified; from marine habitats.

Entophysalis deusta (Menegh.) Dr. & Daily

Ecophenes: *Dermocarpa violacea Crouan (Fig 18)

*Gloeocapsa crepidinum Thur. ex Born. & Thur. (Fig 19)

*Pleurocapsa minuta Geitl. (Fig 20)

On mussel shells, submerged wood, and beneath Ralfsia verrucosa (Aresch.) J. Ag. on stones; Pomquet Harbour, Antigonish Co.; Black Rock, Halifax Co.; February, April, August, October.

Previous records in Nova Scotia: Drouet and Daily (1956), ecophenes not specified but habitat marine; Stephenson and Stephenson (1954), as E. deusta sensu stricto.

NOSTOCALES

Oscillatoriaceae

*Arthrospira brevis (Kütz.) Dr.

Ecophene: Oscillatoria brevis (Kütz.) Gom. (Fig 21)

In exposed turf of Spartina alterniflora at lower edge of salt marsh; Grand Pre and Kingsport, Kings Co.; rare, July, August.

Only scattered trichomes were found, in samples of the turf.

Microcoleus lyngbyaceus (Kütz.) Crouan frat. ex Gom.

Ecophenes: Lyngbya aestuarii [(Mert. in Jürg.) Liebm.] Gom. (Fig 22)

*L. confervoides (C. Ag.) Gom. (Fig 23)

*L. semiplena [(C. Ag.) J. Ag.] Gom. (Fig 24)

*Oscillatoria articulata Gardn. (Fig 25)

*O. corallinae [(Kütz.) Gom.] Gom. (Fig 26)

*O. margaritifera (Kütz.) Gom. (Fig 27)

Supralittoral to sublittoral, on mud, wood, and various algae in salt marshes and sheltered bays, or floating in marsh pans with other algae; Crystal Cliffs and Pomquet Harbour, Antigonish Co.; Barrachois Harbour, Colchester Co.; Waugh Island, Cumberland Co.; Durell Island, Guysborough Co.; Herring Cove and Sandy Cove, Halifax Co.; Grand Pré and Kingsport, Kings Co.; Boat Harbour, Pictou Co.; Bone Island, Victoria Co.; common and widespread, January, March, June-October, December.

Previous records in Nova Scotia: Drouet (1968), ecophenes unspecified.

This species was found wherever salt marsh habitats occur, and varied in abundance from isolated trichomes in algal mixtures to cohesive, nearly pure benthic turf. The prevalent ecophene was L. confervoides, although L. aestuarii and L. semiplena were occasionally locally common. O. margaritifera became abundant in pans at Barrachois Harbour in July 1974 and sublittorally in Pomquet Harbour during August 1974, when it formed slippery brownish-black masses around Chorda filum (L.) Stackh. and Zostera. The smaller ecophenes O. articulata and O. corallinae were collected as adherents to larger algae in sheltered situations.

The inclusion of O. corallinae in M. lyngbyaceus (Drouet 1968) indicates that the type material possesses granulated septa, although many descriptions of this taxon (Desikachary 1959; Frémy 1929-33; Geitler 1932; Setchell & Gardner 1919) state the contrary. Trichomes with granulated septa are usually identified in the literature as O. nigroviridis, which differs from O. corallinae essentially in only this respect. However, Drouet (1968) assigns O. nigroviridis to Porphyrosiphon, a genus which lacks granules on the septa, and this is corroborated by the original description of the former taxon (Harvey 1851, Pl. 251-A). Moreover, Carter (1933) illustrates granulated septa for both taxa, and Umezaki (1961) reports that granules sometimes disappear from the septa of O. nigroviridis. It thus appears that O. corallinae and O. nigroviridis have been confused in the literature. Possibly the slightly thickened outer wall of the terminal cell, usually reported for O. nigroviridis but fundamentally lacking in Porphyrosiphon (Drouet 1968), is also an error. Thus, contrary to most treatments, we reserve O. corallinae for trichomes with granulated septa and thickened terminal membranes, and O. nigroviridis for those without these characteristics but otherwise identical. As we have found the two taxa together, it is possible that our specimens of O. nigroviridis (see below) are in fact immature O. corallinae.

*Oscillatoria lutea C. Ag. ex Gom.Ecophene: Lyngbya lutea [(C. Ag.) Gom.] Gom. (Fig 28)

In algal turf of Spartina patens zone, or mixed with Calothrix crustacea in loose crusts on moderately sheltered, high littoral stones; Pomquet Harbour, Antigonish Co.; Barrachois Harbour, Colchester Co.; rare, June, August, September.

Oscillatoria princeps VaucherEcophene: *Plectonema wollei Farl. ex Gom. (Fig 29)

On outer edge of Spartina alterniflora turf; Pomquet Harbour, Antigonish Co.; uncommon, August.

Although apparently not widespread, P. wollei was common and well-developed in Pomquet Harbour, as small greenish-black webby masses. The specimens are narrower than P. wollei as described by several authors (Desikachary 1959; Geitler 1932; Prescott 1951), and differ also in their marine habitat. However, they agree well in both size and habitat with the description given by Schwabe (1960).

Oscillatoria submembranacea Ardiss. & Straff. ex Gom.Ecophene: *Symploca funicularis S. & G. (Fig 30,67)

In salt marshes, mixed with other small algae at upper levels in turf of Spartina patens and Juncus gerardi Loisel., or matted along drainage ditches; Grand Pré and Kingsport, Kings Co.; occasional to common, July, August, October, December (probably year-round).

Previous record in Nova Scotia: Drouet (1968), ecophene unspecified, in freshwater.

Two growth habits were observed: at higher levels, O. submembranacea occurred primarily as scattered filaments among other algae; at lower levels, and particularly at the outfall of a drainage channel at Kingsport, these filaments were aggregated in dense, cohesive mats and tufts characteristic of Symploca. High-level filaments differed from those at lower levels only in having slightly narrower trichomes and thinner, subgelatinous sheaths suggestive of Phormidium. However, clones from both levels were morphologically identical in culture (Bird, unpubl), and we surmise that only the S. funicularis ecophene was present, despite absence of the characteristic tufted growth habit in upper levels of the marsh.

Trichomes of the Nova Scotian specimens of S. funicularis are considerably broader (7-10 μm) than those described by Setchell and Gardner (1919; 4.5-5 μm), and lack a diffluent sheath, but are comparable with Webber's (1967) concept of the taxon. As culture studies indicated trichomal width and consistency of sheath to be variable features, it appears that S. funicularis in nature was growing under conditions conducive to robust development, and that Webber's and the present concept of the ecophene is justified.

*Porphyrosiphon kurzii (Zeller) Dr.Ecophene: Microcoleus acutirostris Gom. (Fig 31)

Scattered on mudbanks below salt marshes, or entangled with small low-littoral algae in sheltered situations; Pomquet Harbour, Antigonish Co.; Grand Pré, Kings Co.; uncommon, July, August, October, December.

Trichomes of the Nova Scotian specimens generally are narrow for M. acutirostris, being mostly 7-8 μm broad; however, they also lack the abrupt taper and regular, short cells of the comparably small ecophene M. weeksii S. & G. (Setchell & Gardner 1919). More typical trichomes 9.5-11 μm broad were found at Grand Pré in October.

Porphyrosiphon kurzii is an intertidal species of warm-temperate and tropical seas (Drouet 1968). Its occurrence in Nova Scotia is possibly linked with warm summer temperatures in Pomquet Harbour and Minas Basin relative to outlying coastal waters (Bird et al 1976; Bousfield & Thomas 1975).

Porphyrosiphon notarisii (Menegh.) Kütz. ex Gom.

Ecophenes: *Oscillatoria chalybea Mert. (Fig 33)

O. nigroviridis (Thw. in Harv.) Gom. (Fig 32)

In salt marshes, as scattered short filaments or thin mats in algal turf of Juncus and Spartina swards, or on unconsolidated mud beneath S. alterniflora; Pomquet Harbour, Antigonish Co.; Grand Pré and Kingsport, Kings Co.; uncommon, July, August.

Schizothrix arenaria (Berk.) Gom.

Ecophene: *Microcoleus chthonoplastes [(Mert. in Hornem.) Thur.] Gom. (Fig 34)

High to low littoral levels in salt marshes, mixed with other small algae in turf under Juncus and Spartina, rarely among detritus in pans and wet depressions; Pomquet Harbour, Antigonish Co.; Barrachois Harbour, Colchester Co.; Grand Pré and Kingsport, Kings Co.; occasional to locally common, May-October, December (rare).

Previous record in Nova Scotia: Drouet (1968), ecophene unspecified.

In Nova Scotia, the ecophene M. chthonoplastes is a characteristic constituent of algal turf in salt marshes, but does not attain the abundance or dominance described by Carter (1933) in Britain. Rather, it has been observed as locally common, at best, in the upper reaches of Spartina alterniflora zones at Grand Pré and Kingsport during July and August, and in open patches in S. patens swards at Pomquet Harbour in May.

Schizothrix calcicola (C. Ag.) Gom. ex Gom.

Ecophenes: *Lyngbya epiphytica Hieron. ex Kirchn. (Fig 35)

*L. holdenii Forti (Fig 36)

*L. infixa Frey (Fig 37)

*L. nordgaardii Wille (Fig 38)

*Oscillatoria amphigranulata van Goor (Fig 39)

*Phormidium angustissimum W. & G. S. West (Fig 40)

*Ph. frigidum Fritsch (Fig 41)

Ph. mucicola Naum. & Hub.-Pestalozzi (Fig 42)

*Plectonema battersii Gom. (Fig 43)

*Pl. terebrans (Born. & Flah.) Gom. (Fig 44)

On mud, wood, Zostera and various algae, on and in mollusc shells and barnacle tests, usually mixed with other algae in turf or crusts, seldom in pure masses, in all intertidal levels of salt marshes and sheltered bays to extreme high water, often in the supralittoral zone of

exposed coasts, occasionally sublittoral; Pomquet Harbour, Antigonish Co.; Barrachois Harbour, Colchester Co.; Sandy Cove and Westport, Digby Co.; Black Rock, Herring Cove, Lawrencetown, Peggy's Cove and Sandy Cove, Halifax Co.; Grand Pré and Kingsport, Kings Co.; common, year-round.

Previous records in Nova Scotia: Drouet (1968), ecophenes not specified; Stephenson and Stephenson (1954), as Plectonema calothrioides Gom. and Pl. nostocorum Born. ex Gom.

This ubiquitous species exists in so many very similar ecophenes that it is frequently difficult, if not impossible, to distinguish them. Also, filiform bacteria may strongly resemble S. calcicola. The ecophenes listed above represent the species as it appeared in nature, regardless of variability, in culture, of some traditional diagnostic features, particularly the nature of the sheath.

Three of the present ecophenes, L. epiphytica, Ph. angustissimum and Ph. frigidum, are usually freshwater algae (Geitler 1932).

*Schizothrix tenerrima (Gom.) Dr.

Ecophene: Microcoleus tenerrimus Gom. (Fig 45)

Mixed with Vaucheria sp. beneath Spartina patens in salt marsh, or matted with other cyanophytes on barnacle tests; Barrachois Harbour, Colchester Co.; rare, June, July.

Spirulina subsalsa Oerst. ex Gom.

Ecophene: S. subsalsa sensu stricto (Fig 46)

Although previously recorded from Nova Scotia (McLachlan & Edelstein 1970-71), S. subsalsa is so frequently encountered that it is worthwhile to comment on its general occurrence. Its presence in the littoral zone is apparently restricted to late spring and summer (May-September), when it is a usual minor constituent of algal turf in salt marshes, and sometimes forms small, nearly pure patches and films on unconsolidated mud in these habitats. In the upper sublittoral zone of quiet bays and barachois, it often forms numerous small clots and films on benthos during July and August. Winter occurrences have been noted at greater depths in these situations. Additionally, S. subsalsa has been observed as abundant in deep water of Bras d'Or Lake, with a striking rose color instead of its customary blue-green hue (R. Hooper, personal communication).

Nostocaceae

Anabaena inaequalis (Kütz.) Born. & Flah. (Fig 47)

Mixed with other algae in turf beneath Spartina patens; Pomquet Harbour, Antigonish Co.; rare, June.

As akinetes are essential to the identification of species of Anabaena, their presence is implied in this and the following three records.

Anabaena sphaerica Born. & Flah. (Fig 48)

In colonies of Coccochloris stagnina in salt marsh pan; Pomquet Harbour, Antigonish Co.; rare, July.

*Anabaena subcylindrica Borge (Fig 49)

Mixed with other filamentous cyanophytes on unconsolidated mud beneath Spartina alterniflora; Grand Pré, Kings Co.; rare, July.

*Anabaena torulosa [(Carm. in Harv.) Lagerh.] Born. & Flah. (Fig 50)

In salt marshes and protected bays: on unconsolidated mud, in algal turf beneath Spartina alterniflora and S. patens, in pans, occasionally forming nearly pure masses on shallow benthos; Crystal Cliffs and Pomquet Harbour, Antigonish Co.; Barrachois Harbour, Colchester Co.; Grand Pré and Kingsport, Kings Co.; Red Islands, Richmond Co.; common and occasionally abundant, July-October.

This is the most common species of Anabaena in Nova Scotia, with July and August the period of maximum abundance. In a notable occurrence in Pomquet Harbour, July 1974, small clots of A. torulosa were abundant in sheltered shallows and frequently cast up on Spartina turf, often as masses of akinetes. The species has not been observed thus far in winter collections.

Calothrix crustacea Thur. ex Born. & Flah. †

Ecophenes: *Calothrix aeruginea [(Kutz.) Thur.] Born & Flah. (Fig 51)

*Microchaete aeruginea Batt. (Fig 52,53)

*M. grisea (Thur.) Born & Flah. (Fig 54)

*Rivularia nitida (C. Ag.) Born. & Flah. (Fig 55, 56,57)

In salt marshes and quiet bays; on other algae, Ruppia L., old Zostera leaves, Spartina debris and wood, at times on stones or ground and then usually abundant; Pomquet Harbour, Antigonish Co.; Barrachois Harbour, Colchester Co.; occasional to common, year-round.

Previous records in Nova Scotia: Bird (1973), as C. scopulorum [(Web. & Mohr) C. Ag.] Born. & Flah.; Drouet (1973), ecophenes not specified; Edelstein and McLachlan (1966), as C. scopulorum; McLachlan and Edelstein (1970-71), as C. confervicola [(Roth) C. Ag.] Born. & Flah. and Rivularia atra (Roth) Born. & Flah.; Stephenson and Stephenson (1954), as C. scopulorum, C. vivipara (Harv.) Born. & Flah. and R. atra. Fan (1956) included several Nova Scotian collections in his revised concepts of C. confervicola and C. crustacea (Thur.) Born. & Flah.

As the number of prior records indicates, C. crustacea is one of the most conspicuous and abundant cyanophytes in Nova Scotia. The widespread ecophenes C. crustacea sensu stricto†† and C. scopulorum are major constituents of a characteristic supralittoral black zone on rocky, exposed coasts (cf Stephenson & Stephenson 1954), and C. crustacea is also occasionally epiphytic on benthic angiosperms and algae in sheltered bays and salt marshes. Rivularia atra is frequent on protected rocky shores, in the upper intertidal zone above fucoids or in permanent pools. Rivularia nitida occasionally occurs as closely aggregated, small bullate thalli in open patches of Juncus and Spartina along marshy shores. Calothrix confervicola is a common epiphyte in sheltered waters, particularly during summer, while C. aeruginea and Microchaete are less common epiphytes observed from May to October.

†=C. crustacea Schousb. & Thur. (Drouet 1973).

††Not C. crustacea Wolle, =Scytonema hofmannii (Drouet 1973).

Calothrix parietina (Näg.) Thur. ex Born. & Flah.

Ecophene: *Rivularia biasolettiana [Menegh.] Born. & Flah. (Fig 58,59)

On Zostera debris in salt marsh pans; entangled with Rhizoclonium in sheltered water; Pomquet Harbour, Antigonish Co.; Waugh Island, Cumberland Co.; uncommon, July, October.

Previous records from Nova Scotia: Geitler (1932), as R. bornetiana Setch., from a salt marsh. As the exsiccata and reference cited by Geitler refer to specimens from Rhode Island, this record appears to be in error. Fan (1956) included collections by the Stephensons from St. Margaret's Bay, N.S. in his reappraisal of C. parietina; however, in view of the marine habitat studied by these authors (Stephenson & Stephenson, 1954), it seems likely that these collections are assignable to C. crustacea, although they are not the same Nova Scotian specimens as cited under C. crustacea by Drouet (1973).

Calothrix parietina is primarily a fresh-water species, seldom found in brackish environments (Drouet 1973). Rivularia biasolettiana, a mainly freshwater ecophene, has been reported to penetrate saline habitats (Frémy 1929-33; Parke & Dixon 1968, 1976; Setchell & Gardner 1919).

Nodularia harveyana (Thw. in Harv.) Thur. ex Born. & Flah. (Fig 60)

Salt marshes, in algal turf under Spartina and Juncus, occasionally in pans; Pomquet Harbour, Antigonish Co.; Barrachois Harbour, Colchester Co.; Kingsport, Kings Co.; uncommon, June-August.

Akinetes were not observed in any of the Nova Scotian specimens.

*Nodularia spumigena Mert. in Jürg. ex Born. & Flah. (Fig 61)

Mixed with Anabaena torulosa near shore in a protected basin; Pomquet Harbour, Antigonish Co.; rare, July, with akinetes.

*Nostoc punctiforme (Kütz.) Hariot (Fig 62,63)

In all levels of salt marshes, mostly on decaying grasses and forbs, or wood; often in pans or in algal mats floating in quiet backwaters; Pomquet Harbour, Antigonish Co.; Barrachois, Colchester Co.; Kingsport, Kings Co.; occasional, July-October, December; hormogonia observed in October.

Scytonema hofmannii C. Ag. ex Born. & Flah.

Ecophene: Tolypothrix tenuis (Kütz.) Born. & Flah. (Fig 64)

Among Calothrix crustacea (Rivularia nitida) on upper levels of marshy shores, and sublittoral to 3 m depth in sheltered bays; Pomquet Harbour, Antigonish Co.; rare, October, December.

Previous record in Nova Scotia: Drouet (1973), unspecified ecophene from a freshwater habitat.

STIGONEMATALES

Nostochopsidaceae

*Mastigocoleus testarum Lagerh. ex Born. & Flah. (Fig 65)

In empty shells of molluscs and barnacles, littoral to upper sublittoral zones in sheltered bays; Pomquet Harbour, Antigonish Co.; Barrachois Harbour, Colchester Co.; uncommon, July-October, probably year-round.

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FIGURE LEGENDS

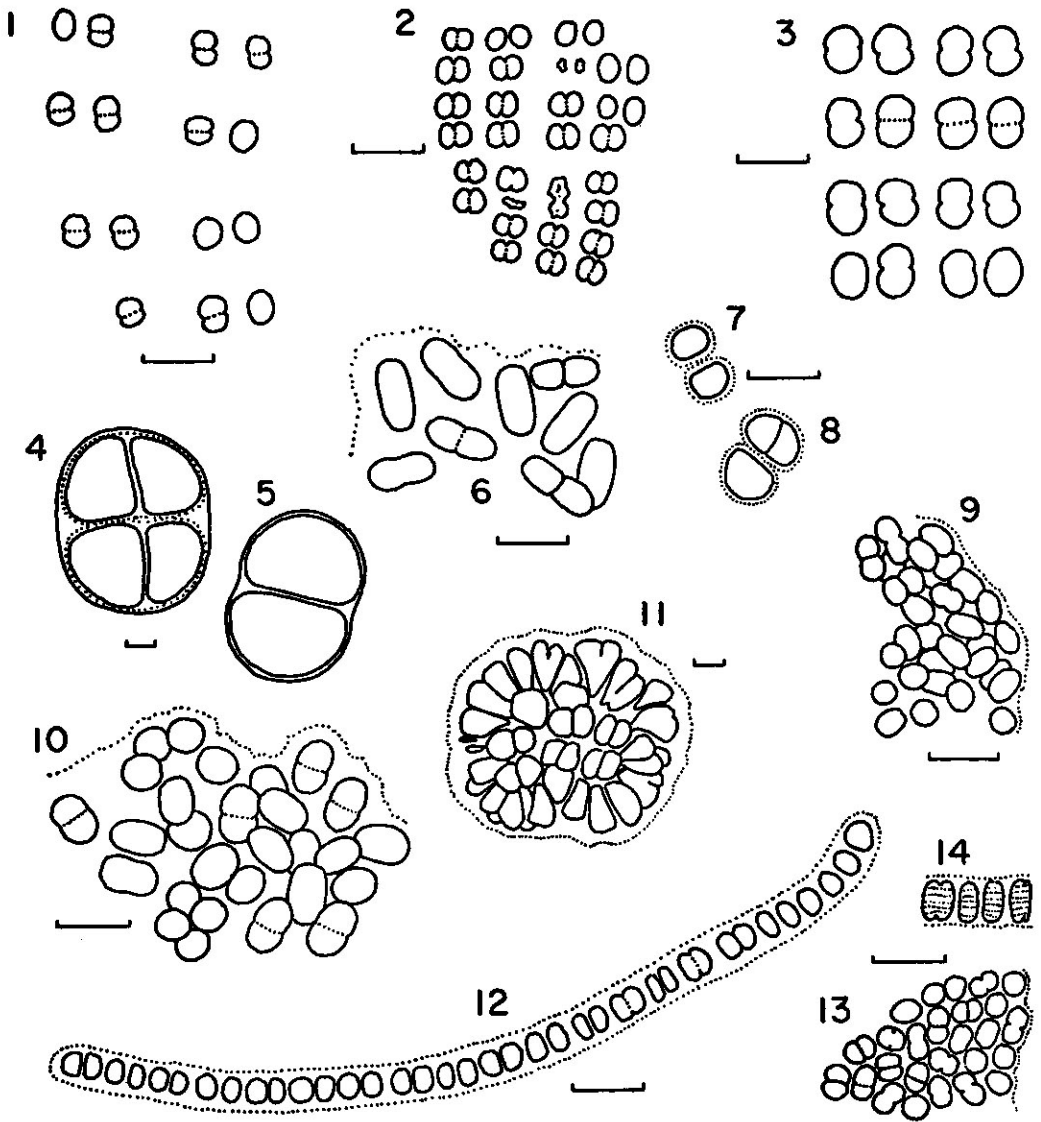
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- Figs 1, 2. Agmenellum quadruplicatum (Merismopedia punctata), colonies differing in proximity of cells. Fig 3. Agmenellum thermale: Fig. 3, (Merismopedia glauca), portion of a colony. Figs 4, 5. Anacystis dimidiata (Chroococcus turgidus). Figs 6-10. Coccochloris stagnina: Fig 6, (Aphanothece stagnina); Fig. 7, 8, (Chroococcus minutus); Fig 9, (Microcystis litoralis); Fig 10, (M. pallida); only portions of colonies are illustrated in Fig. 6 and 10. Fig 11. Gomphosphaeria aponina (sensu stricto). Fig 12. Johannesbaptistia pellucida (Cyanothrix willei). Figs 13, 14. Microcrocis geminata (Holopedia sabulicola): Fig 13, surface aspect of part of a colony; Fig 14, sectional view, showing transverse striae.
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- Fig 21. Arthrospira brevis (Oscillatoria brevis). Figs 22-23. Microcoleus lyngbyaceus: Fig 22, (Lyngbya aestuarii), showing discoid hormogonia and laminate sheath in the older portion of the filament; Fig 23, (L. confervoides); Fig 24, (L. semiplena); Fig 25, (Oscillatoria articulata); Fig 26, (O. corallinae); Fig 27, (O. margaritifera). Fig 28. Oscillatoria lutea (Lyngbya lutea). Fig 29. Oscillatoria princeps (Plectonema wollei). Fig 30. Oscillatoria submembranacea (Symploca funicularis) C-calyptra. Fig 31. Porphyrosiphon kurzii (Microcoleus acutirostris). Figs 32, 33. Porphyrosiphon notarisii: Fig 32, (Oscillatoria nigroviridis); Fig 33, (O. chalybea), with peripheral refractive inclusions.
- Fig 34. Schizothrix arenaria (Microcoleus chthonoplastes) apex of filament with relatively few trichomes. Figs 35-44. Schizothrix calcicola: Fig 35, (Lyngbya epiphytica) on Microcoleus; Fig 36, (L. holdenii); Fig 37, (L. infixa) on Bangia; Fig 38, (L. nordgaardii) on Calothrix; Fig 39, (Oscillatoria amphigranulata); Fig 40, (Phormidium angustissimum); Fig 41, (Ph. frigidum); Fig 42, (Ph. mucicola), from empty sheaths of Microcoleus; Fig 43, (Plectonema battersii); Fig 44, (Pl. terebrans).

Fig 45. Schizothrix tenerrima (Microcoleus tenerrimus), apex of filament.
 Fig 46. Spirulina subsalsa (sensu stricto). Fig 47. Anabaena inaequalis.
 Fig 48. Anabaena sphaerica. Fig 49. Anabaena subcylindrica.
 Fig 50. Anabaena torulosa.

Figs 51-57. Calothrix crustacea: Fig 51, (C. aeruginea); Fig. 52, 53, (Microchaete aeruginea); Fig 52, habit on Zostera; Fig 53, detail of several filaments; Fig 54, (M. grisea); Figs 55-57, (Rivularia nitida); Fig 55, young filament from surface of thallus; Fig 56, older filament with subapical meristematic zone (M) and young filament (F) forming; Fig 57, detail of base of older filament. Figs 58, 59. Calothrix parietina: (Rivularia biasolettiana): Fig 58, fascicle of filaments from a squashed thallus; Fig 59, detail of bases of filaments.

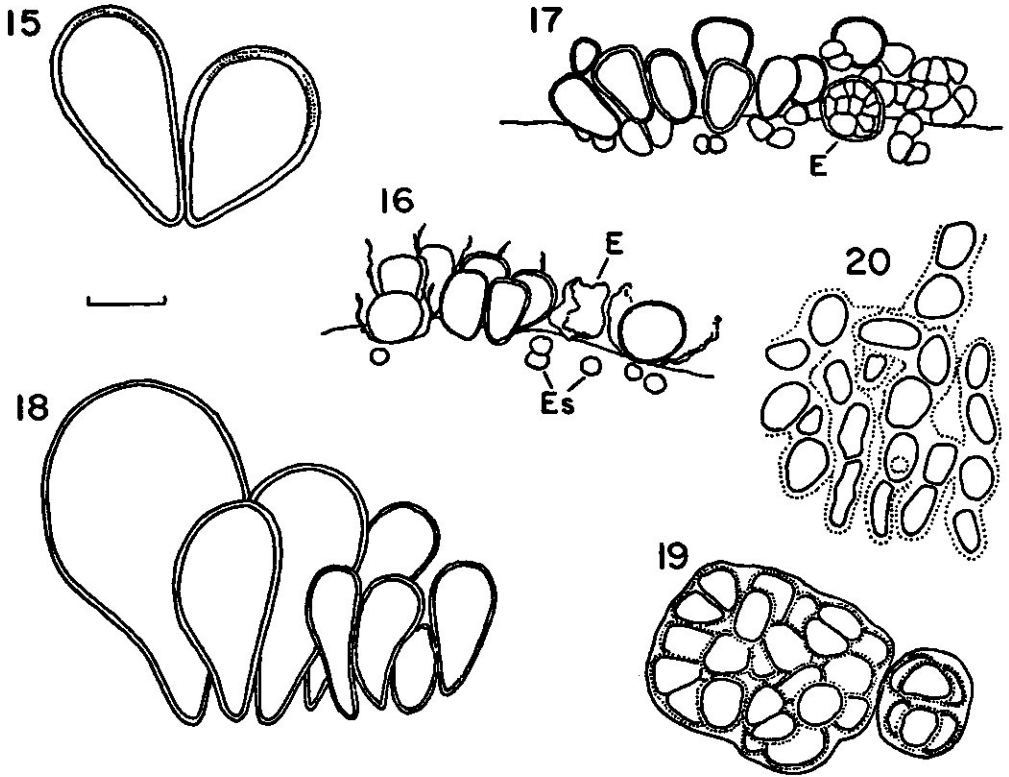
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Fig 66. Agmenellum thermale (Merismopedia convoluta). Fig 67. Oscillatoria submembranacea (Symploca funicularis), showing characteristic tufted habit. Fig 68. Schizothrix arenaria (Microcoleus chthonoplastes). Fig 69. Nostoc punctiforme.



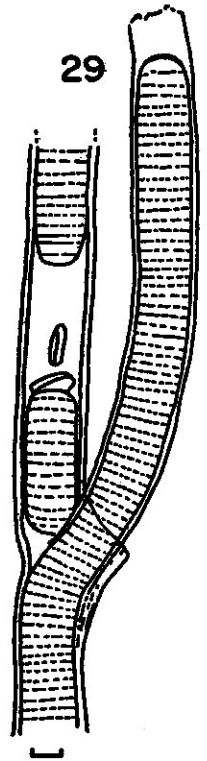
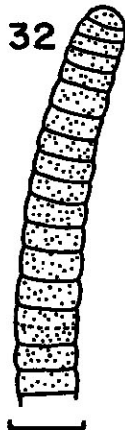
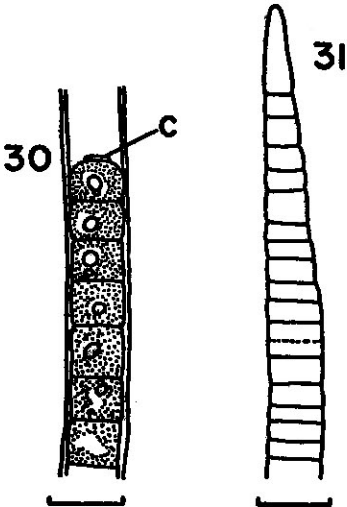
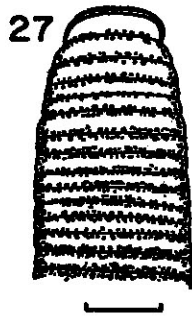
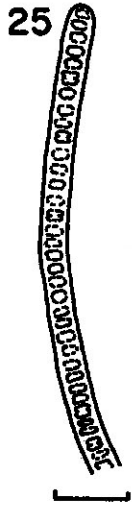
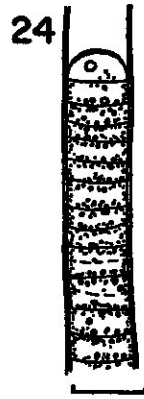
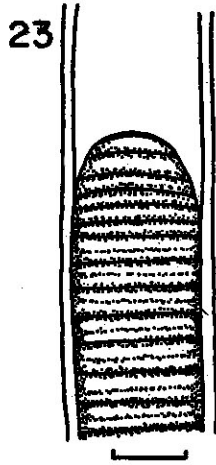
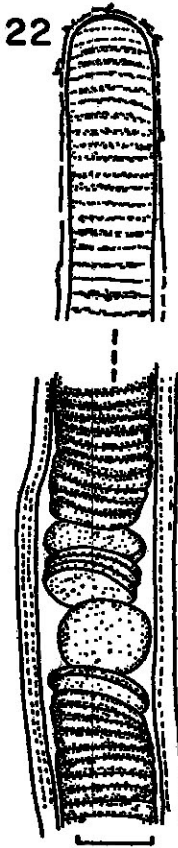
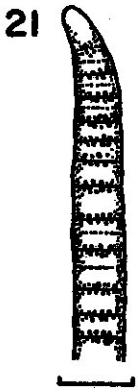
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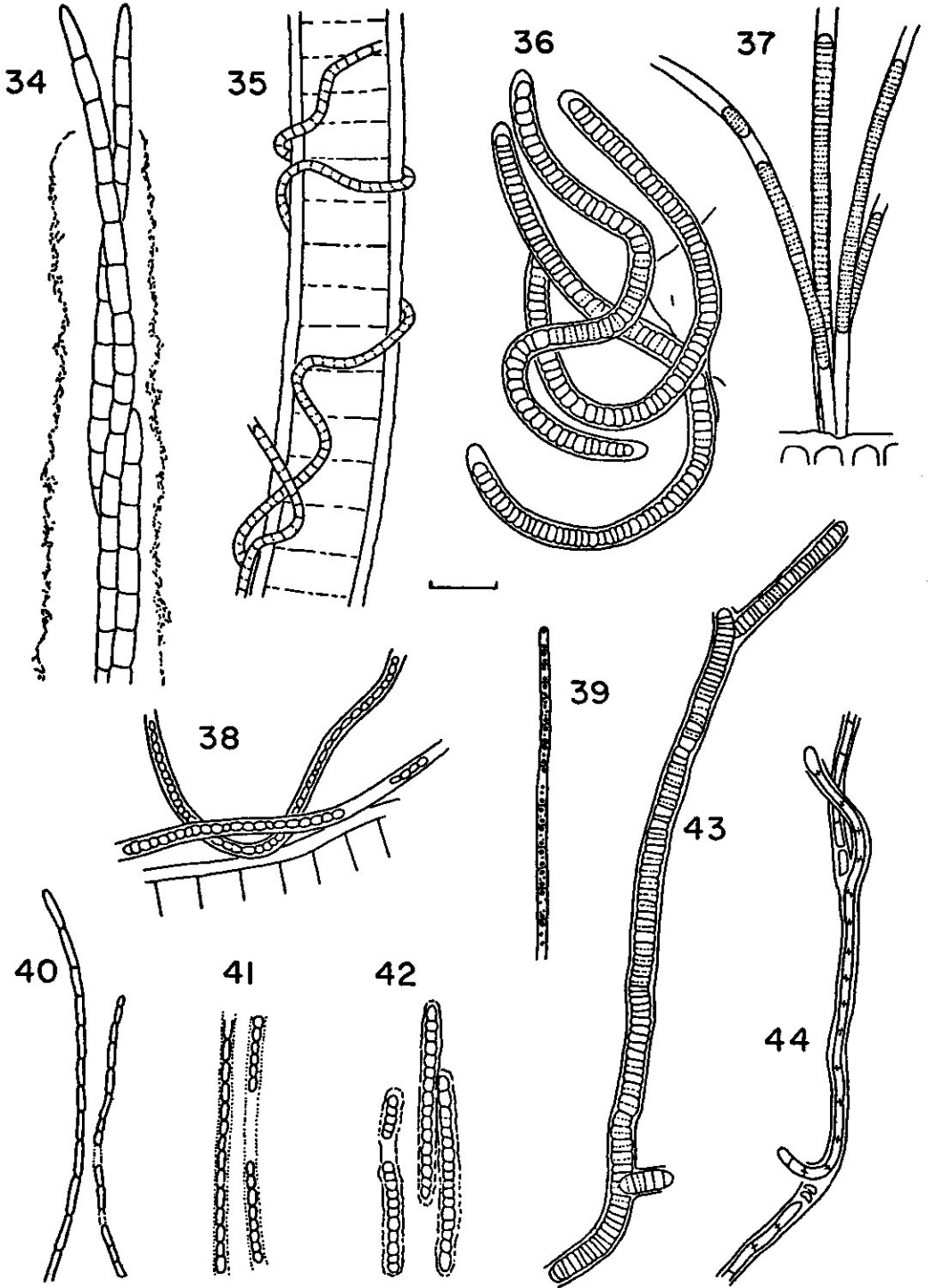
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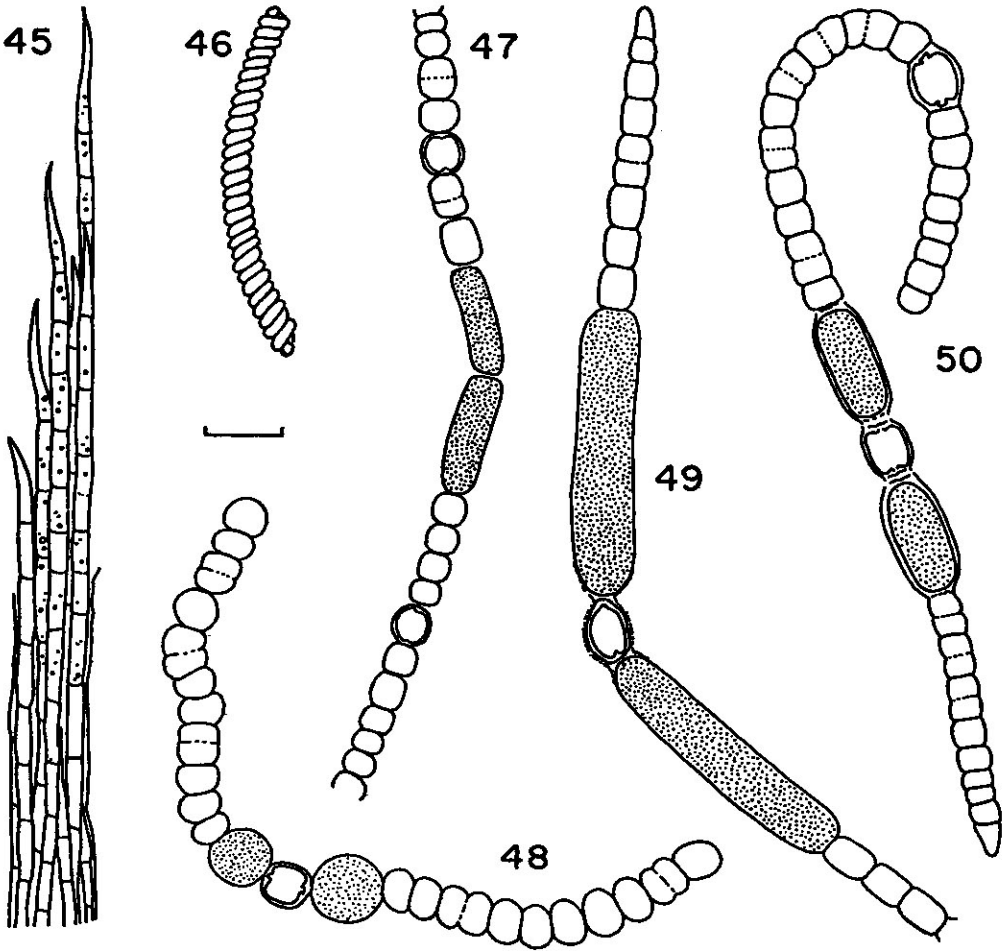
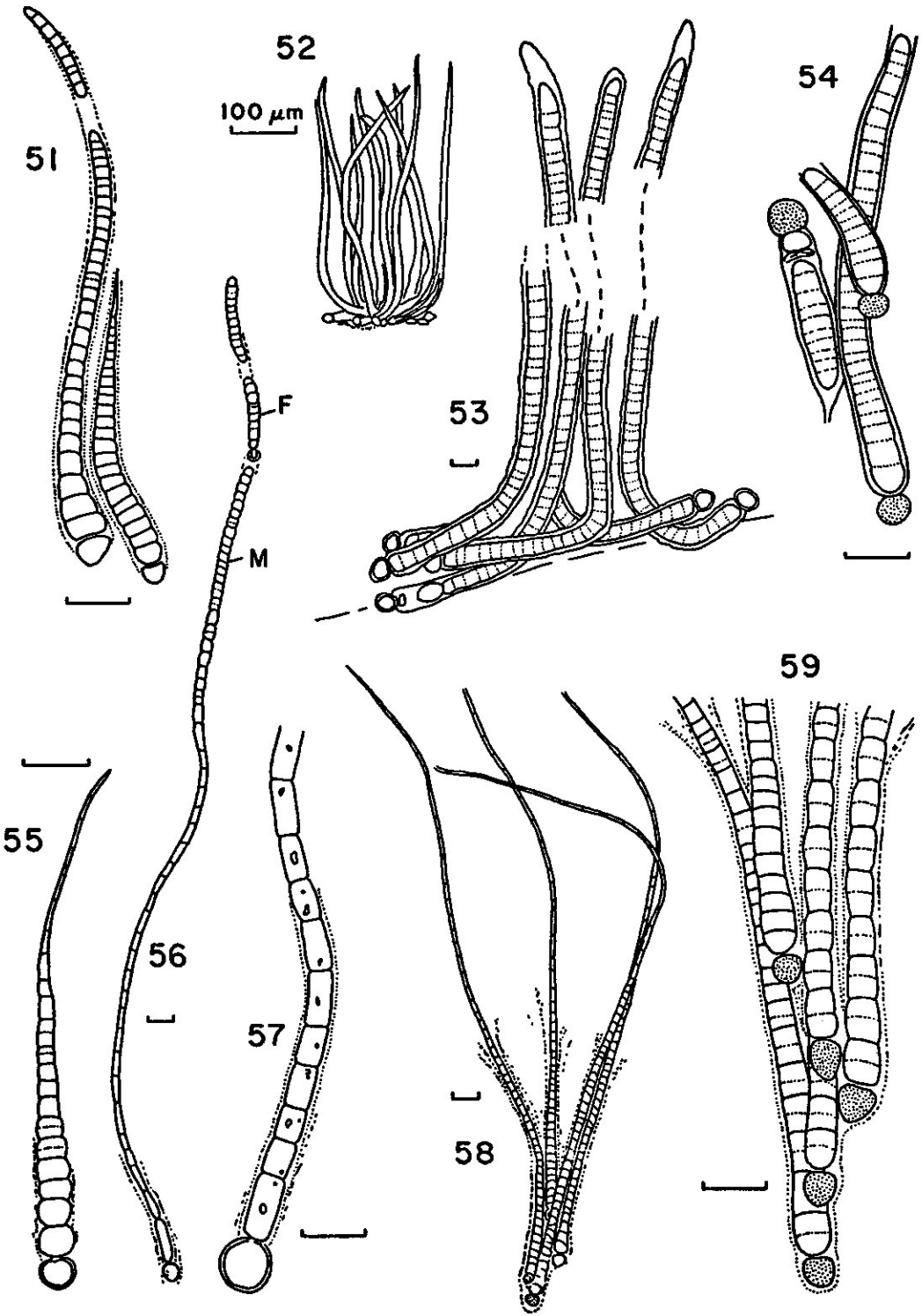


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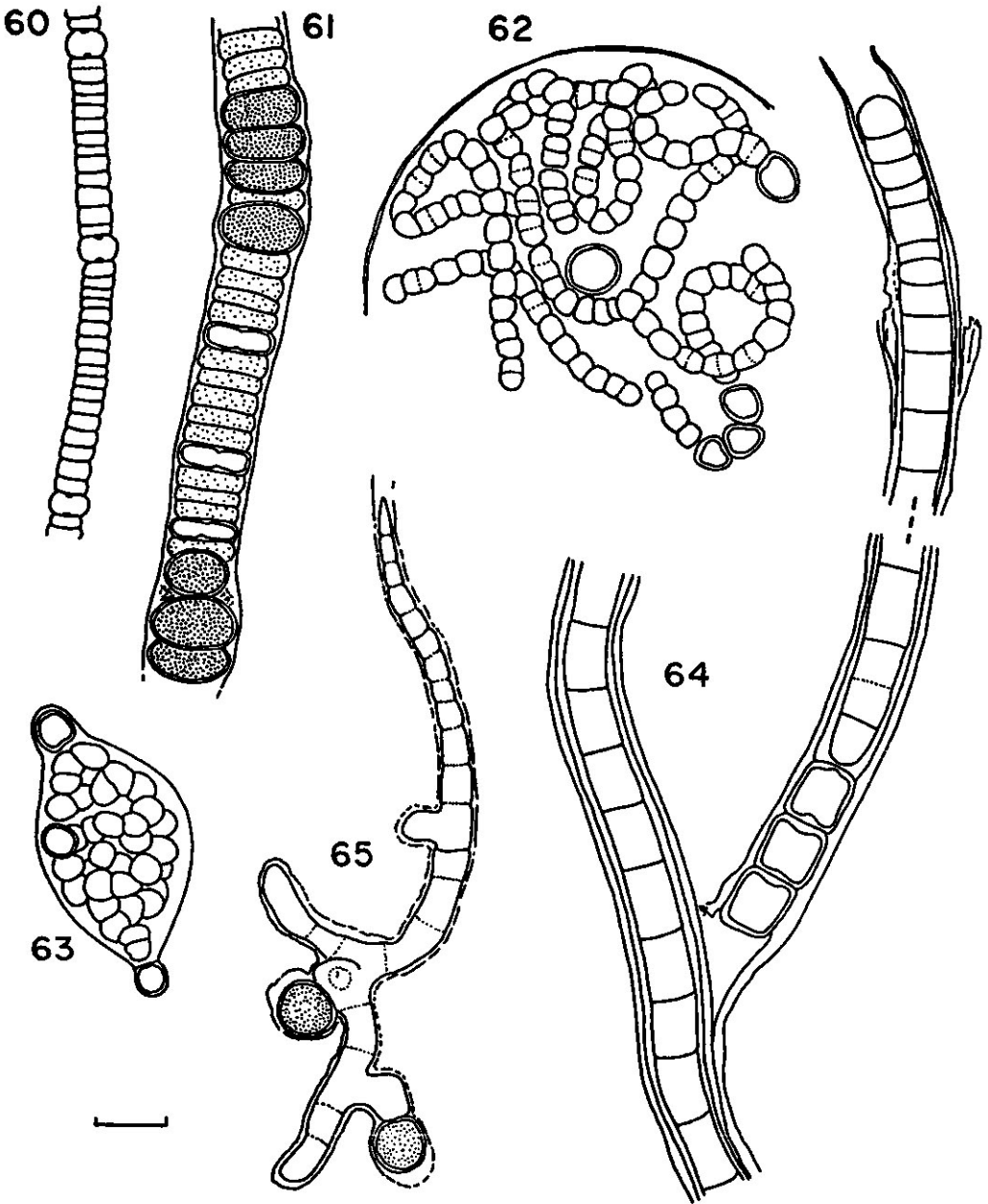


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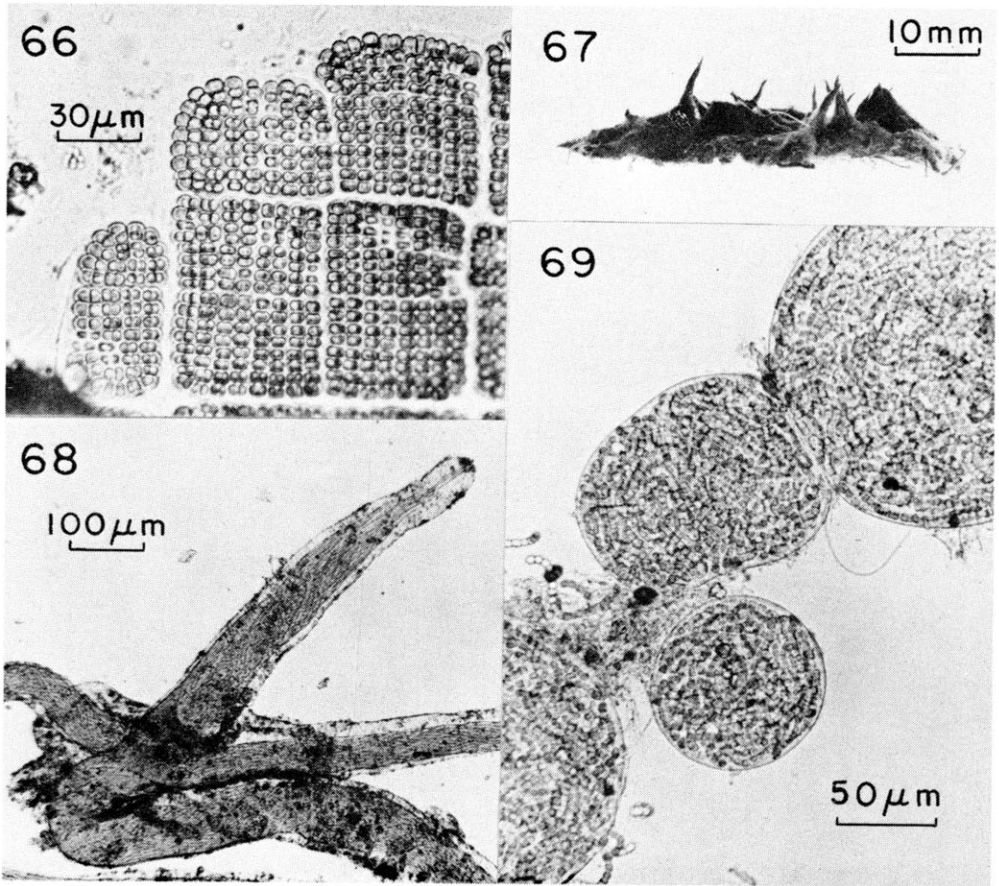


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