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FIRST RECORD OF FILAMENTOUS ALGAL REMAINS FROM THE LATE PRECAMBRIAN ROCKS OF RANDOM ISLAND (TRINITY BAY), EASTERN NEWFOUNDLAND, CANADA

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ABSTRACT

The late Precambrian shales of the Trinity Bay area (Random Island) of Eastern Newfoundland, Canada, yielded a rich concentration of filamentous algal remains (*Siphonophycus kestron, Siphonophycus* sp. A, *Gunflintia* sp. A, *Heliconema* sp. A) of living cyanophycean (nostocalean) affinities. The general morphological characters of these four species of ancient algae are described. Their discovery in these rocks of the area is the first find of these groups of microfossils known to-date. The presence of these microorganisms in the rocks assists in the reconstruction of palecenvironments, dating of Precambrian sediments and in delineation of boundary between the Precambrian and Cambrian sequences of the area.

INTRODUCTION

THE occurrence of fossil filamentous algal remains from the Precambrian sedimentary rocks of Newfoundland, Canada, has not been reported so far. In Canada, however, Barghoorn and Tyler (1965 *a*, *b*) have recorded microorganisms, including algal filaments, from the Gunflint chert (Gunflint Iron Formation, Animikie Series), of Middle Precambrian age. Similarly, Hofmann and Jackson (1969) also observed microfossils (chains and clumps of bacteria, filamentous and spheroidal structures of probable algal or fungal affinities) from the dark gray chert (Belcher Group) of Hudson Bay, Ontario.

It may be interesting to note that the Australian Precambrian sediments have revealed an amazingly rich and varied assemblage of microorganisms, including algal filaments (Barghoorn and Schopf, 1965; Schopf and Barghoorn, 1968; Schopf and Barghoorn, 1969; Schopf, 1970; Schopf and Blacic, 1971; Schopf, 1972), which are universally well known at present. The present paper reports the first discovery of filamentous algal remains from the Late Precambrian rocks exposed on Random Island in the Trinity Bay area of Eastern Newfoundland, Canada.

In Eastern Newfoundland (Canada), a fairly thick cross-section of the Precambrian to Lower Paleozoic sedimentary rocks (of the Appalachian Mountain system) occurs in the Trinity Bay area of Atlantic ocean. The exposures of the algal filament bearing shale beds are confined between the coordinates 48° 06′ 35″ N to 48° 06′ 45″ N and coordinates 53° 00′ 53′ 30″ W to 53° 00′ 53′ 50″ W of Random Island in Trinity Bay (Table I).

MORPHOLOGICAL DESCRIPTION

The algal filaments recovered through maceration from the medium gray shales are well preserved and are medium to dark brown in colour. The general morphological characters of the four species of ancient algae discovered are given below.

Systematic Descriptions and Biological Relations of algae:

Phylum: CYANOPHYTA, Class: CYANOPHYCEAE, Order: NOSTOCALES, Family: OSCILLATORIACEAE (S. F. Gray) Dumortier ex Krichner, 1988,

Genus: *Siphonophycus* Schopf, 1968,

Siphonophycus kestron Schopf, 1968,

Figs. 10 and 11

Thallus broad, tubular, moderate size, unbranched, non-septate, straight to slightly bent in nature, finely rugose, 42 to 45 μ long (in partly broken specimens), apices partly capitate (apparent in a specimen), in places more or less constricted adjacent to expanded parts, broadly conical with a bluntly pointed terminus; thallus 6 to 7 μ wide, finely microgranulose throughout, ornamented and ringed by finely punctate surficial ridges (*see* arrow in Figs. 10, 11) regularly spaced about 2/3 μ apart.

Siphonophycus sp. A

Figs. 1–9

Thallus broad, tubular, non-septate, unbranched, straight to slightly bent, 30 to about 95 μ long (in partly broken specimens), slight constrictions rarely seen in places throughout; however, constriction (of 2·50 to 4·50 μ across) distinct at one end of thallus (*see* arrow in Figs. 1, 4, 5), other end tapering to a sharp point with a slightly curved hook; thallus 6 to 9·50 μ wide, commonly 6 μ wide, finely microgranulose (with diameter of granules 0·50 μ) throughout.

Genus *Heliconema* Schopf, 1968

Heliconema sp. A

Figs. 12–16

Thallus tubular, flattened just like a ribbon, non-septate, unbranched, loosely coiled at an angle of approx. 45° into a helical fashion, spirals (*see* arrow in Figs. 15, 16) commonly about 6 μ broad and set apart from the adjacent ones; apices not attenuated and flat-rounded; surface texture finely microgranulose (granules up to 0·50 μ diameter); thallus 5–10 μ wide, commonly about 6 μ wide, up to 85 μ long; coiled thallus nearly straight (Fig. 13).

Genus *Gunflintia* Barghoorn, 1965

Gunflintia sp. A

Fig. 17

Thallus broad, tubular, septate (*see* arrow in Fig. 17), unbranched, straight to curved, about 114 μ long (in a partly broken specimen), more or less slightly constricted adjacent to slightly expanded parts of thallus;

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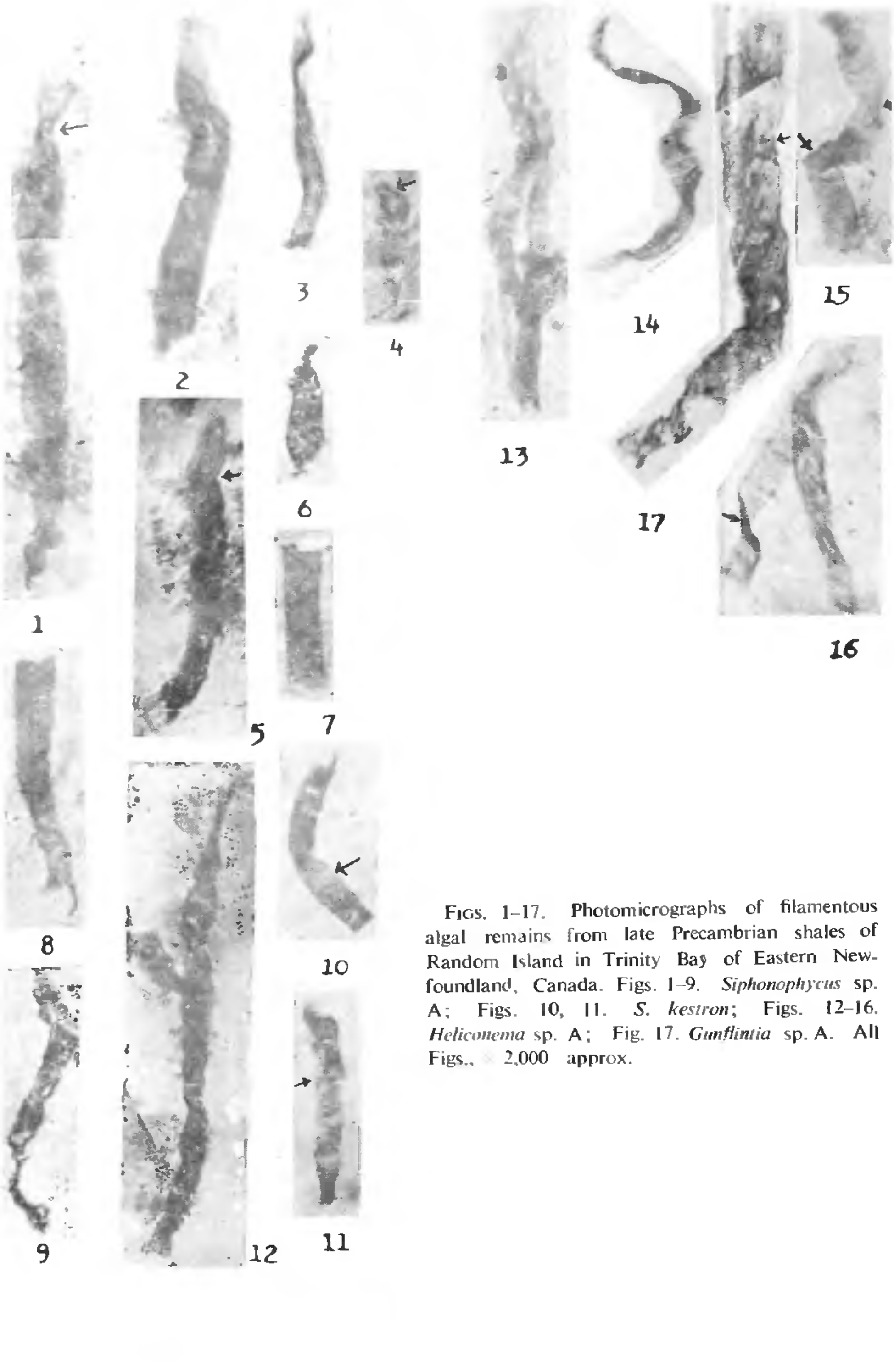

FIGS. 1–17. Photomicrographs of filamentous algal remains from late Precambrian shales of Random Island in Trinity Bay of Eastern Newfoundland, Canada. Figs. 1–9. *Siphonophycus* sp. A; Figs. 10, 11. *S. kestron*; Figs. 12–16. *Heliconema* sp. A; Fig. 17. *Gunflintia* sp. A. All Figs., × 2,000 approx.

thallus about 12 μ wide, finely and densely microgranulose throughout (diameter of granules less than 0·50 μ), septae distinct and very thin (about 0·50 μ thickness), apart from adjacent ones by about 15 μ distance; individual filaments of commonly uniform diameter throughout but in places with slightly constricted parts.

Palaeoenvironment

The occurrence of these filamentous, benthic algal remains discloses some facts about their close comparison with the living nostocalean blue-green algae which may be referred as lower thallophytes. They are of cyanophycean (nostocalean) affinities.

The development of benthic, filamentous blue-green algae requires the process of photosynthesis. Their rich concentration in the sediment is suggestive of existence of the extensive shallow ocean that provided a highly favourable environment (littoral photic zone) for algal growth. A similar view is also shared by Schopf and Blacic (1971) for the development of blue-green algae in the late Precambrian sediments (Bitter Spring Formation) of North-Central Amadeus Basin of Australia. Furthermore, this benthic assemblage is associated with the rare microorganisms (*Leiosphaeridia* sp. 1 types 1, 2 and *Leiovalia ovalis*, Table I) to planktonic habitat of shallow marine environment.

Age Assignment and Correlation

There is a high concentration and dominance, in quantitative composition, of blue-green algal filaments (Figs. 1–17) with some fungal remains in the medium gray shales (Unit No. 33, Table I) of the Trinity Bay area. Schopf (1970, 1972) and Schopf and Blacic (1971) also suggest that the blue-green algae had reached their zenith during the late Precambrian time. Their view on the occurrence of ancient blue-green algae also confirms the authors proposal that the medium gray shales are undoubtedly of late Precambrian in age. In addition, these algal forms (*Gunflintia* sp. A, *Heliconema* sp. A, *Siphonophycus* sp. A, *S. kestron*) have not been recorded from the Cambrian sequences of any part of the world to-date. They are the representatives of the late Precambrian sequences (Schopf 1970, 1972; Schopf and Blacic, 1971).

The profuse concentration and confined occurrence of blue-green algae in the uppermost late Precambrian sequence (Unit No. 33, Table I) of Eastern Newfoundland (Trinity Bay area) is of great significance, suggesting that they can profitably be used as "biostratigraphic markers" for the biostratigraphic correlation of the Precambrian sequences (upper part). Furthermore, their presence in the sediments assists to delineate the boundary between the Precambrian and Cambrian sequences (Table I).

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Table I

General stratigraphic succession of Precambrian (uppermost part) and Early Cambrian (lowermost part) sequence at northern Northwest Arm section of Random Island in Trinity Bay, Eastern Newfoundland, Canada, with algal remains. Formational nomenclature after Jenness[5] (colour names given to rocks are taken from *Rock-Colour Chart* distributed by the Geological Society of America, 1963).

Lithological characters and microflora Approximate thickness of units studied (in feet)
ADEYTON GROUP
Chamberlain's Brook Formation:
Nautiyal's Rock Unit No. 31,
Shale, greenish gray, non-calcareous, compact and hard; acritarchs, *Leiosphaeridia* sp. 1, type 1, *Leiosphaeridia* sp. 1., type 2, *L.* cf. *granulata*, and *Leiofusa filifera* 20
Unit No. 32,
Shale and Quartzite; Shale, medium gray, non-calcareous, partly papery, quartzitic, with thin bands of medium grained and greenish gray quartzite; acritarchs, *Archaeohystrichosphaeridium* sp. 2, *Baltisphaeridium* sp. 1, *Leiosphaeridia* sp.1., type 1, *Leiosphaeridia* sp. 1, type 2, *Leiofusa filifera*, *Multiplicisphaeridium lancarae*, *M. martae*, *Nucellosphaeridium* sp. 2, and *Orygmatosphaeridium* sp. 1.....5 Units 31 and 32, Early Cambrian age (after Jennes[5] and also by Nautiyal method of this paper).
Random Formation:
Unit No. 33,
Shale, medium gray, non-calcareous, compact and hard, occasionally with some black carbonaceous inclusions; acritarchs, *Leiosphaeridia* sp. 1, type 1, *Leiosphaeridia* sp. 1, type 2, *Leiovalia ovalis*; filamentous algal remains, *Gunflintia* sp. A, *Heliconema* sp. A, *Siphonophycus* sp. A and *S. kestron*. Late Precambrian age (after Nautiyal method of this paper). 5
Unit No. 34,
Shale, medium gray, non-calcareous, compact and hard, a fault (?) contact seems to be present between the Units 33 and 34; acritarch, *Nucellosphaeridium* sp. 1. 12
Unit No. 35,
Chert, light olive gray, non-calcareous, with sporadic distribution of fine grains of pyrite; phytoplankton, *Huronispora* sp. 1, *H. psilata*; acritarch, *Nucellosphaeridium* sp. 1. 3
Units 34 and 35, Late Precambrian age.
Lower part of Precambrian sequence not incorporated.

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