## TRIP A3 (1)

# CAMBRO-ORDOVICIAN STRATIGRAPHY, SEDIMENTATION, AND ICHNOBIOLOGY OF THE ST. LAWRENCE LOWLANDS - FRONTENAC ARCH TO THE CHAMPLAIN VALLEY OF NEW YORK

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## INTRODUCTION

This trip is being offered for the purpose of introducing students of geology to some of the interesting and important relationships to be found in the first Cambrian(?) rocks to be "properly" described on this continent. Indeed, the name Potsdam is the oldest recognized stratigraphic name in North America accepted under the terms of the Code of Stratigraphic Nomenclature. The unit is, however, not strictly homogeneous, nor are its age and stratigraphic relationships known throughout its geographic distribution. The aim of this field trip is to point out some of the stratigraphic, sedimentologic, paleontologic, and paleoenvironmental variety that has been included under the label of "Potsdam Sandstone" in the region of the type area, northern New York.

This field trip will span the North Country from Chippewa Bay to Champlain, New York, (Figure 1) and will emphasize the basal units in the Paleozoic sedimentary cover of the basement. During its progress the guide will attempt to point out relationships between bedrock and the activities and deposits of the Wisconsinan glaciation which covered the entire field area. The trip will be entirely within the St. Lawrence Lowlands physiographic province as used by Fisher, 1977 (Figure 2).

Please note that the articles in support of this trip (Erickson & Bjerstedt; Erickson; and Erickson et al.) follow this road log.

## ROADLOG

In this road log one will find, associated with each stop description, a number of questions that are best addressed by relationships at that particular stop. To stimulate thought and discussion participants are encouraged to make their own observations in an attempt to answer these and any others that arise in the process. The author assures you that he does not have answers to most of these!

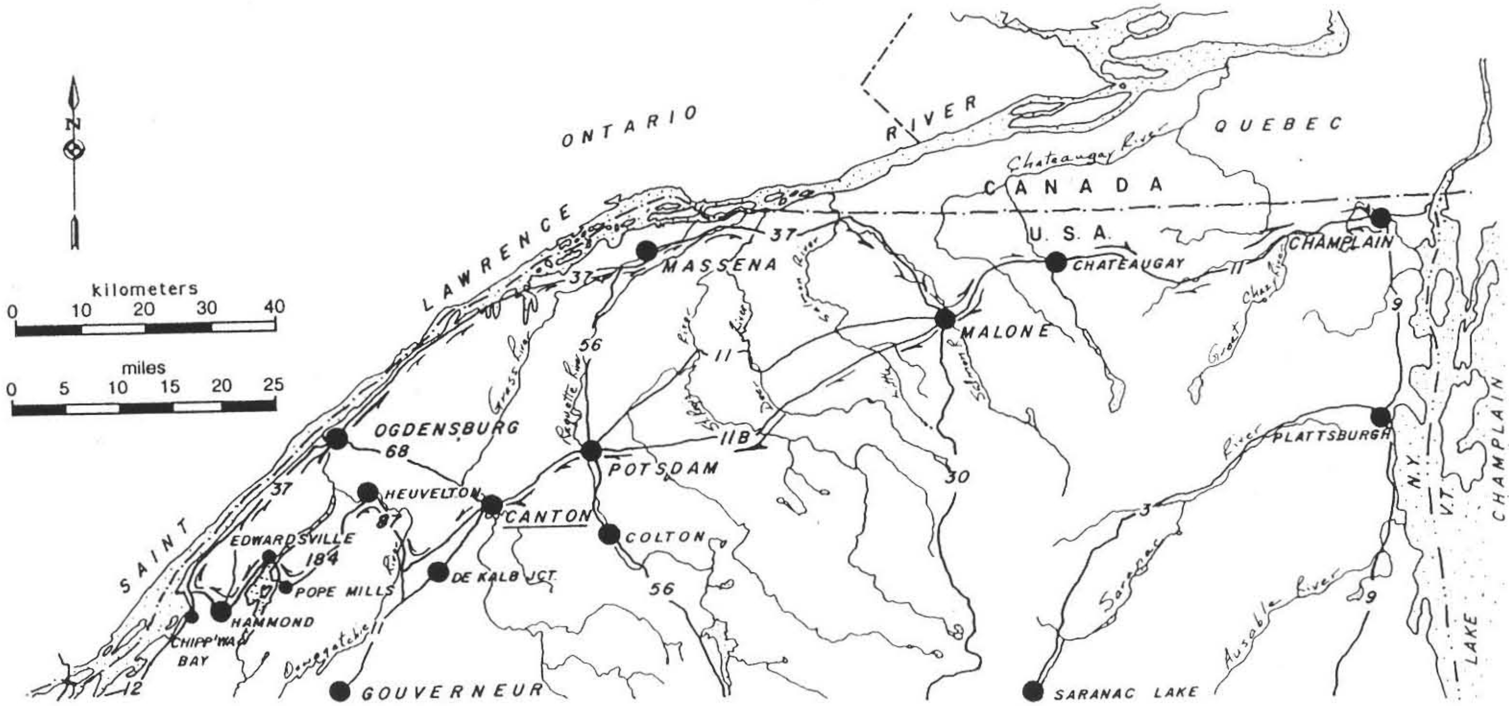


Figure 1: Map indicating route of the field trip.

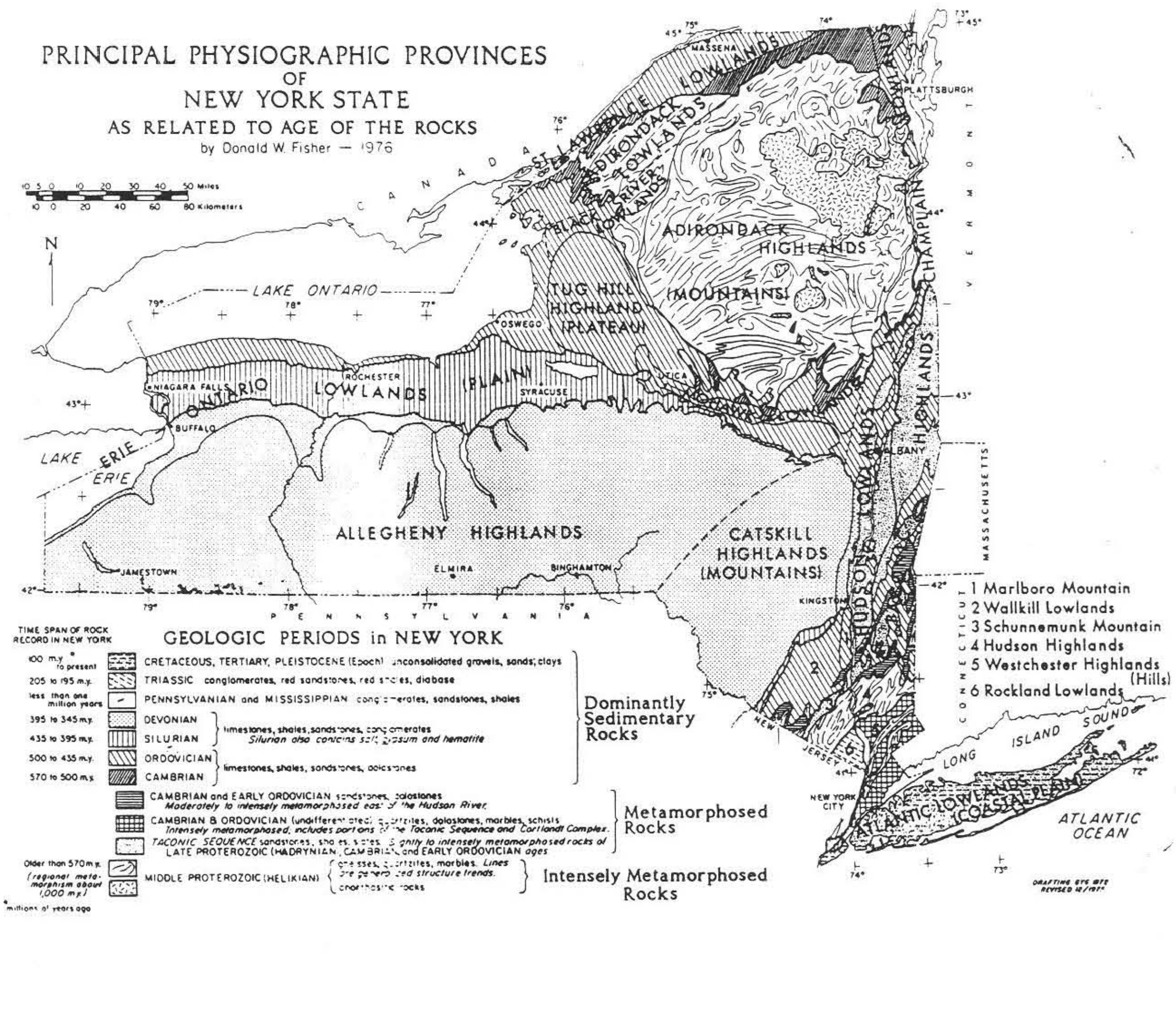


Figure 2: Physiographc map of New York from Fisher (1977) indicating extent of the St. Lawrence Lowlands physiogarphic province as used on this trip.

Questions to be raised by this field trip:

1. What is meant by "Potsdam" - how well defined is the unit? Is the name being applied properly? Is misapplication preventing better understanding of regional tectonic and depositional histories
2. What is the age of the Potsdam Sandstone?
3. What depositional environments are involved in the Potsdam Fm.?
4. What are the relationships between the Potsdam-Theresa-Ogdensburg Formations?
5. What was the biota of the Potsdam-Theresa interval?
6. What was the paleoecology of the ichnotaxa (and of the trace-making organisms) found in these rocks?
7. Is the first appearance of trace fossils in regional rocks indicative of evolutionary change or of depositional environment?
8. What are the stratigraphic relationships of the formation?

| Cumulative mileage | Miles from last point | Route description |
|---|---|---|
| 0.0 | 0.0 | Mileage log begins at the intersection of Main and Park/Court Streets in the center of the Village of Canton, N.Y. |
| 0.1 | 0.1 | Proceed N. on Court Street 1-1/2 blocks to parking lot of the newly expanded St. Lawrence County Court House. Disembark and walk to original wing of the complex centered on Court Street. |

**STOP 1:** St. LAWRENCE COUNTY COURT HOUSE. (Figure 3)

Photo stop - no hammers please!

The field trip begins appropriately at this classic structure because it contains most of the impressive elements of the Potsdam Sandstone as it occurs in the stratigraphic/lithographic type locality in the vicinity of Potsdam, N.Y., 10 miles to the East. The edifice also demonstrates many of the uses of the Potsdam and the skills of the quarry craftsman.

Emmons (1838, p. 214; 1842) named this unit in the Report of the Survey of the 2nd Geological District of New York. Quarries of the Potsdam are no longer accessible; however, the lithologic character of the "type" Potsdam is easily seen in this structure.

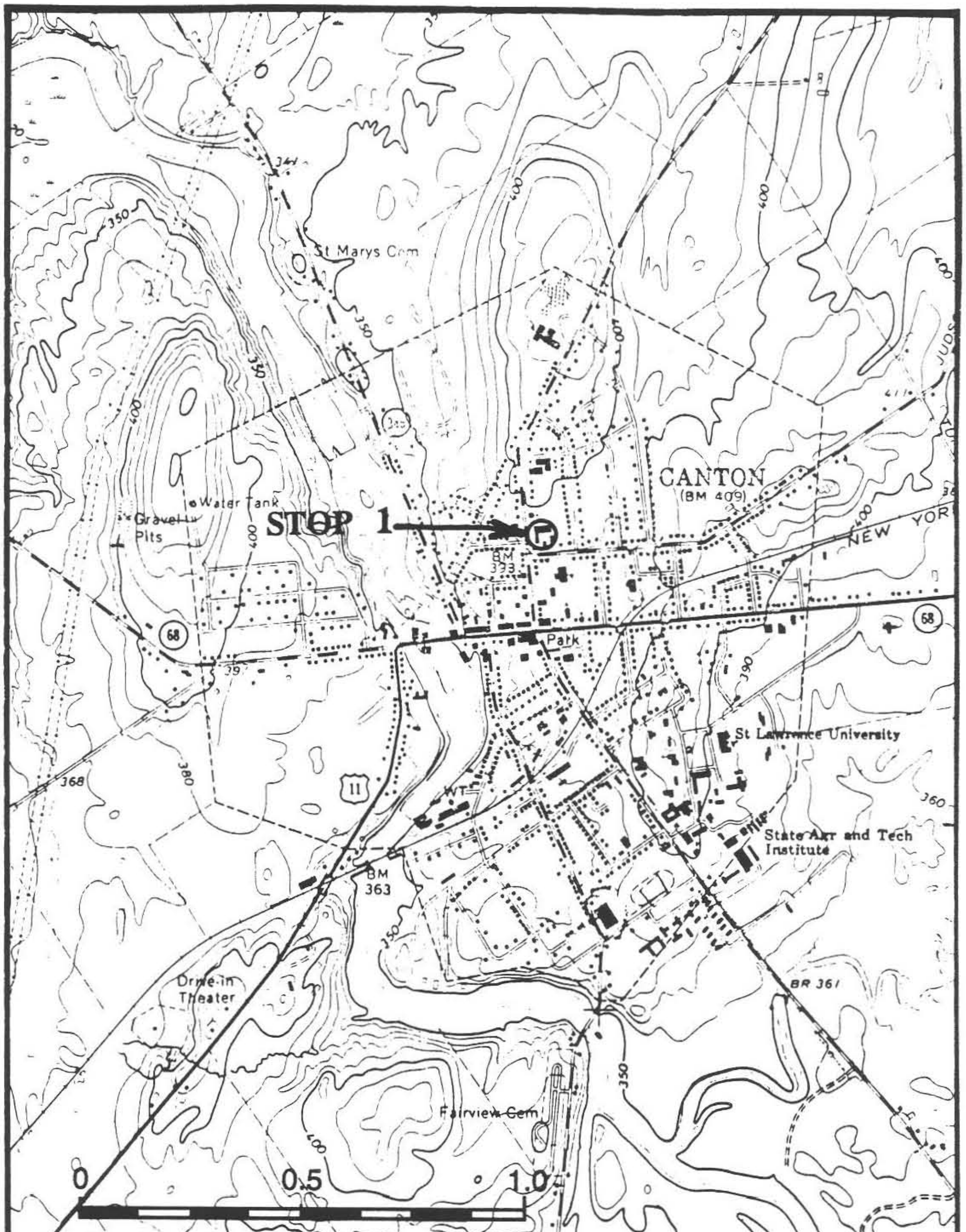


Figure 3: Topographic map illustrating location of Stop 1 on the Canton, N. Y. Quadrangle.

The rock is a fine-to-medium grained, well-rounded, well sorted, laminated, plane bedded or cross-stratified, hematitic, silica cemented orthoquartzite. It has very unique decorative properties because quartz grains were individually coated by hematite before the silica cement was introduced. For this reason the red coloration is protected from weathering, thus facades do not become streaked or stained as is the case with some hematitic or limonitic building stones having calcitic cement that contains the oxides or with pyritiferous limestones and sandstones.

The gray ashlar blocks of the courthouse are a Precambrian unit known as Gouverneur Marble. Red trim is all Potsdam Sandstone. Both were produced in St. Lawrence County. Please note that the newly completed addition to the courthouse attempts to use the same color themes but employs man-made materials rather than native building stone.

Questions to be raised at Stop 1, in particular are:

1. What are the lithologic properties of the Potsdam Sandstone?
2. What depositional environments are represented in the "type" Potsdam Sandstone?
3. Do the rocks contain fossils - either ichnofossils or body fossils?
4. What primary sedimentary structures are present?

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|---|---|---|
| 0.2 | 0.1 | Return to Main Street (Hwy. 11). Turn RIGHT (West) on Main Street and proceed west. Note sandstone facade on Canton Municipal Building on left. Cross Grass River, pass straight through traffic light and follow Rte. 68 toward the North for two blocks to Old Dekalb Road.<br><br>The Grass River is one of several northward-flowing rivers whose headwaters are in the Adirondack Highlands. These are tributary to the St. Lawrence River approximately 20 miles to the North. Several have major power dams or paper mills on them thus being developed to the degree that the original character and fishery of the river has been lost. Canton's water supply is drawn from the Grass River. |
| 1.0 | 0.8 | Jct. Hwy. 68 and Old Dekalb Road just before True Value Hardware. Turn LEFT and follow Old Dekalb Road to its end at Hwy. 87. The route passes along the Canton phaccolith, a body composed of alaskite and surrounded by marble and paragneiss, all presumably Grenvillian age (Bloomer, 1965; 1967). |
| 3.3 | 2.3 | Outcrops of Canton Alaskite are visible at crest of hill. |
| 6.8 | 3.5 | The entire region has been glaciated multiple times, most recently during the Wisconsinan Stage of the Pleistocene. Topography of both bedrock and surficial material reflect that process. Outcrops |

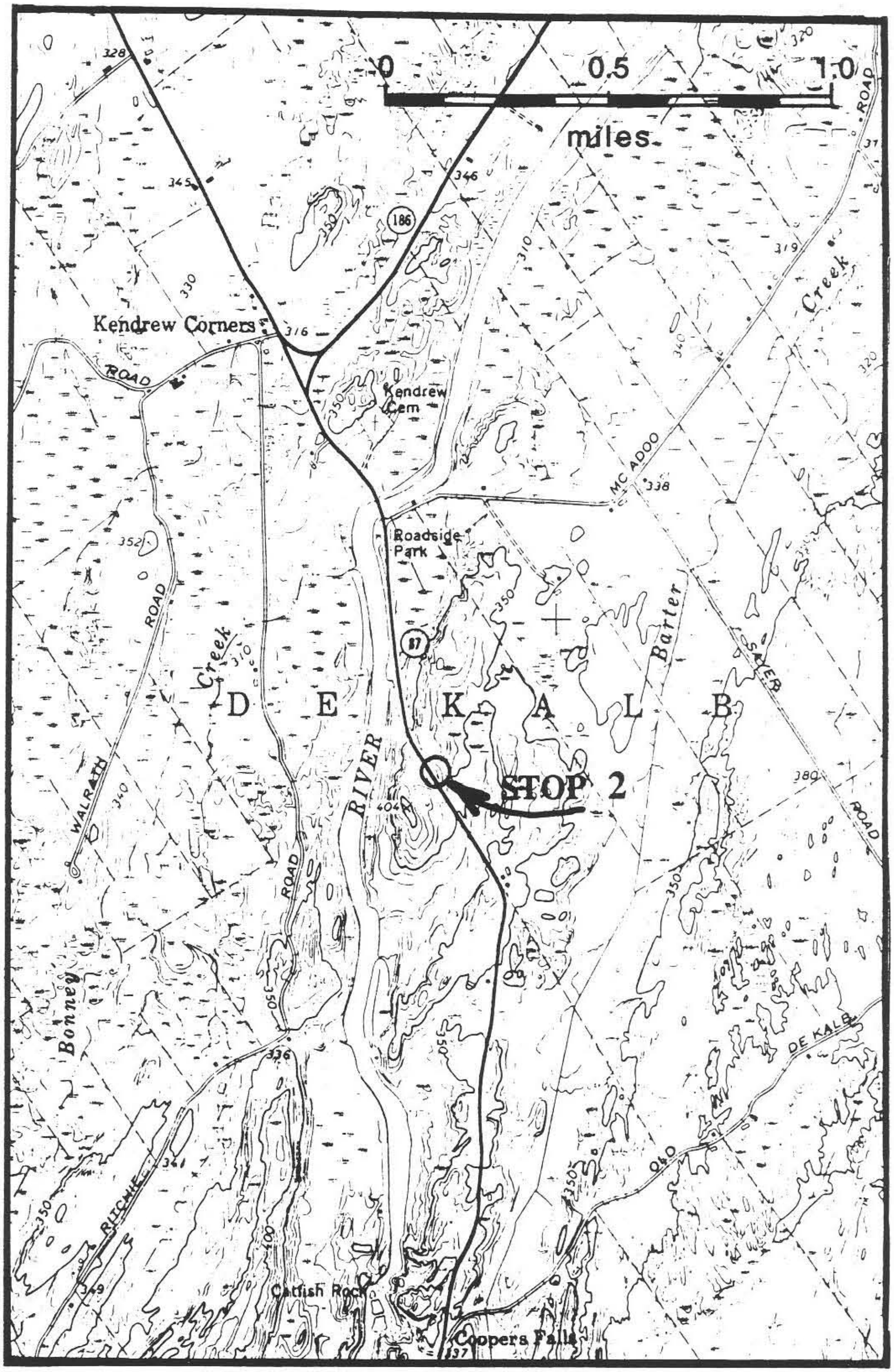


Figure 4: Topographic map illustrating location of Stop 2 on the Rensselaer Falls, N. Y., Quadrangle.

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| | | of alaskite and gneiss having smooth glacial polish and protruding from surrounding till are referred to as "whalebacks" because of their appearance and morphology. |
| 10.0 | 3.2 | Differential scouring of softer marble and subsequent valley filling by alluvium and bog deposits has produced prominent valleys through the alaskite-gneiss terrain. The bus will cross such a valley at the given mileage. The next stop lies within such terrain. |
| 10.01 | 0.1 | Jct. with Hwy. 87. Turn RIGHT (North) and proceed northwestward along the east side of the Oswegatchie River. |
| 11.4 | 1.3 | Stop 2. Bus will turn onto gravelled parking strip on W. side of the highway. Disembark and carefully cross this busy highway to examine low outcrops in roadcut on east side. |

**STOP 2:** POTSDAM OUTLIER or GRENVILLIAN QUARTZITE? (Figure 4)

In the North Country no trip in the Potsdam would be complete without visiting one of the region's outcrops of enigmatic sandstone. Cushing (1916) included this hill as an OUTLIER of Cambrian Potsdam Formation overlying Grenvillian marble.

Bloomer (1965, 1967), after structural mapping and petrographic studies of included minerals, concluded that the quartzites mapped as outliers were in structural and mineralogical equilibrium with enclosing Grenvillian rocks, implying for the sandstones a Precambrian age as well. Others (eg. Brown, 1967) have considered the quartzites to be collapse fillings of , or deposition in, a karst developed on Grenvillian marbles, or fillings of cavities created by hot, high-pressure, acidic brines conducted through the porous Potsdam (see trips by Selleck, and by Bursnall and Elberty in this volume for further discussion). As one examines this outcrop bear in mind that the type Potsdam is an outlier of quartzite on Grenvillian rocks!

Careful examination of the outcrop will reveal at least six lithologic units (including those to be seen in the continuation of the roadcut approx. 75 yards to the north). The lowest unit is white, buff-weathering, fine- to-coarse grained, laminated, trough cross-stratified quartz sandstone, 3+ feet thick dipping NE at 28 degrees.

Unit is overlain disconformably(?) by laminated, plane bedded, more friable, pink and white quartz sandstone. Unit persists through thickness of approximately 20" grading into unit 3, a more massive expression of the same lithology. A 3" set of trough cross-strata that occurs 4" below top of unit 2 may be filling a channel. Unit 2 contains laminae packaged in coursening-upward bundles one to three inches thick.

Tracing unit 2 toward to South end of the outcrop reveals at least two instances where it is brecciated and fills vertical interstices on planes of displacement(?). Flow lamination in the sand matrix parallel (?) to the plane of movement suggests deposition of the matrix by fluid but indices for the direction (stratigraphically up or down) of fluid motion are lacking. Such autobreccias constitute a 4th unit. Lest there be question regarding structural motion on these surfaces, there are well-developed, if a bit weathered, slickensides in the upper portion of the south end of the outcrop.

Walking northward will bring one to a low outcrop of siliceous autobreccia and finally to a second laminated sandstone, the exact relationship of which is unclear.

Coloration in the Potsdam Sandstone is often a point of interest, even contention. Lower surfaces of pink, hematitic(?) color bands on this outcrop sometimes transgress bedding planes and show sharp boundaries having micro-irregularities similar to those of stylolytes. Coloration seems diagenetic not primary depositional in origin in this case. Such may not always be the case for Potsdam coloration, therefore each outcrop should be examined without prejudgment in the matter of color.

Stratigraphic relationships of many sandstone outliers, including those of the type Potsdam (Reed, 1934), to the main lithosome are unknown. Most workers today discuss informally the red, pink (or peach in Canada), pink and white, and white Potsdam. The terms lower and upper Potsdam are used as well. Although relationships among these units are unclear, paleoenvironmental interpretations are likely to eventually afford means for distinction.

At this outcrop consider the following questions:

1. What depositional environments are represented by the various units?
2. What are the structural relationship of the outcrop?
3. What might the sources of coloration in the sandstones be?
4. Are trace or body fossils present?
5. What is the age of this sandstone?

Reboard bus after 20 minutes. Proceed northwestward on Hwy. 87 toward village of Heuvelton.

| | | |
|---|---|---|
| 13.0 | 1.6 | Cross Oswegatchie River. |
| 13.3 | 0.3 | Note roadcut exposure of Precambrian granite gneiss. |
| 19.3 | 6.0 | Village of Heuvelton. This region of St. Lawrence County has been settled by Amish groups so it is probable that we will see horse-drawn buggies or other farm equipment while driving along the south side of Black Lake. These gentle folk are superior craftspersons who contribute much to the diverse culture of this county. |

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| 19.6 | 0.3 | Turn LEFT (WSW) on Hwy. 184 and proceed to Pope Mills & Jct. with Hwy. 58. |
| 26.1 | 6.5 | Note stone house in Federal architectural style on right. |
| 29.7 | 3.6 | Note outcrops of pink and white orthoquartzite on both sides of the road. There are no fossils in this rock and it resembles some of the laminated units seen at the last stop. Note the terrain change ahead as bus crosses into metamorphic country rock. |
| 30.3 | 0.6 | Grenvillian gneiss. |
| 31.2 | 0.9 | White, poorly bedded sandstone. |
| 31.9 | 0.7 | Gray gneiss with granitic dikes cutting outcrop. |
| 33.0 | 1.1 | Pope Mills. Note outcrop of marble in the village as bus turs toward North. Bend to the RIGHT (NW) on Hwy. 58 to Edwardsville. |
| 35.7 | 2.7 | Cross Black Lake at Edwardsville. |
| 35.8 | 0.1 | Jct. with Hwy. 6. Turn LEFT (SW) and proceed to village of Hammond along the north shore of Black Lake. The north shore of this long, narrow lake marks the edge of rather flat-lying, Paleozoic sediments. |
| 41.8 | 6.0 | Exposure of Paleozoic sandstone. |
| 43.0 | 1.2 | Blinker light at jct. with Hwy. 37 in Hammond, N.Y. Proceed straight through the intersection. |
| 43.3 | 0.3 | Turn RIGHT in Hammond on Co. Rd. 3 toward Oak Point. Note use of stone in the new house on the right at corner. |
| 44.4 | 1.1 | On left is a bedding plane exposure of white orthoquartzite having a striated, polished surface. It reveals no bed features, nor any fossils. Please notes its elevation with respect to the outcrop of Precambrian gneiss 0.1 mi. ahead and to the left side of the road. |
| 45.8 | 1.4 | After crossing Chippewa Creek, arrive at Jct. with Pleasant Valley Road. Turn LEFT and proceed to Jct. with Hwy. 12. While driving note the escarpment cut in Paleozoic sediments on the right in the trees and the wide valley to the left in which Precambrian granitic gneiss whalebacks stand as evidence of proximity to the Precambrian-Paleozoic contact. |
| 49.1 | 3.3 | Turn RIGHT and travel NE along Hwy. 12 climbing through the outcrop to be visited. It is a road cut made where Hwy. 12 crosses the escarpment just viewed. Take this opportunity to preview the outcrop which we will spend some time examining. |
| 49.85 | 0.75 | Bus will turn LEFT at top of hill on Blind Bay Rd. and LEFT again at "T" intersection, returning to jct. of Pleasant Valley Rd. and Hwy. 12. |

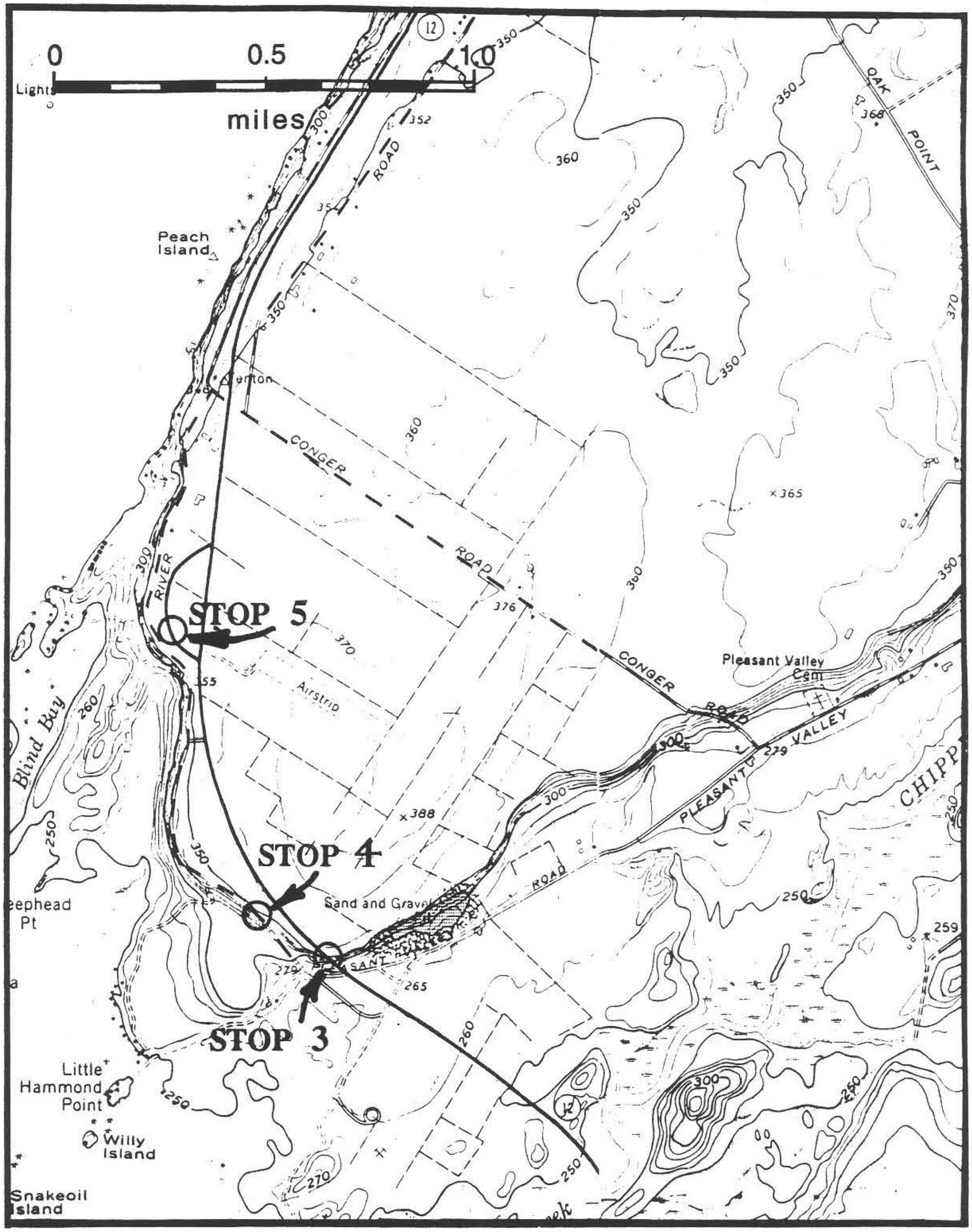


Figure 5: Topographic map illustrating location of Stops 3, 4, and 5 from portions of the Hammond and Chippewa Bay, N. Y., Quadrangles.

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|---|---|---|
| 50.8 | 0.95 | Turn LEFT on Hwy. 12. |
| 51.05 | 0.25 | Stop 3. Bus will proceed up hill to wide shoulder beyond guardrail. Discharge quickly. WATCH OUT FOR TRAFFIC. |

**STOP 3:** "White" Potsdam and Theresa Formations are exposed in this important outcrop (Figure 5). PLEASE USE PROFESSIONAL CARE - WATCH FOR TRAFFIC AND FOR LOOSE ROCK ON THE OUTCROP.

This outcrop provides one of the most complete exposures of the Precambrian-Potsdam-Theresa transitions in the northwestern St. Lawrence Adirondack Lowlands on the American side of the St. Lawrence River. That is not to say that the section is chronostratigraphically complete; almost certainly it is not, because the more angular, poorer sorted, ferrugenous, often arkosic and siliceous-cemented sandstone facies generally associated with the older (lower) Potsdam are not present in the immediate vicinity. The red rocks exposed approximately 0.3 miles to the SE are Precambrian alaskitic gneiss. Pleasant Valley intervenes between the exposure now being examined and the Precambrian outcrop leaving the possibility that the lower Potsdam section has been removed by erosion.

Other local sections, however, preserve the transition into white Potsdam Sandstone through a few to several feet of quartz cobble conglomerate which marks a marine transgression that is probably younger than Dresbachian in this region. Its precise age is not yet well constrained (Fisher, 1977) in this location, yet lithologic relationships in northeastern New York (Fisher, 1977; 1982) and recent ichnobiostratigraphic studies by Yochelson and Fedonkin (1993) infer a Franconian or even a Trempealeauan age for rocks not containing species of the ichnogenus *Climacticnites*. No *Climacticnites* sp. have yet been recovered from the "white" Potsdam sandstones locally.

The trip first examines a relatively unweathered exposure of Potsdam-Theresa deposits created as a roadcut approximately 25 years ago. This section includes units 3 through 8 on the composite stratigraphic column given herein (Erickson and Bjerstedt). The Potsdam is white, cream or buff, brown-weathering, moderately sorted, fine to coarse, medium-to thick bedded, cross-stratified or laminated, calcite- or silica-cemented orthoquartzite. Current ripples and "herringbone" cross-strata suggest deposition under tidal conditions (see Erickson and Bjerstedt herein). Contact between Potsdam and Theresa is taken to be at the inception of dominant calcareous cement in grey, buff-weathering, more poorly sorted ferrugenous, thin- to medium-bedded, limey sandstones and sandy dolostones. Bioturbation becomes a controlling element of preservation of primary sedimentary structure at this point. Iron is often present as pyrite framboids. Originally these sediments were very rich in organics. Much of that original food resource was removed by trace-making organisms leaving rocks of the unique "Theresa aspect" in which bedding planes are formed between bioturbated sedimentation units seen in this outcrop.

Cross-strata and presence of *Skolithos* sp. suggest that the white Potsdam lithofacies originated as sandwaves built across expansive tidal flats subsequently reworked by shifting tidal currents. Varying eustatic conditions resulted in recurrence of such conditons a number of times during Theresa deposition. Thus a "white Potsdam" lithofacies of rather clean quartz arenite can be found in the Theresa repeatedly. The *Skolithos* ichnofauna is not, however, always contained in it. It seems the Potsdam lithofacies does not always carry the Potsdam Ichnofacies.

At this outcrop the two styles of ichnofaunal development - infaunal suspension feeders and infaunal deposit feeders - are recognized. Bjerstedt and Erickson (1989) and Erickson and Bjerstedt (herein) discuss these trace fossil relationships, particularly as they relate to energy of depositional environment and depth of burrowing. Here it is emphasized that body fossils are essentially absent from this unit so that knowledge of the biota is developed from the ichnofauna. The Potsdam was unable to support deposit-feeding organisms as it was too well-sorted, reflecting high energy conditions of deposition on the tidal platform. Theresa sediments, on the other hand, must have held a rich admixture of organic matter within their more muddy matrix. These are burrowed extensively to depths of more than 5 cm by a wide variety of trace-making organisms. These are illustrated in the accompanying article by Erickson and Bjerstedt (herein).

Questions to be considered at this stop:

1. What were the depositional environments of the Potsdam and Theresa Formations.
2. Why are there no body fossils in these rocks?
3. What is the significance of the depth of burrowing n the Theresa? (Does it reflect ability of the Burrowing organisms, food content of sediments, sedimentation rates, oxygen content, or other environmental factors.)
4. What types of organisms were the likely trace-makers?
5. What was the source for the organics being utilized by deposit feeding ichnofauna?

Walk 0.1 mi up section along route 12. The bus will meet us at the top of the hill after 40 minutes. Please work your way up section steadily.

| | | |
|---|---|---|
| 51.3 | 0.25 | Turn left at sign to Blind Bay. |
| 51.35 . | 05 | Turn left at "T" intersection. |
| 51.85 | 0.5 | Proceed SW to low roadcut outcrop on scarp wall. |

**STOP 4:** WEATHERED THERESA FORMATION. (Figure 5.)

In the weathered bedding plane exposures found along this roadcut and the scarp to the SE one finds a diverse ichnofauna preserved in hyporelief, or occasionally in epirelief, on bed soles and surfaces. Examples of *Monocraterion* sp., *Phycodes flabelliforme*,

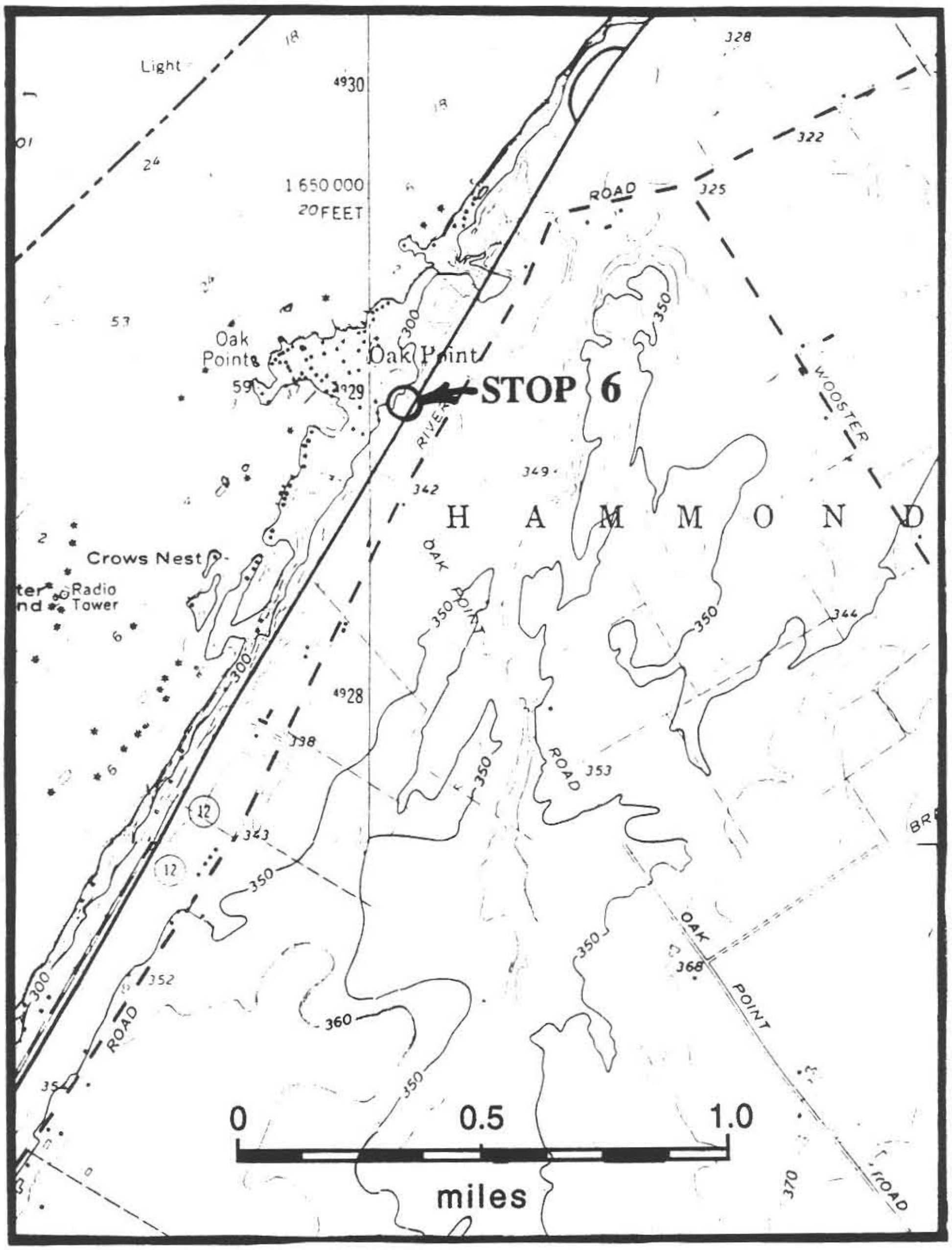


Figure 6: Topographic map illustrating location of Stop 6 from portions of the Oak Point and Hammond, N. Y., Quadrangles.

*Planolites* sp., *Roselia socialis* and perhaps of *Cruziana* sp., will be found here. Weathering along the scarp face represents approximately 10,000 years of development, whereas that along the roadcut may be much less. Apply the same questions examined at Stop 3.

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| 56.35 | 4.5 | Proceed back to Hwy 12. Turn left (NE). |
| 57.15 | 0.8 | Stop 5. Turn into Rest Stop overlooking Chippewa Bay/Blind Bay and the beginning of the Thousand Islands Region. |

**STOP 5:** ST. LAWRENCE SEAWAY SENIC VIEW. (Figure 5)

**Photo pause - 10 minutes**. Islands in the St. Lawrence River are formed by Precambrian (Grenvillian) granitic gneiss which is elevated along the Frontenac Arch, a structural high that links the Adirondack Dome to the Canadian Shield proper. This view of the region is probably not unlike that which one would have seen during the Cambrian as the Sauk marine transgression crossed the region. Knobs of grenvillian metamorphic basement became islands about which conglomerate, and subsequently sandstone, were deposited as tidal currents swept between the islands.

The St. Lawrence River, now a "seaway" for ocean-going vessels, flows NE draining the Great Lakes of Canada and the U.S. The international boundary passes up the middle of the river here, but east of Massena, NY the river lies entirely in Canadian territory.

Note boulders of local and regional rock types.

Return to Hwy 12 turning LEFT (NE) once again. You will be traveling on a surface held up by Paleozoic calcareous sandstones of the Theresa Formation. Note the appearance of this St. Lawrence Lowlands topography; it is typical of landscapes with very thin, or no, glacial drift remaining on it..

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|---|---|---|
| 59.65 | 2.5 | Proceed to Riverledge Rd. Turn LEFT (west) and follow road to Oak Pt. turn. |
| 60.10 | 0.45 | Turn LEFT at sign to Oak Point. Drive around the loop at Oak Point which is nearly at river level. Note Precambrian gneiss.<br>Where loop closes on itself Precambrian gneiss lies NE of road and Potsdam Ss has SW forming ledge behind garage. Contact not exposed but quartz pebble conglomerate occurs in wooded area to ENE of the side roads. |
| 61.0 | 0.9 | Jct. of Oak Pt. road and Riverledge roads. TURN LEFT and proceed .2 mi. |
| 61.2 | 0.2 | Stop beside low outcrop. |

**STOP 6:** SECTION AT OAK POINT. (Figure 6)

The drive around the Oak Point loop has provided a typical example of many of the exposures along both Canadian and American sides of the St. Lawrence River in this immediate region. Exposures along the frontage road contain the Potsdam-Theresa contact.

This outcrop offers another opportunity to investigate the burrowing depths, bioturbation thicknesses, and trace fossil taxa involved in the transition to carbonate rich mudflat sedimentation in lower energy conditions (?) upsection. This section is noteworthy because it has produced one example of an arthropod trackway of large size probably assignable to the ichnogenus *Protichnites* as is discussed herein by Erickson and Bjerstedt. The trackway will be available for examination and discussion at this stop.

Depart Oak Point turning LEFT (NE) onto Hwy. 12 toward Ogdensburg.

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| 61.8 | 0.6 | Note white sandstone bed in blue-gray Theresa Formation on right of road. |
| 64.3 | 2.5 | Slight deformation of Paleozoic strata can occasionally be seen in roadcuts such as that near Brier Hill. |
| 67.2 | 2.9 | Jct. with Hwy. 37. Several exposures of Theresa Formation form roadside outcrops here. |
| 68.4 | 1.2 | Stone fences constructed of slabby, upper Theresa Fm. begin to be a local hallmark in this region. They will be emphasized in the "Stone Fence Motel" that will be seen in about 15 miles on the LEFT (NW) side of the road. |
| 70.5 | 2.1 | Scotch Bush Road. A small quarry opened in the "white Potsdam" (or Heuvelton). Sandstone lies 1.3 miles south along this road. It is now being used to store rubble, but it once presented a fine view of this unit. |
| 75.8 | 5.3 | Stratigraphically the trip has traversed the Theresa-Ogdensburg contact. Bedrock now is Ordovician limestone and dolostone. The highway here passes through a small (no admittance) private, abandoned quarry in the Ogdensburg Formation in which can be found domal stromatolites. The depositional setting of these rocks was described by Kerans (1977) and conodont faunas from two larger quarries in the formation were investigated by Judson (1981). |
| 76.0 | 0.2 | Stone Fence Motel on left. |
| 77.3 | 1.3 | Pass a large stone quarry (behind berm on left) in the Ogdensburg Formation (See Kirchgasser and Theokritoff, 1971). It is beyond scope of this trip. |

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| 78.1 | 0.8 | Cross the Oswegatchie River the confluence of which with the St. Lawrence lies in the city of Ogdensburg. Note the "Golden Dome", a highschool hockey arena. |
| 78.9 | 0.8 | Jct. Hwy. 37 with Hwy. 68 to Canton. |
| 80.9 | 2.0 | Bridge to Prescott, Ontario, CANADA. Frequent views of the St. Lawrence Seaway and terraine formed on glacial Lake Iroquois sediments will be seen between Ogdensburg and Massena, NY. |
| 90.8 | 9.9 | Full view of Iroquois Dam, a waterlevel control structure, can be seen to the north. |
| 95.9 | 5.1 | Jct. Hwy. 37 and 345 (to Madrid) in the center of Village of Waddington. |
| 97.4 | 1.5 | Construction of the St. Lawrence Seaway raised water levels in the valley greatly. Many St. Lawrence River tributaries now have drowned valleys above their confluence. That of Sucker Brook, crossed here, and Brandy Brook are typical. |
| 98.0 | 0.6 | Valley of Brandy Brook. |
| 100.7 | 2.7 | Cole's Creek, the drowned valley now being crossed, marks a former channel of the Grass River drainage which was pirated eastward after the marine waters of the Champlain Sea were excluded from the St. Lawrence Lowland by isostatic rebound. Development of the present drainage followed. |
| 105.0 | 4.3 | To the LEFT (N) view a coffer dam constructed across another abandoned channel of the Grass River. This dam is designed to keep the valley from being flooded by waters of manmade lake St. Lawrence. |
| 110.3 | 5.3 | Jct. Hwy. 37 and 56. Continue on route 37 toward Malone. |
| 111.3 | 1.0 | Village of Massena. There are several items of geological interest associated with Massena. It was the site of a major rapids in the St. Lawrence River which became the site for the Moses-Saunders power dam of the NY Power Authority and Ontario Hydro. Massena was also the epicenter of the 1944 magnitude 4.0 (Richter) earthquake of regional significance.The Massena Clay, a blue, marine clay deposited in the Champlain Sea, underlies much of the region. This deposit contains the marine bivalve mollusks *Macoma baltica* and *Hiatella arctica*, a modest foraminiferid (Katz, 1981) and ostracod (Erickson et al., 1984 ) fauna, and to the south at Norwood, N.Y., the skeleton of a Beluga whale was recently recovered by Bill Kirchgasser (Kirchgasser and Steadman, 993). |
| 115.0 | 3.7 | Jct. with road to Robert Moses Park, (left) and St. Lawrence Mall (right). |

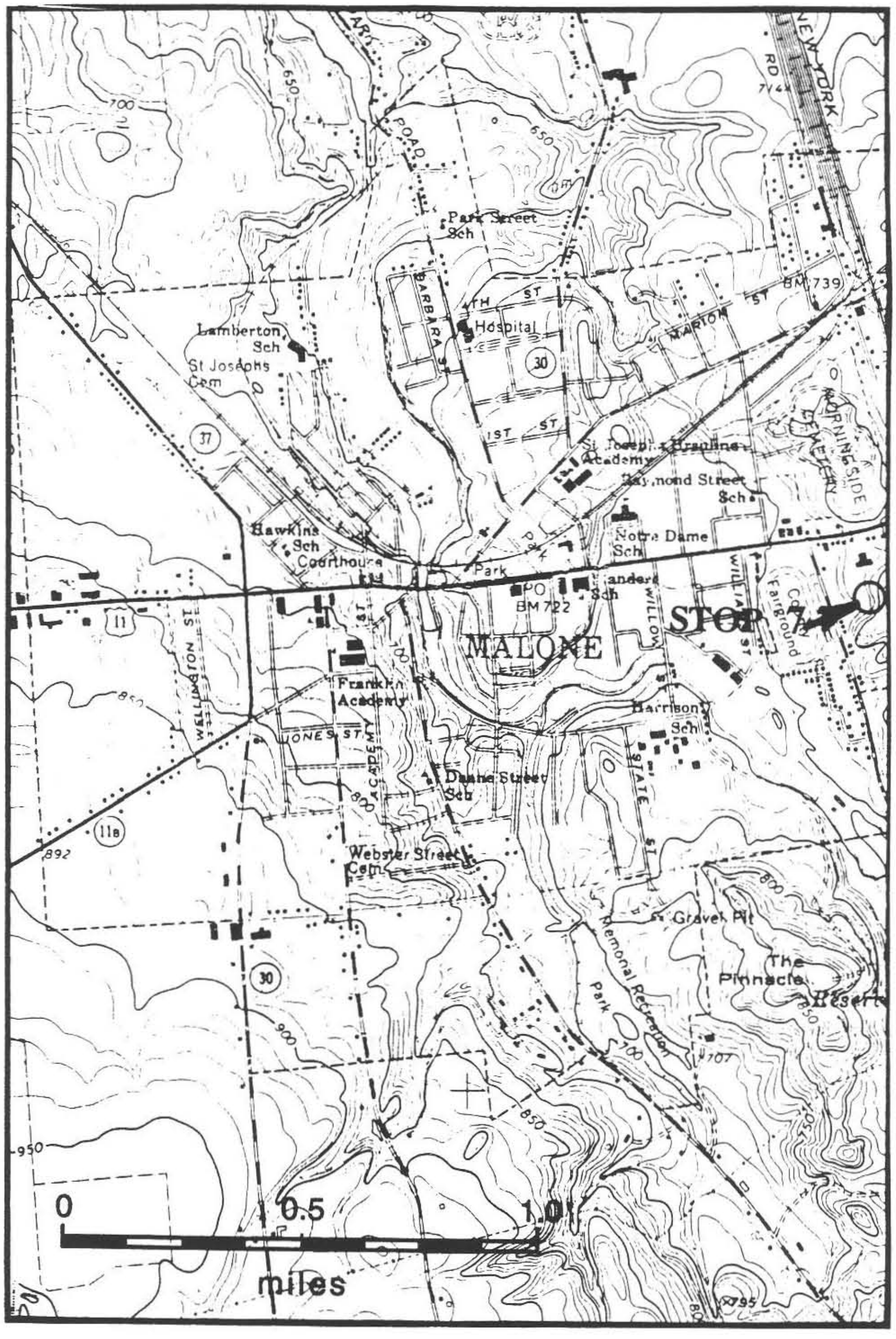


Figure 7: Topographic map illustrating location of Stop 7 on the Malone, N. Y., Quadrangle.

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| | | To the left is the visitor center of Eisenhower Lock, one of the sites where zebra mussels (*Dreissena polymorpha*) were first introduced to U.S. waters. Robinson Bay, northeast of the lock, will be the site of the $14 million St. Lawrence Aquarium and Ecological Center. |
| | | Inexpensive electric power from the NYPA project has made this the site of ALCOA, Reynolds, and GM plants producing and using aluminum. Some serious environmental problems have also been generated: the large earth moving project on the left is part of a PCB mitigation effort. |
| 119.9 | 4.9 | Biomass Poplar Plantation, are experimental, quick-growing strain of the poplar to be used for wood chips which fire a heating plant. This project was spawned by the energy crisis of the 1970's when some institutions like Clarkson University installed wood-fired heating plants. |
| 120.3 | 0.4 | View of the Raquette River to the right. |
| 121.0 | 1.0 | Cross Raquette River. |
| 121.4 | 0.4 | Enter Akwasasne the Mohawk Nation.7 |
| 123.6 | 2.2 | Cross St. Regis River. |
| 131.8 | 8.2 | Cross Little Salmon River. |
| 132.3 | 0.5 | Village of Ft. Covington at confluence of Little Salmon and Salmon Rivers. |
| 136.8 | 4.5 | Westville. The Salmon River here flows on bedrock. |
| 138.7 | 1.9 | Cross Salmon River. |
| 142.6 | 3.9 | Terrane begins to "roll" at the approaches to the town of Malone and begins to climb onto the platform of a major delta built into the Champlain Sea (Clark and Karrow, 1984). |
| 148.1 | 5.5 | Jct. N.Y. route 37 with routes 11, 11B & 30 at stoplight, western edge of Malone, N.Y. Turn LEFT and proceed E. on route 11 through downtown Malone, crossing the Salmon River, and begin to ascend hill on E. side of town. |
| 149.4 | 1.3 | Turn RIGHT on Hillside Dirve (before "Parts Plus" auto parts store), proceed to top of hill and make RIGHT turn on Strand Drive. |
| 149.6 | 0.2 | Disembark and carefully cross to driveway of gray house on the corner. This is our stop. Cameras; **no hammers**. |

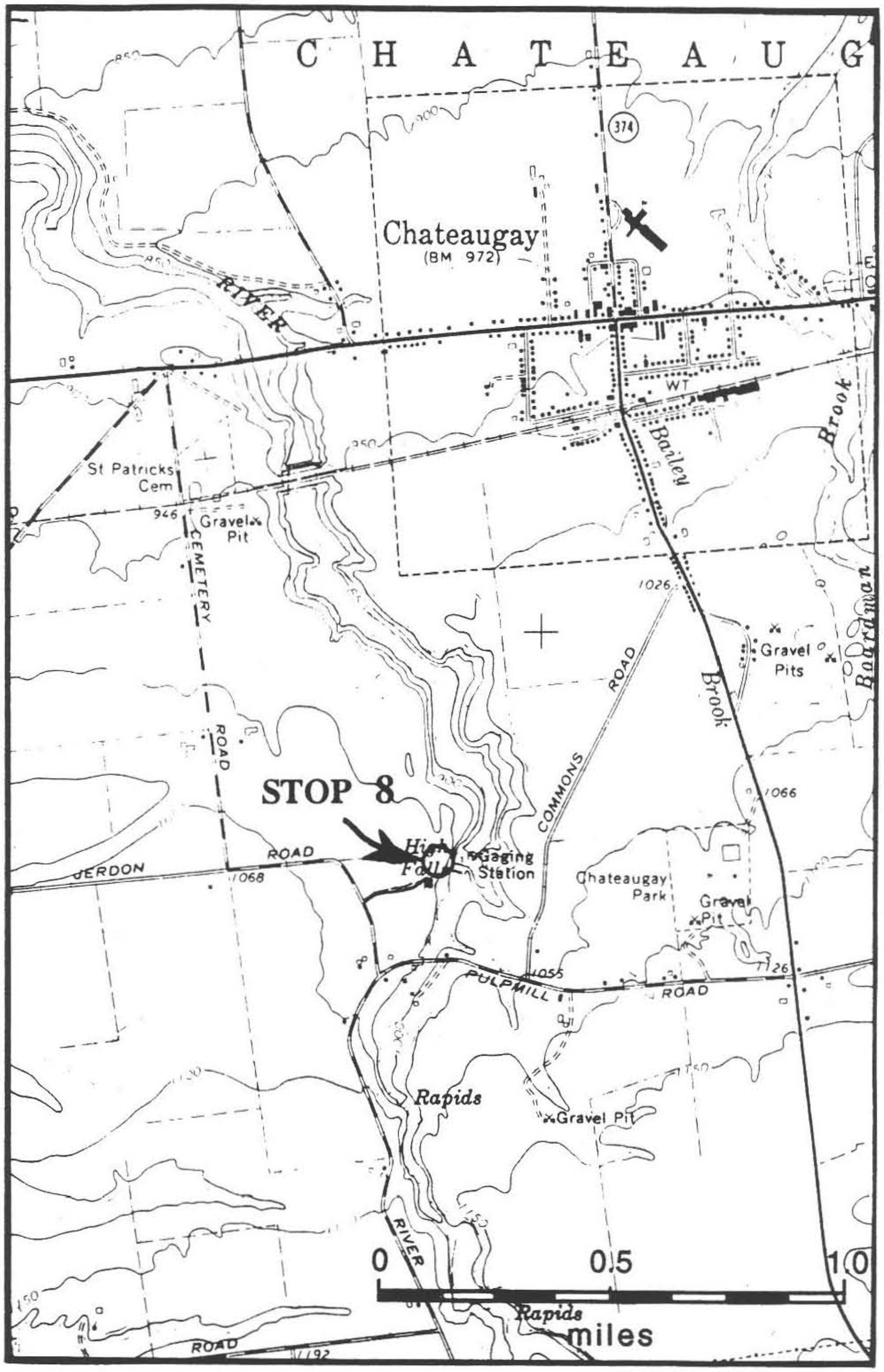


Figure 8: Topographic map illustrating location of Stop 8 on the Chateaugay, N. Y., Quadrangle.

**STOP 7:** MEAGAN RESIDENCE. (Figure 7)

Field trip members are the guests of the Michael Meagan Family. Walk up driveway and enter backyard through gate in fence. **Please stay on path**. Mr. Michael Meagan is the owner of the unusual Malone dubiofossils which we are here to view. The specimens, which are displayed near the pool, were discovered during excavation in 1992, and were recognized by Mr. Meagan to be unusual. He permitted removal of the specimens to St. Lawrence University where they were studied by Erickson.

Preliminary findings presented herein interpret these structures as slighly-transported fragments of algal mat with included trapped sediments. Please examine the specimens which are part and counterpart of a single block of laminated Potsdam Sandstone. During examination one may wish to keep the following questions (and others!) in mind.

1. What conditions were required to produce such an algal mat?
2. How much transport might they withstand?
3. Were there no animals present in the environment of deposition?
4. Could these be something other than algal/sediment features?
5. What is the age of this specimen?
6. Similar structures seem to be restricted to the Cambrian and very late Precambrian - why?

| | | |
|---|---|---|
| 149.8 | 0.2 | Retrace route to Hwy. 11 East. Turn RIGHT (eastward). You will climb again onto the plain of the Malone delta built into glacial Lake Iroquois (Clark and Karrow, 1984). From this vantage there is a commanding view of the St. Lawrence Valley to the North - the former basin of Lake Iroquois and later the Champlain Sea. |
| 156.8 | 7.0 | Entering Burke Center. The careful viewer will see to the north-northeast a prominent elevation across the St. Lawrence Valley. This may be Covey Hill, a Potsdam Sandstone ridge against which glacial ice lay to dam glacial Lake Iroquois. The lake drained between approximately 12,000 and 11,500 B.P. (Pair and Rodrigues, 1993). |
| 157.6 | 0.8 | Again, cross an abandoned drainage through a deltaic platform related to the ancestral Chateaugay(?) River. |
| 163.6 | 6.0 | Make a Right turn (Southward) on County Road 23, then bear left and follow signs to High Falls Park Campground, a distance of 1.6 miles. |
| 165.2 | 1.6 | Park at designated space and await trip leader to acquire entry to private property through a group rate fee. Pass through campstore and briskly walk to falls along designated trail. |

NO HAMMERS PLEASE.

**STOP 8:** HIGH FALLS PARK. (Figure 8)

This scenic stop affords the opportunity to view a more easterly exposure of the Potsdam Sandstone. Comparison with the sections seen previously at Pleasant Valley Road and Oak Point in St. Lawrence County will support the idea that the sandstone of the Potsdam thicken northeastward across the Laurentian Platform. Here more than 100' of section is exposed. As thickening occurs it is probable that age relationships within the formation become increasingly complicated. Trace fossils have assisted stratigraphers to make regional correlations and paleoenvironmental intrepretations in the absence of body fossils.

At this stop one may wish to examine character of the Potsdam lithologies, bedding characteristics and contacts, weathering profile, and trace fossil content of the rocks. What paleoenvironments are suggested? Time allowed 1/2 hour. Please return to bus promptly when requested.

| | | |
|---|---|---|
| 166.8 | 1.6 | Retrace route to Hwy. 11. Turn Right (eastward). |
| 166.9 | 0.1 | Cross Chateaugay River. |
| 167.2 | 0.3 | Intersection of Hwy. 11 and Depot Street at stop light, Village of Chateaugay, N.Y. |
| 167.9 | 0.7 | Rising out of ancestral Chateaugay River Valley, note retaining wall constructed of local sandstone. On the upland there is another view northward toward the St. Lawrence Valley and Canada. South of the highway lies a newly constructed substance abuse center, one of several penal facilities that have proliferated northward in the past decade. |
| 169.9 | 2.0 | Enter Clinton County, N.Y. |
| 178.8 | 8.9 | Ellenburg, N.Y. |
| 181.9 | 3.1 | Ellenburg Depot, N.Y. |
| 182.8 | 0.9 | The trip has crossed into the basin of the Great Chazy River, the North Branch of which is crossed here. |
| 185.3 | 2.5 | Again the trip crosses a deltaic sand plain, probably an element of the ancestral Chazy River system. |
| 191.3 | 6.0 | Cross Great Chazy River in Mooers Forks. |
| 194.3 | 3.0 | Jct. with Hwy. 22 at blinker light, Mooers, N.Y. Turn Left. Route winds eastward once gain at edge of the village where the modern floodplain of the Great Chazy River can be seen well developed south of the highway. |

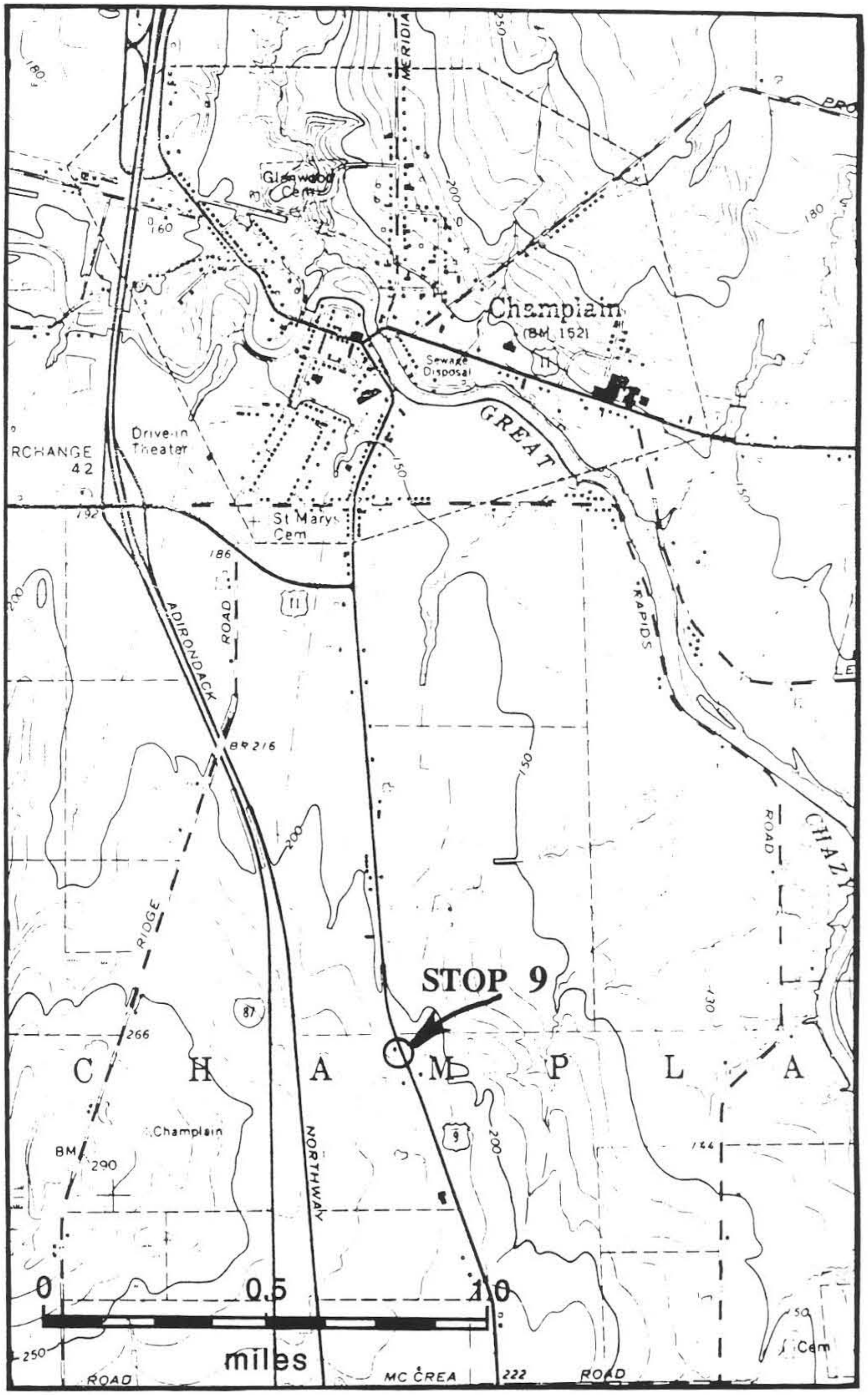


Figure 9: Topographic map illustrating location of Stop 9 from the Champlain, N. Y., Quadrangle.

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|---|---|---|
| 197.7 | 3.9 | Cross Great Chazy River once more on East edge of town of Champlain. |
| 200.7 | 2.3 | Cross I-87 ("Northway"). |
| 200.7 | 0.7 | At stoplight, jct. with N.Y. Route 9. Turn Right (South) and travel on surface held up by Potsdam Sandstone which underlies glacial deposits. |
| 201.8 | 1.1 | Stop 9. Parking lot of Clinton Farm Supply. |

**STOP 9**: CLINTON FARM SUPPLY. (Figure 9)

Exposed in the north half of the parking lot and surrounding an abandoned quarry to the rear of the Clinton Farm Supply are bedding planes of the Potsdam Sandstone. Rocks here are assumed to be in the upper or Keeseville Member. These are medium bedded, cream to white, plane and cross-stratified, quartz arenites (Fisher, 1968).

This outcrop affords an exceptional opportunity to examine bedding plane features, including large scale ripple marks, trough cross strata, sand waves and associated ichnofossils. The unusual and abundant trace fossils are of particular interest. Some aspects of these rocks are very similar to the white sandstone facies seen at Pleasant Valley Road (Stop 2) and within the Theresa Formation at Oak Point (Stop 3) this morning. At first look the traces fossils seem unique, however.

Some of the paleoenvironmental and ichnological features of this outcrop are described in the accompanying paper (Erickson, Connett, and Fetterman, this volume) resulting from studies by the 1993 St. Lawrence Paleoecology Class. Relationships here give insights into some questions raised at previous stops as well as spawning new questions such as:

1. What organism produced the large traces?
2. What controlled their distribution?
3. How deeply did they burrow?
4. What is the relationship, if any, of burrows to the ripples in both space and time?
5. How did the trace makers feed, on what, and where? (e.g., were they filter feeders, suspension feeders, or deposit feeders?)
6. Is this Potsdam Sandstone? What age is it?

Examine the outcrop thoroughly. Several bedding planes are preserved but the lowest surface, that displaying the ripples, is the most interesting. It continues on the south side of the road where some brittle-fracture patterns are present as well.

| | | |
|---|---|---|
| 202.9 | 1.1 | Jct. with Hwy 11. Turn LEFT (Westward) following Route 11 to Malone via Chateaugay. Proceed to west side of the village. |
| 250.0 | 47.1 | Jct. of Hwys. 11, 11B, 30 and 37 at stop light on the west side of village of Malone. Turn **LEFT** and proceed southward to next light - one long block. |
| 250.3 | 0.3 | Turn RIGHT (westward) at the light and follow Hwy. 11B to Potsdam. |
| 250.4 | 0.1 | Climb again onto rich soils of the Malone paleo-delta. Once a major potato-growing area, the presence of Popeye on the sign denotes that spinach is now the major crop. It is frozen on sight for sale to several brands. Rotation of fields assures nearly steady production during the growing season. |
| 255.0 | 5.0 | Bangor, N.Y., on the East Branch of the Little Salmon River. |
| 257.3 | 2.3 | W. Bangor |
| 260.9 | 3.6 | East Dickinson |
| 270.9 | 10.0 | Enter St. Lawrence County |
| 273.9 | 3.0 | Nicholville, NY on the St. Regis River. The Nicholville Conglomerate Member (Postel, et al., 1959) of the Potsdam Sandstone crops out along the river near here. It is overlain by orthoquartzite which occurs along Hopkinton Brook, .75 mi. N of Village of Hopkinton. Stratigraphic relationship between members are uncertain and distribution is local. As such, the Nicholville is one of three or four difficult-to-define, restricted, basal conglomeratic units that may be "Potsdam," but are more likely Precambrian. The Allens Falls Fanglomerate (Harris, 1988) is another such unit. Their examination is beyond the scope of this trip. |
| 275.9 | 2.0 | Hopkinton, N.Y. |
| 284.1 | 8.2 | Cross West Branch of St. Regis River. |
| 289.6 | 5.5 | Potsdam, N.Y. |
| 289.7 | 0.1 | Jct. with Hwy. 11. Turn LEFT at second stoplight. Proceed one block. Note use of true Potsdam Sandstone in buildings of Clarkson University and the village museum and library. This rock came from quarries south of the village that are no longer available for study. |
| 289.8 | 0.1 | Turn RIGHT and proceed "straight" through next light. |
| 290.2 | 0.4 | Cross the Raquette River. Note church of Potsdam Sandstone. on left when crossing island. Follow route 11 to Canton. |
| 301.9 | 1.0 | Intersection of Main and Park/Court Streets. |

END OF TRIP. HOPE YOU HAVE ENJOYED IT.

## ACKNOWLEDGMENTS

Numerous individuals and organizations have rendered assistance that has made this trip possible. If we should omit their mention here, it is due to our oversight rather than their lack of support.

Stratigraphy classes at St. Lawrence in the 1970's and early 1980's contributed much to my interest in the Cambro-Ordovician rocks of the St. Lawrence Valley. Marguerite Walsh, Catherine Goodmen,
Neil Sammis, Mark Klett, Charles Kerans and Michelle Judson made studies of particular note.

Dr. Thomas W. Bjerstedt was responsible for much of the descriptive work presented in conjunction with the second and third stops of this trip.

Mr. Michael Meagan alerted us to the Malone dubiofossil and expedited its removal for study at St. Lawrence. His efforts are commendable. Mr. Rick Scott of the St. Lawrence University Physical Plant and Witherbee and Whalen effected transport of the specimens to SLU and their return to Malone. Dr. H. Hoffmann gave the benefit of his experience with Cambrian dubiofossils.

Mr. and Mrs. Richard Laurin of Clinton Farm Supply graciously welcomed St. Lawrence students on several occasions during study of their outcrop. Dr. Richard Lindeman called our attention to the CFS outcrop originally.

Dr. Ellis Yochelson has discussed numerous points of stratigraphy and paleobiology with Erickson in the field and in laboratory on several occasions. The result has been an improved field trip.

Dr. Michael R. Owen and his students contributed to studies of the Potsdam Sandstone and Dr. James S. Street and his students have greatly contributed to studies of the history and process of deglaciation in the St. Lawrence-northern Adirondack region.

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