

AN ASSESSMENT OF THE ORDOVICIAN ALGA *SOLENOPORA* FROM NEAR QUÉBEC CITY, CANADA: SYSTEMATIC POSITION AND SPECIFIC NOMENCLATURE

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Solenopora is an extinct genus that occurs in the fossil record as bulbous, calcareous nodules of tightly packed tubes. The genus in its broad definition first appears in Middle Cambrian strata and extends into the Paleogene. These organisms resemble chaetetids, to which the genus was referred when it was originally described by Wladislaw Dybowski in 1878. Today, however, *Solenopora* is widely considered to be an alga related to or the direct ancestor of modern calcareous coralline algae. The type species of *Solenopora* was described from the Middle Ordovician of Estonia in 1878; it has been suggested that the described *Solenopora* species from the Mesozoic and Cenozoic are not truly referable to the original organism described from the Ordovician. The genus has a worldwide distribution, but there are three geographical areas within the Ordovician system where *Solenopora* can be found in unusually large numbers: the Baltic, Britain and northeastern North America.

This study concentrates on specimens of *Solenopora* found in Ordovician strata of the immediate Québec City, Québec, Canada region. The focus of the study is on the systematic position of *Solenopora*, specific nomenclature within eastern Canada, and the variations of morphologic features within *Solenopora* from this area.

Collecting Localities

There were two collecting areas in this study: Montmorency Falls (locality 2 of Riva and Pickerill, 1987), a few kilometers east of downtown Québec City, Québec, Canada, and Pont Rouge, west of Québec City (Fig. 1). Specimens were collected from the basal Trenton Group of the Middle Ordovician. In this region, the basal sediments are primarily bioclastic limestones unconformably overlying gneiss of Grenville age (Fig. 2). The richest *Solenopora* concentration occurs in the "*Solenopora* gravels", a unit that is well exposed on a knob of gneiss just above Montmorency Falls (Fig. 3). This unit contains highly abraded and eroded fossils, including brachiopods, bryozoans, trilobites, gastropods, nautiloids, ostracods and *Solenopora*, the primary constituent. Despite a published account (Riva and Pickerill, 1987), *Solenopora* is not found attached to the surface of the gneiss at this locality, though it is apparent that the gneiss surface was exposed in the Middle Ordovician as a rocky, hard substrate which was part of an extensive archipelago called the Montmorency Promontory. Only one specimen of *Solenopora* was found still preserved on a hard substrate. This specimen was attached at its base to a cobble of gneiss that was surrounded by the matrix of the "*Solenopora* gravels".

Systematics

Solenopora was originally classified as a chaetetid, which was, in turn, originally considered a tabulate coral. *Solenopora* and the chaetetids share many of the same characteristics. The principal problem with placing *Solenopora* with the chaetetids is the roughly one scale of magnitude size difference in morphologic features. Additionally, chaetetids are now generally considered sclerosponges. *Solenopora* does not exhibit any poriferan characteristics. *Solenopora* has also been found with presumably original pink pigment, indicative of a rhodophyte. Previously, this pigment has only been found in Mesozoic strata. Specimens from Montmorency Falls, in the Ordovician System, occasionally display a distinctive red, not pink, coloring. Chaetetids have never been reported with such pigments. This represents an excellent example of convergent evolution between two organisms not within the same kingdom.

Six species of *Solenopora* (*S. canadensis* (Foord, 1883), *S. ouareauensis* Fritz, 1941, *S. trentonensis* Brown, 1894, *S. cf. S. trentonensis* Brown, 1894, *S. dentata* Sinclair, 1956, and *S. canis* Sinclair, 1956) and two species that are questionably *Solenopora* (*S.? paquettiana* Ami, 1892, and *S.? embrunensis* Wilson, 1948) have been described from the Ordovician of eastern Canada (Sinclair, 1956). The described specific differences are often ambiguous in that the defining features of one species blend into features of another species. The dominant features used to define the eight species listed above are the size and shape of transversely cut tubes (the outlines) and the growth pattern of tube walls as seen in longitudinal sections.

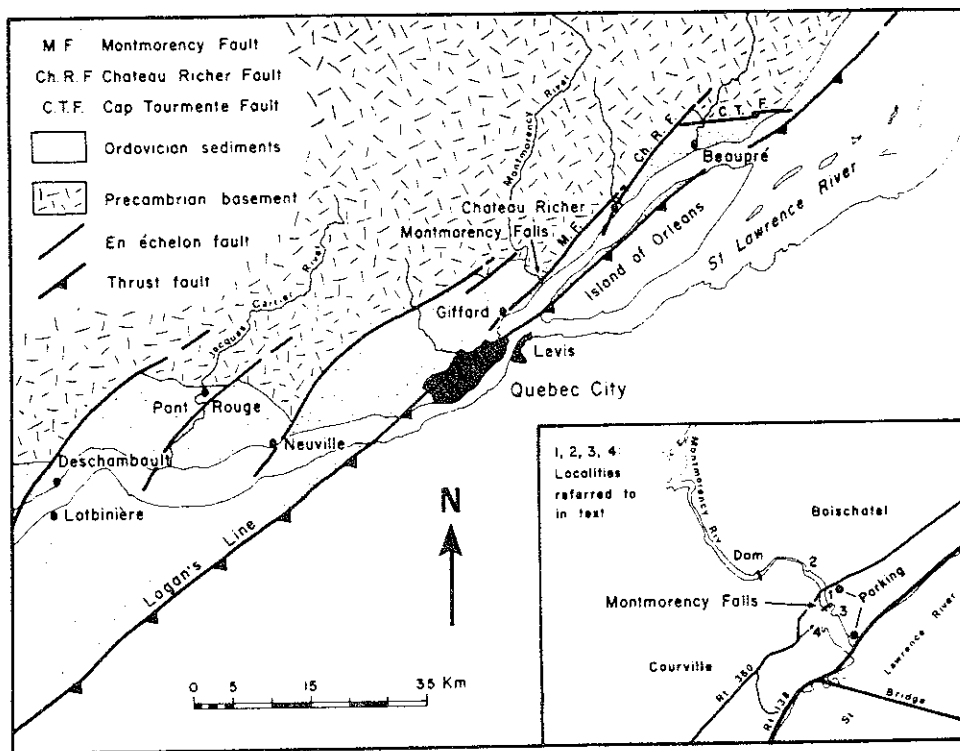


Figure 1. Generalized Geologic Map of Québec City Region, showing Montmorency Falls and Pont Rouge collecting localities. From Riva and Pickerill, 1987, fig. 1.

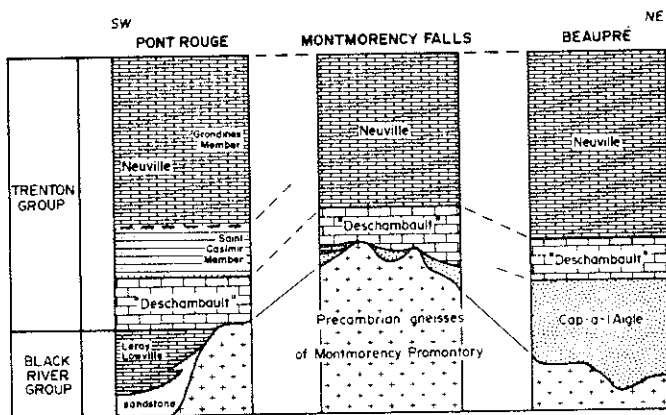


Figure 2. Regional Stratigraphy of Québec City Region, showing the Precambrian gneiss-Trenton Group unconformity. From Riva and Pickerill, 1987, fig. 3.

Figure 3. Stratigraphy at Montmorency Falls locality, showing the "*Solenopora* gravels" unconformably above the gneiss. Based on Riva and Pickerill, 1987, fig. 4.

Lithology	Sedimentary facies	Ichnofauna	Biota	Interpretation
	<i>Solenopora</i> gravels sandy matrix and boulders	unbioturbated	abundant, including <i>in situ Solenopora</i>	Algal maerls and rock pool clusters
	Arkosic sandstones	unbioturbated	rare, reworked	Marginal clastics
	Precambrian gneisses			

Tube outlines vary from rosette-shaped, with pseudosepta, usually one to four within one tube, to rounded or sub-rounded with no pseudosepta, to irregular, polygonal or elongated outlines. *Solenopora canadensis*, *S. ouareauensis*, *S. canis*, *S. dentata*, and *S. cf. S. trentonensis*, as they were each originally described, typically contain the rosette-shaped, highly-septate tubes. *S. trentonensis*, though not a legitimate species because of Brown's (1894) inadequate description, was illustrated with large, elongated tubes interspersed among small, non-pseudoseptate, polygonal tubes. The two doubted species of *Solenopora* were both described with rounded, non-septate tube outlines.

Transversely cut tubes display three growth conditions: straight walls, gently sinuous walls or crenulate walls. *Solenopora canadensis* possesses distinctly crenulate walls, while *S. ouareauensis* has straight walls. The other species, *S. dentata*, *S. canis*, and *S. cf. S. trentonensis*, are described as having gently sinuous walls. *S. trentonensis* was not originally illustrated in longitudinal section and no type material exists so the tube wall growth pattern cannot be determined. The two doubtful *Solenopora* species possess irregularly crenulate and wavy tube walls in longitudinal section that frequently recurve in gentle arcs.

Results of this Investigation

Montmorency and Pont Rouge specimens typically have rosette-shaped, pseudoseptate tube outlines (Fig. 4), while rounded to sub-rounded, non-pseudoseptate outlines are less common. Uncommon but present are the irregular, polygonal or elongated outlines. Longitudinally cut walls are commonly gently sinuous (Fig. 4), followed in dominance by the straight-walled and crenulate forms. However, many single specimens show the presence of more than one aspect in each of these features. That is, rosette-shaped, pseudoseptate tubes may be found in one area while rounded, non-pseudoseptate tubes are present in another portion of the same specimen. Likewise, tube walls may be found crenulate in one portion of a specimen and gently sinuous and/or straight walls are apparent in another portion. The tube walls of *Solenopora* consist of finely granular calcite crystals. The space between walls is typically filled with coarse calcite spar (Fig. 5).

A continuum of features has been used for species differentiation in past literature. The Montmorency and Pont Rouge specimens display blends of features that are not precisely indicative of any one described species. This suggests that the described *Solenopora* species of eastern Canada are not legitimate, as the existing definitions for species differentiation are not consistent with the biological species concept. *Solenopora canadensis* was the first species described from the Ordovician of Canada and it is proposed here that it is the only legitimate name. *S. trentonensis* and *S. cf. S. trentonensis* are *nomen nudum*, since the names are based on the inadequate description of Brown (1894). *S. dentata* and *S. canis* are probably variations within a single species of *Solenopora* and it is suggested that these are junior synonyms of *S. canadensis*. *S. ouareauensis* is probably an ecophenic variation of *S. canadensis*. The two doubted *Solenopora* species should remain so until more detailed studies can be done with specimens from the type localities of each.

References Cited

- Riva, J. & R.K. Rickerill. 1987. The late mid-Ordovician transgressive sequence and the Montmorency Fault at the Montmorency Falls, Québec. Geological Society of America Centennial Field Guide--Northeastern Section, 1987: 357-362.
- Sinclair, G.W. 1956. *Solenopora canadensis* (Foord) and other algae from the Ordovician of Canada. Transactions of the Royal Society of Canada. Vol. 50. Series 3. No. 4: 65-81.

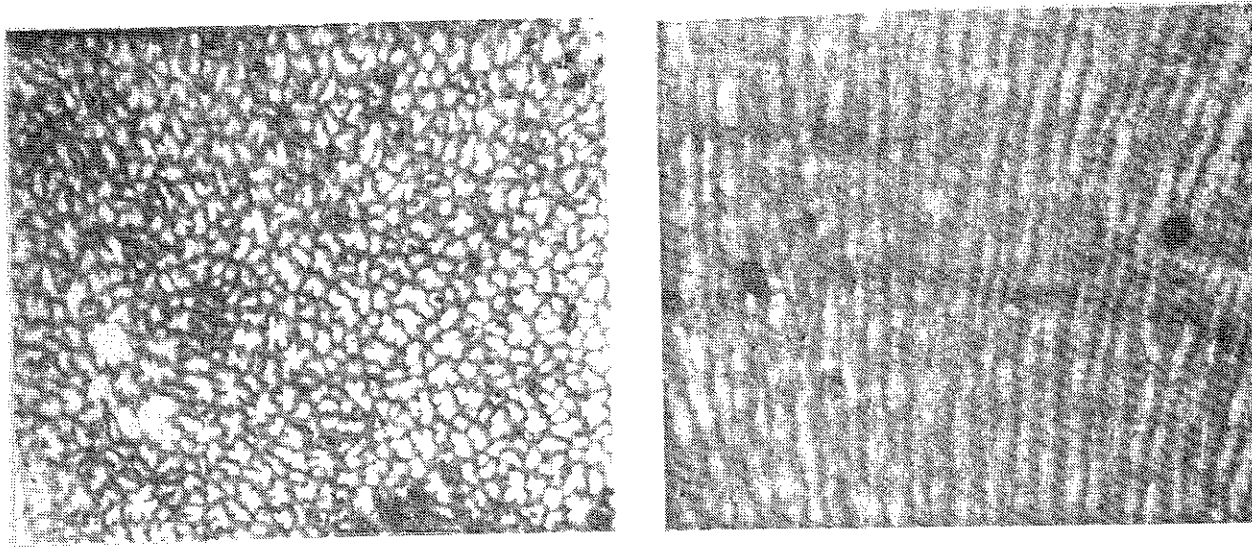


Figure 4. *Solenopora* thin sections from Montmorency Falls. At left are transversely cut tubes, showing the most common outline form: rosette-shaped with many pseudosepta. At right are longitudinally cut tubes, showing the gently sinuous nature typical of Montmorency specimens. Enlarged app. 55x.

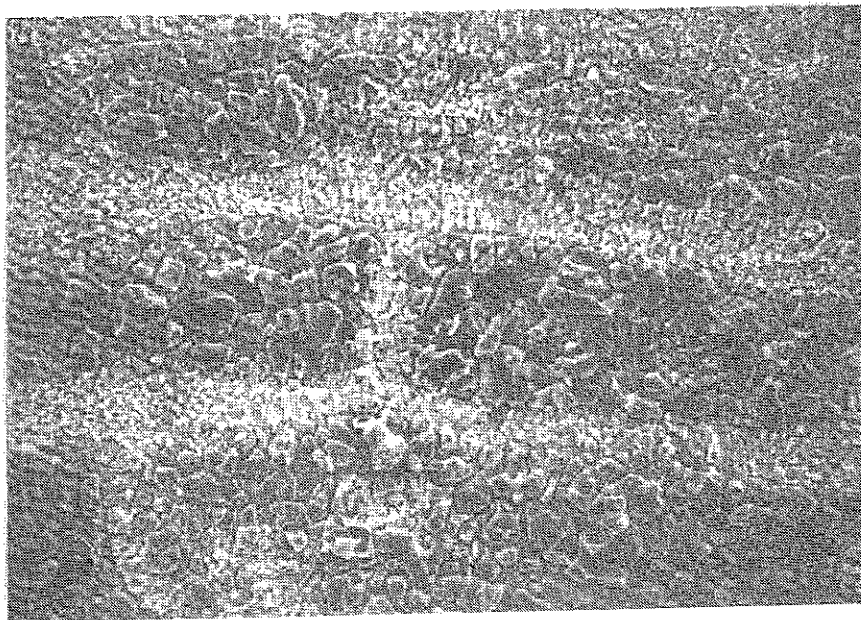


Figure 5. SEM photo of *Solenopora* from Montmorency Falls. Longitudinally cut tubes are composed of finely crystalline calcite. Tube interiors filled with coarse calcite spar. Enlarged 430x.