xanthin was found both in the bottom and near-surface samples. This lake is not yet truly dystrophic.

Carotenoids and chlorophylls have been found in Connecticut lake sediments that are up to 11,000 yr old. Concentrations of all carotenoids and chlorophylls do not progressively decline with depth. In the Bethany Bog core, a carotenoid tentatively identified as rhodoviolascin reached maximal values in the uppermost sediments, carotene (alpha plus beta) in the middle section of the core, whereas a third carotenoid (not yet identified) had maximal values in the lowermost part of the core.

Such results indicate the promise of the approach, even though the interpretation may be difficult. It is unlikely that much reliable information will come from the study of plant pigments in lake sediments until a great deal more is known about their destruction in lake waters and sediments.

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Occurrence of Structurally Preserved Plants in Pre-Cambrian Rocks of the Canadian Shield

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A small but varied assemblage of primitive lower plants, representing both blue-green algae and simple forms of fungi was discovered recently by the writers in nonferruginous cherts of the Gunflint iron formation of southern Ontario. The plant fossils were first observed in dense black cherts collected from the lower "algal" members of the Gunflint formation near Schrieber, Ontario, but additional material has been secured from widely separated localities along the strike of the formation. The collective plant remains thus far studied constitute a small, but significant, flora of remarkably ancient plant life.

As far as we are aware, these plants are the oldest structurally preserved organisms that clearly exhibit cellular differentiation and original carbon complexes which have yet been discovered in pre-Cambrian sediments and, as such, are of great interest in the evolutionary scheme of primitive life. Their discovery likewise appears to validate the somewhat questionable organisms described by Gruner (*1–3*) from the pre-Cambrian of northern Minnesota and tend to support the evidence presented by Rankama (*4*) regarding the organic origin of *Corycium enigmaticum,* a supposed organism of pre-Cambrian age.

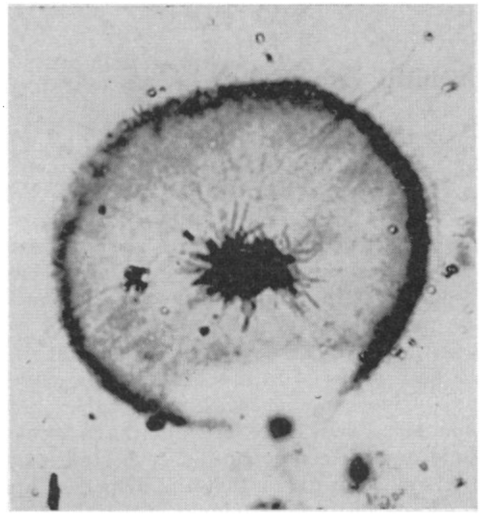

Fig. 1. Globose colony showing actinomorphic central mass of filaments surrounded by the remains of what is interpreted as a gelatinous "sheath." "Sheath" is outlined by mineral stain, partially ground away in lower quadrant of colony. Thin section, ×725.

Although detailed studies of the plants and comparisons with existing forms among lower groups of algae, fungi, and protophyta are being carried out, it seems desirable at this time to present a preliminary

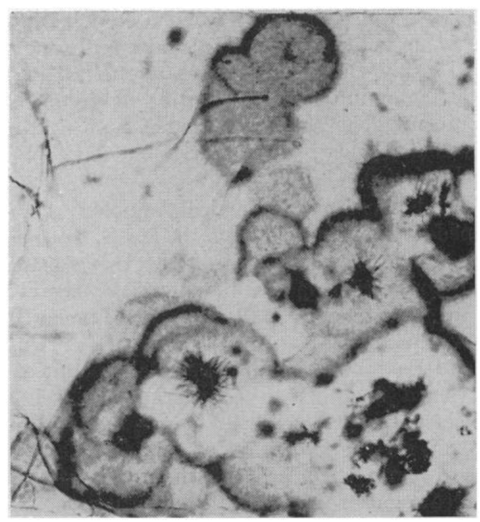

Fig. 2. Aggregation of colonies similar to that shown in Fig. 1. Black threads at upper and lower left are unbranched free filaments, not associated with the globose colonies. Thin section, ×325.

statement regarding these organisms and outline their possible biological affinities and geologic significance.

The organic residues of the plants occur in a matrix of fine- to medium-grained chert containing occasional carbonate rhombs. The petrographic character of the plant remains varies from amber brown to coalified and opaque. The majority of the organic constituents, attrital material as well as structurally distinct plant parts, however, is relatively uncoalified and remarkably uncompressed. The quality of preservation of the plants and the lithologic appearance of the chert in thin section is quite comparable to that of the celebrated Rhynie chert deposit of the middle Devonian of Scotland. Fragments of the original plant parts, in particular the spores and longer filaments, may be released from the embedding chert by dissolving the silica in hydrofluoric acid. Such released portions may be washed free of acid, pipetted onto microscope slides and examined directly, free of the mineral matrix.

Thus far, five morphologically distinct organic entities have been recognized, of which two are algal, two fungal, and one a unicellular type, probably a calcareous flagellate. The algal forms are of two diverse types: one consists of free, unbranched filaments, devoid of heterocysts and spores, with filaments approximately $1.5\,\mu$ in diameter; the second consists of colonial, actinomorphic aggregates of short filaments embedded in what appears to be the silicified remains of a globular mass of "jelly" (Figs. 1 and 2). The first of these may be compared to certain species of the existing genera Lyngbya or Oscillatoria, although the comparison is limited to only the grossest of morphological detail. The globular colonial forms may be compared to such existing groups as the Rivulariaceae, although the more extensive development of the globular sheath, complete absence of heterocysts, and extremely thin filaments in the fossil forms are significant features that differentiate them from Rivularia and its related genera. It should be noted, however, that certain genera of the Rivulariaceae are devoid of heterocysts.

Of the two fungal types observed, one form has been found to consist of many-branched hyphae, apparently nonseptate, bearing small sessile laterally attached spores (Fig. 3), a structural feature comparable to that found in certain existing Phycomycetes. The second fungal form consists of matted hyphae, abundantly branched and nonseptate (Fig. 4). Numerous spores occur distributed throughout the mycelial mass, but none have been observed to be clearly attached. In addition to the mycelia found in distinct aggregates, numerous isolated spores, possessing well-defined reticulate sculpture, and probably of fungal origin, have been noted in several thin sections of the chert.

Unicellular organisms, or the dissemination or calcareous platelets of multicellular colonial forms (flagellates?) occur in considerable profusion in the chert. Of these, one distinctive form has been recognized, a cell of radially symmetrical organization,

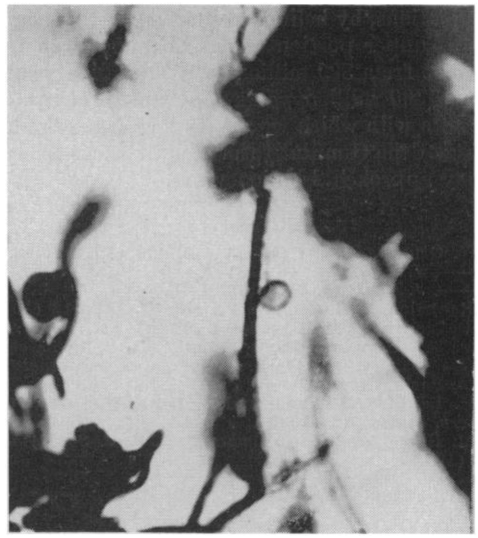

FIG. 3. Portion of a mycelium with attached sessile spore. The black areas are coalified portions of the same mycelium. Hypha and spore attached are light amber brown in transmitted light. Thin section, ×1025.

resembling that found in the genus Discoaster, a group of planktonic calcareous marine flagellates of uncertain systematic position, probably related to the Coccolithophorides (*5*). It is hoped that further study will establish the presence of other unicellular forms and some evidence concerning their systematic position in terms of existing groups, despite the limitations of structural detail provided by the fossils.

The general stratigraphic position of the Gunflint iron formation, containing the organisms noted here, is generally regarded as middle Huronian (*6*) on the basis of correlation with the Negaunee iron formation of the Marquette district in Michigan. Several age

FIG. 4. Portion of a mycelium showing branching, nonseptate hyphae and detached spores. Thin section, ×725.

determinations, by helium measurements, of magnetite from the upper portion of the Negaunee iron formation range from 800 million to 1650 million years and average 1300 million years (*7*). Since the pre-Cambrian flora with which we are dealing comes from near the base of the Gunflint formation, it seems likely that age may approach 2 billion years.

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Hemoglobin Regeneration Following Oral Administration of Chelated Iron

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Published evidence suggests that heavy metals attached to a chelate nucleus are available to plants but not to animal organisms. Stewart and Leonard (*1*) reported iron in the form of ferric potassium ethylenediamine tetraacetate to be readily utilized by chlorotic grapefruit trees when applied to the soil. On the other hand, Brendel *et al.* (*2*) administered several heavy metal-chelate combinations intraperitoneally to mice and obtained indirect evidence which led them to postulate that heavy metal ions attached to the chelate nucleus are not available to the animal body. We became interested in determining, by a direct experiment, whether or not this is true.

It is well known that extreme nutritional anemia can be induced in young rats maintained on a milk diet. The hematinic effect of iron added to the diet of the anemic rats is then clearly reflected in the rate of hemoglobin regeneration. Mitchell and Miller (*3*) showed that, in this procedure, the optimum daily iron requirement for a rat is about 0.25 mg if sufficient copper supplement is provided.

Fifty male, recently weaned, Sprague-Dawley rats were placed on a diet of powdered whole milk and water *ad libitum*. Blood hemoglobin determinations by the direct photometric method (*4*) were made on tail blood at intervals. At the end of 7 wk, the blood hemoglobin levels were uniformly low in more than two-thirds of the animals, and 30 of the most uniformly low animals were selected and divided into three groups of ten animals each.

Iron supplementation in the diet was then instituted in two of the groups. The first group received 0.1 mg iron per rat daily in the form of ferrous sulfate. The second group received the same daily dose of iron in the form of ferric sodium ethylenediamine tetraacetate (*5*). The third group received no iron and served as a control. These are suboptimal levels of iron intake, so intended in order to show possible differences in ab-

TABLE 1. Blood hemoglobin levels of anemic rats treated orally with ferrous sulfate and chelated iron.

Group	No. of animals	Form of iron	Average blood hemoglobin levels (g/100 ml) (5–26–53)	(6–9–53)	(6–23–53)	(7–8–53)	(7–22–53)	(8–3–53)
I	10	Ferrous sulfate	5.4 (± 0.4)*	8.2 (± 1.3)	10.5 (± 1.3)	11.0 (± 1.1)	11.4 (± 1.7)	12.3 (± 2.0)
II	10	Ferric sodium ethylenediamine	5.4 (± 0.5)	7.5 (± 1.3)	10.4 (± 0.5)	11.2 (± 0.8)	11.3 (± 1.1)	11.9 (± 1.8)
III	10	Control (no iron)	5.5 (± 0.4)	4.6 (± 0.5)	3.6 (± 0.4)	3.5 (± 0.3)	†	—

* Standard deviations.
† Controls in poor condition, two dead; see text for fate of remaining eight animals.

TABLE 2. Blood hemoglobin levels of anemic rats treated intravenously with saccharated iron oxide and chelated iron.

No. of animals	Form of iron	Average blood hemoglobin levels (g/100 ml) (7–15–53)	(7–22–53)	(7–29–53)	(8–3–53)	(8–12–53)
4	Saccharated iron oxide	3.5 (± 0.4)*	5.1 (± 0.4)	8.3 (± 0.2)	11.6 (± 1.4)	12.0 (± 1.5)
4	Ferric sodium ethylenediamine tetraacetate	3.5 (± 0.1)	4.2 (± 0.6)	4.6 (± 1.0)	5.4 (± 0.7)	5.2 (± 0.6)

* Standard deviations.