The Tully Limestone of Central New York - Stratigraphy and Facies Variation

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INTRODUCTION

The Tully Limestone of central New York is an anomalous sequence of carbonate rocks lying within thick coarse clastic rocks of Devonian age constituting the Appalachian Basin. The thin carbonates are sandwiched between terrigeneous detrital rocks thickening westwards from the Catskill Delta and represent a significant change of depositional environments through the Devonian epicontinental seas. The events leading to the development of the Tully Limestone have been described in detail by Heckel (1973) and this field trip is designed to provide a description of the Tully Limestone field relationships studied at Syracuse University within the framework of Heckel's study.

STRATIGRAPHY

The position of the Tully Limestone within the clastic wedge of the Catskill Delta has been delineated by Heckel (1973) and Chadwick (1935) (Fig. 1). Previous work recognized that the Tully Limestone was an unusual occurrence within the Catskill deltaic complex (e.g. Grabau, 1917; Cooper and Williams, 1935; Heckel, 1973). However, the majority of the work was oriented towards deciphering the changing patterns of deltaic deposition within the basin and did not consider the problem of unusual events that interrupted the normal succession. Heckel (1973) undertook the detailed examination of the Tully Limestone, the interpretation of the depositional environments and formulated causes for occurrence of a carbonate bed within a major detrital sequence.

The Tully Limestone is recognized for 100 mi in New York State in outcrops from the Chenango Valley on the east to Canandaigua Lake on the west (Fig. 2). It consists of well-bedded, dense, resistant, gray, fine-grained limestone and calcareous clastics that stand out in marked contrast to the adjacent less-resistant formations. Rarely exceeding 30 ft in thickness, the formation lies disconformably on approximately 1000 ft of the Middle Devonian Hamilton Group dark shales and siltstones. In central New York the boundary is marked by a slight diastem (Heckel, 1973) although in western New York the Hamilton-Tully boundary represents a non-depositional period and eastward the contact is erosional. Conformably overlying the Tully Limestone is the Geneseo Shale of the Genesee Formation. Between the Geneseo black shales, sandstones, and redbeds that

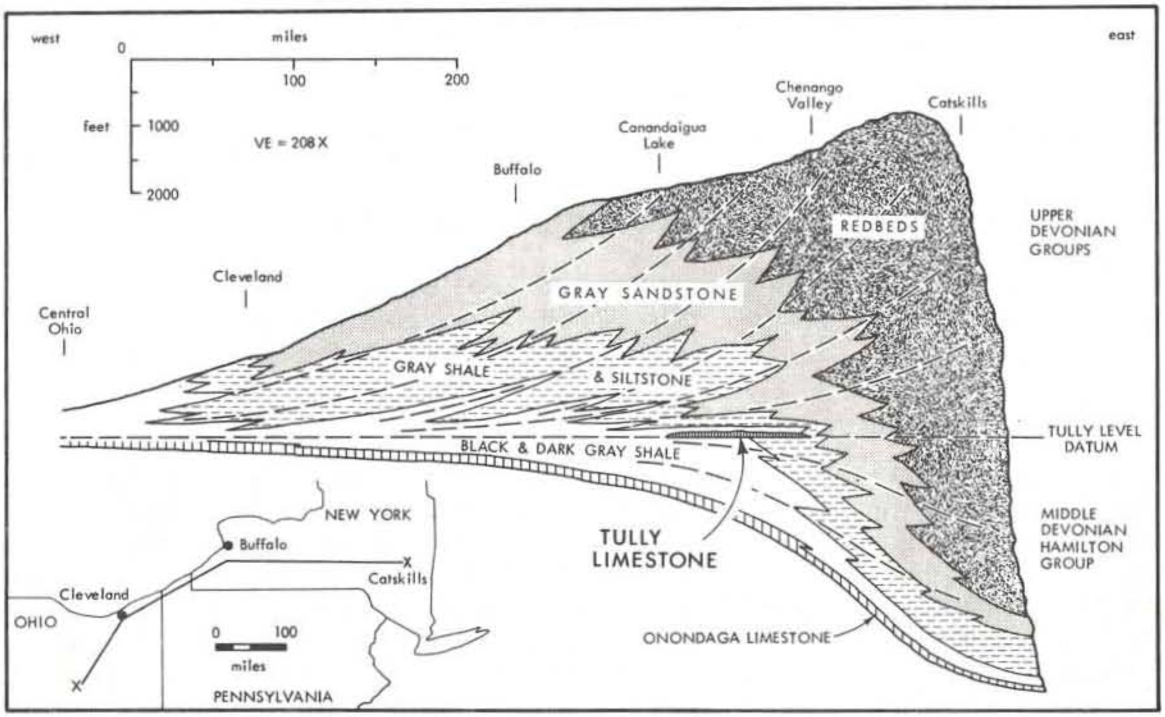

Figure 1. Position of Tully Limestone in cross section of Catskill delta.

exceed several thousand feet in thickness, and the persistent limestone beds of the Tully, occur interbedded limestones and shales from Cayuga Lake to DeRuyter. On the basis of fossil evidence and predominately carbonate lithology, the transitive beds have been assigned a Tully age. The Tully Limestone Formation consists of two members separated by a marked disconformity (Fig. 3). The Lower Member has seven beds of limestone, sandy limestones, and siltstones that are best developed in central New York. Beds of the Lower Member are listed with the dominant lithology in stratigraphic order.

Carpenters Fall Bed	(Limestone)
Vesper Bed	(Silty limestone to thin-bedded siltstone)
Tully Valley Bed	(Limestone to massive calcareous sandstone)
Meeker Hill bed	(Silty limestone to thin-bedded siltstone)
Fabius bed	(Limestone to thick-bedded calcareous siltstone)
Cuyler bed	(Thin-bedded calcareous siltstone)
DeRuyter bed	(Limestone to calcareous sandstone)

Representative sections through these units will be examined in the field trip and are described in Figure 4.

The Upper Member of the Tully Limestone is subdivided into a sequence of six beds. In descending order, these are:

Filmore Glen bed	(Limestone and shale)
Moravia bed	(Limestone)
Bellona coral bed	(Shaly limestone)

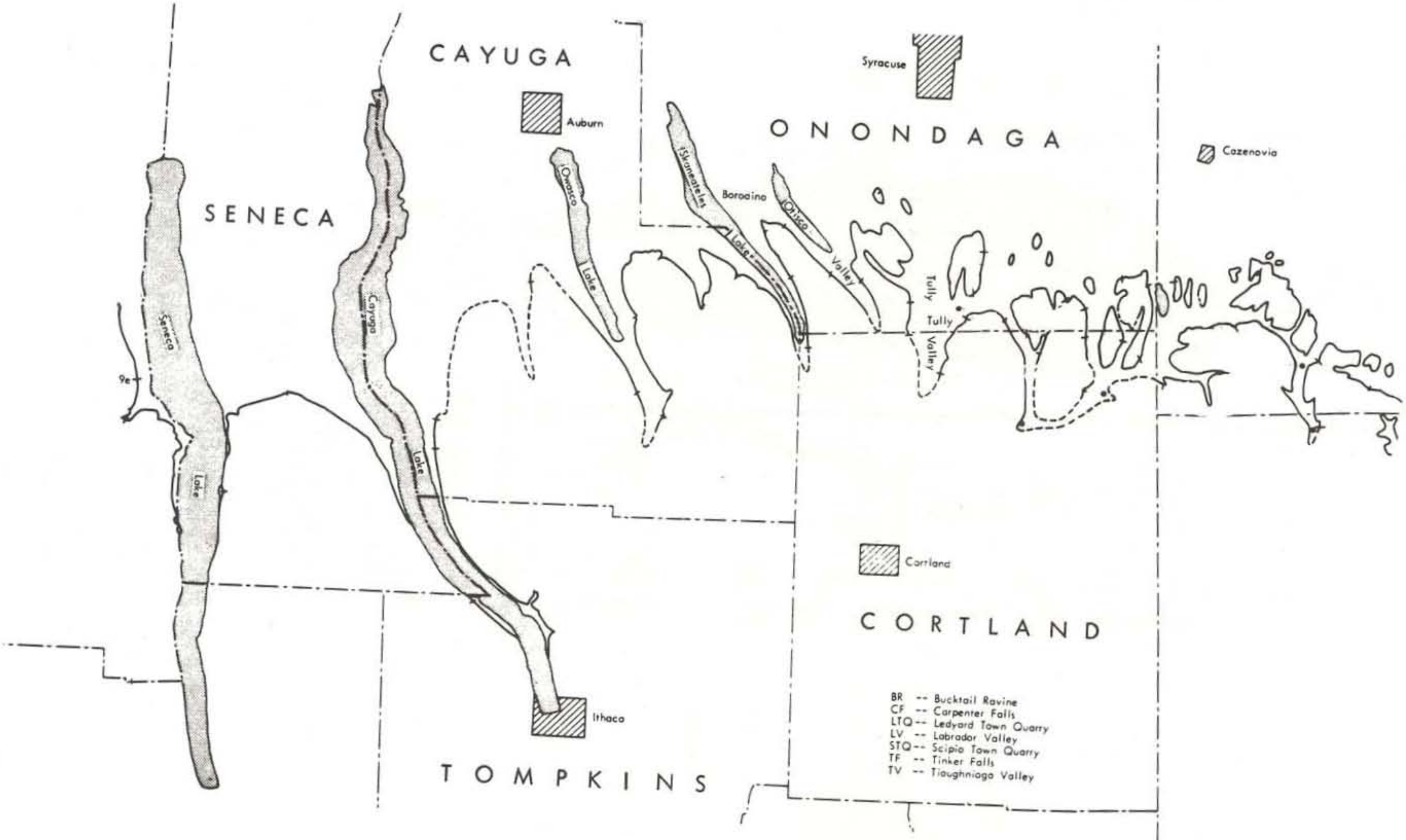

Figure 2. Outcrop map of Tully limestone in central New York.

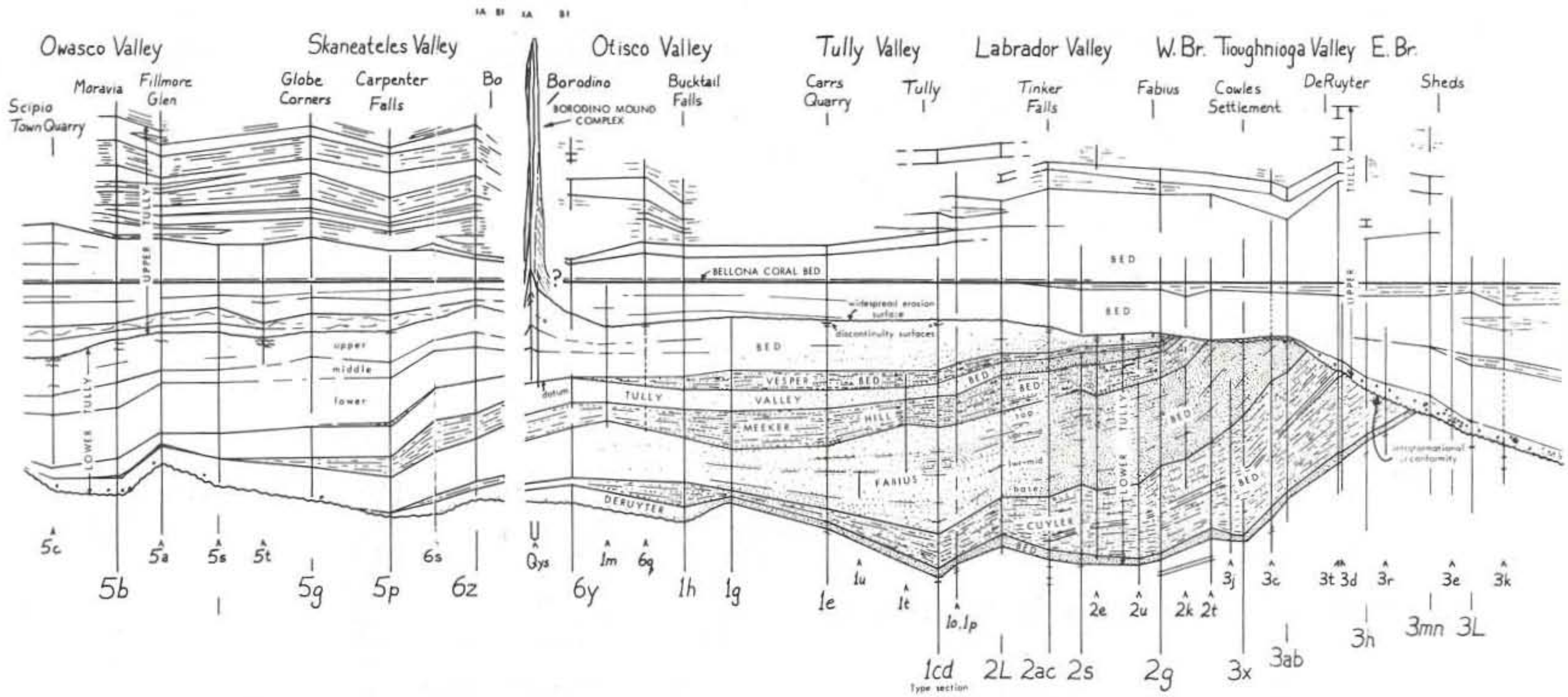

Figure 3. Correlation cross section of Tully Limestone from DeRuyter to Globe Corners.

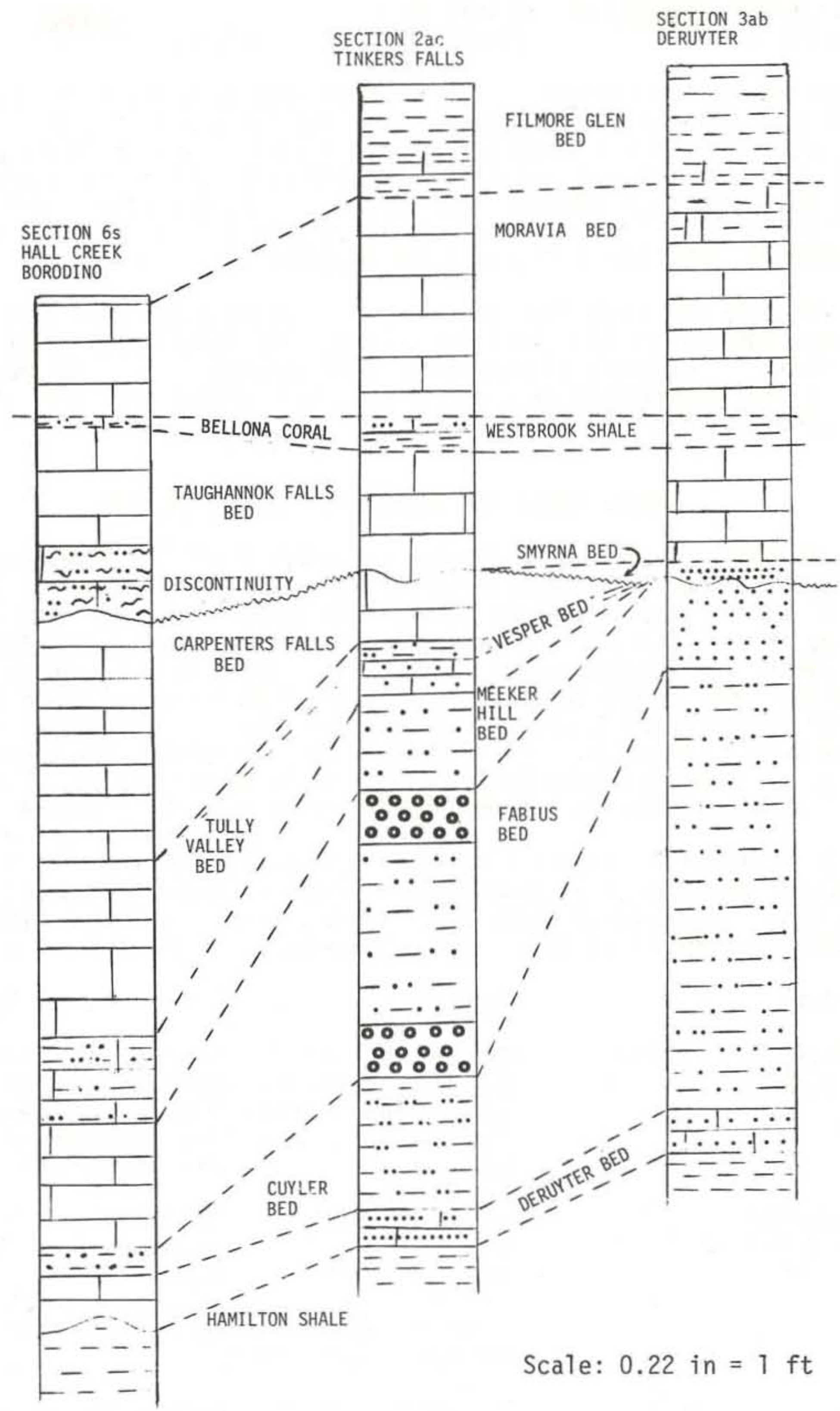

Figure 4. Measured Tully Limestone sections at Borodino, Tinkers Falls and DeRuyter.

Taughannock Falls bed	(Limestone)
Smyrna bed	(Sandy, oolitic limestone)

Separating the two members is a widespread erosion surface, an intraformational unconformity. At the west end of the Tully outcrop, the Taughannock Falls bed rests on the Carpenter Falls bed whereas progressing eastwards the Taughannock rests on successively lower units within the Lower Member until to the east of DeRuyter, the Upper Tully Member lies directly on Hamilton Formation shales. These relationships will be examined at stops 1 through 4, detailed in Figure 4 and Appendix 1.

The only deviation from conformable relationships noted in the Upper or Lower Members, is the development of a thick calcilutite mound complex at Borodino. Southeast of Borodino, the Taughannock Falls and Moravia beds thicken anomalously to 4 or 5 times their normal thickness into massive calcilutite and encrinite units.

FACIES VARIATION WITHIN THE TULLY LIMESTONE

The Tully Limestone, considered by Heckel (1973) to represent a shallow-water carbonate deposit formed during the development of a clastic trap in eastern New York State between the generally coarse deltaic sequences of the Catskill beds, reveals a carbonate facies variation consistent with a terrigenous source to the east. Throughout the Tully Limestone formation, beds in the easternmost sections show a coarser grain size, greater proportions of clastic constituents, and consequent lowering of the carbonate components. To illustrate this variation, three sections will be examined, DeRuyter Quarry [site 3ab in Heckel (1973)], Tinkers Falls (site 2ac), and Hall Creek near Borodino (site 6s) (Fig. 4).

In contrast the fourth site visited in the field trip will represent an unusual exposure of a carbonate mound complex developed outside Borodino (site Qys). Composed of skeletal calcilutites and encrinites, the mound depicts environments of deposition corresponding to the following list.

Facies	Appearance	Environment of Deposition
(1) Mound calcilutite facies	Massive, low content of terrigenous material, stromatactis, tabulate corals dominant	Quiet water, lime-mud deposition similar to Carribean region mud mounds. Local thickening occurred on a topographic high.
(2) Buckmound calcilutite facies	Dark-gray calcilutite with thin shale partings. Contains fine noncarbonate mud and sponge spicules.	Partially restricted marine equivalent to lagoonal conditions with access to normal Tully marine conditions.
(3) Encrinite facies	Consisting primarily of echinoderm fragments, with	Marine environment in which pelmatazoans flourished. Also, abraded

	possible stylolitic contacts and abraded grains in parts.	encinites represents winnowed shoal deposits and unabraded encrinites with mud matrix suggest off-mound conditions.

Heckel (1973) recognized within the Tully Limestone at sites 3ab, 2ac and Qys, both detrital and carbonate facies. Summarizing his published results and incorporating additional field evidence, the following set of facies can be described.

Facies	Appearance	Environment of Deposition
(1) Laminated muddy siltstone	Equal proportions of quartz silt and non-carbonate mud. Thin-bedded and laminated with a restricted brachiopod fauna esp. Chonetes aurora. Lithology is present in the Cuyler bed, Fabius, and east ends of Vesper and Meeker Hill beds.	Represents rapid deposition in a shallow near-shore, perhaps prodelta region, with variable salinity.
(2) Burrowed quartz sandstone	Coarse quartz sand in a carbonate and non-carbonate mud matrix with original lamination obliterated by burrowing. Lithology is present in eastern sections of Fabius, DeRuyter, and Tully Valley beds. Diverse fauna dominated by brachiopods.	A slow accumulation of sediment indicated by thorough burrowing. Normal salinity.
(3) Abraded calcarenite	Abraded, sand-sized, skeletal material forms the Smyrna bed and the eastern Carpenters Falls Bed. A finer grained, glauconitic variety of this facies is the Bellona Coral band.	Slow deposition with winnowing characterizes the facies. Reducing conditions may be prevalent during the Bellona.
(4) Skeletal calcilutite	Lime mud with large grains and with shell lenses. Dense and dark. Three subfacies are noted based on lithology and fauna.	Deposited in a marine environment with an available lime-mud source and low turbulence.

(a)Coral-Stylioline	Shaly laminae impart a wavy, knobbly appearance. Beds in the Moravia, Filmore Glen, and Taughannok Falls all represent this facies. Low faunal diversity. Burrowing.	Shallow-water, marine environment, partially restricted regime.
(b)Brachiopod	Constitutes all Lower Tully calcilutites dominated by brachiopods. Sandy portions prevail in the Fabius, Tully Valley, Lower Carpenter Falls, and DeRuyter whereas nonsandy sections are developed in the Tully Valley, Fabius, and DeRuyter beds particularly in the west. Emanuella and Schuchertella dominate the nonsandy sections and Chonetes in sandy beds.	Quiet water marine environment with diverse brachiopod faunal and well-developed burrowing indicating a low deposition.
(c)Diverse skeletal	Characterized by bryozoans, brachiopods, echinoderms, trilobites, and small corals. Contains shaly laminae, extensive burrows and intraclasts. It comprises parts of the Taughannok Falls and Moravia beds.	Optimum marine conditions for a diverse fauna. Slight wave or current action. Intermittent mud deposition.
(5) Barren shaly calcilutite	High content of noncarbonate mud and low diversity and numbers of fossils. Constitutes the Filmore Glen and Moravia Beds locally. Skeletal material is sparse.	Relatively undisturbed environment with intermittent sources of fine carbonate and detrital muds. Restricted, stagnating waters probably accounted for low fossil content. Deep waters are suggested by absence of agitated sediments.

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Appendix 1. Route Description & Road Log

Start: Heroy Geological Laboratory, Syracuse University, New York

End: Borodino, New York

Total Mileage: 75.8 miles

Total Mileage	Miles from Last Stop	
0.0	0.0	Assemble at Heroy Geology Laboratory. 8:30 AM. Turn R leaving the parking lot and proceed past the security booth down Crouse Drive. At the stoplight proceed directly onto Crouse Avenue. Turn L onto Harrison St. 3 blocks from the stoplight. Turn L at the 3rd stoplight going under the Rt. I81 bridge. Turn right immediately upon executing the L turn and enter the Rt. I81 South entrance ramp (watch the signs)
0.9	0.9	At the stoplight proceed across East Adams St. onto Rt. I81 South. Proceed to Exit 14, Tully.
2.6	1.7	On the R (SSW) observe the view down the Onondaga trough. This is one of a number of U-shaped glacial valleys characteristic of the area south of Syracuse. As glaciers receded a network of troughs and cross channels were established during the Pleistocene Epoch.
4.1	1.5	On the L in this roadcut observe the gently folded, well-fractured limestone strata of the Onondaga Formation. Stratigraphically this formation lies conformably below the Hamilton Formation upon which the Tully Formation disconformably rests.
5.8-6.2	1.7-2.1	Through this roadcut observe the protruding, differentially weathered chert layer in the upper portion of the exposure of this Middle Devonian outcrop.
11.9	5.7	Lafayette Exit. The shale outcrop in view is of the Hamilton Formation.
16.5	4.6	On the R observe the etched Tully moraine terminating this trough. It is part of the Valley Heads moraine system and is associated with kame and kettle topography representing a

Total Mileage	Miles from Last Stop	
		period of stagnation during the retreat of the glaciers in the Wisconsin Glacial Stage of the Pleistocene Epoch. Southward the moraine grades into a pitted outwash plain.
18.2	1.7	Exit 14, Tully; exit from Rt. I81 S. Hamilton shale and siltstones outcrop along the north-bound lane. At the end of the exit ramp turn L onto Rt. 11A. At the junction with Rt. NY80 turn L and proceed easterly towards Tully.
18.8	0.6	Off to the R (S) observe the tree lined kettle. Along the rest of the route note the gently to steeply rolling terrain and N-S trending glacially deepened valleys.
---	---	Pass through Apulia Station and Apulia (gas station - opposite land) along Rt. NY80.
26.0	7.2	Fabius
29.8	3.8	Turn R onto W Lake Rd (sign reads only "De Ruyter").
31.5	1.7	De Ruyter Reservoir on L. lower and upper Tully Formation outcrop on R (location 3c, Heckel, 1973).
32.8	1.3	Enter Madison County
34.2	1.4	Enter Cortland County
36.1	1.9	Stop 1 Turn R onto Coon Rd. on shoulder and park (W. Lake Rd. has become Highbridge Rd.). The abandoned quarry is located in the post-glacial stream valley upstream from Highbridge Rd. (location 3ab Heckel, 1973).
---	---	Continue on Highbridge Rd.
37.3	1.2	Stay R onto Rt. NY 13 and proceed to Truxton
43.6	6.3	Turn R (N) onto Rt. NY 91 in Truxton.
45.8	2.2	Labrador ski slopes
48.6	2.8	Stop 2 Pull off onto shoulder or carefully cross the oncoming lane and park in widened shoulder area. Tinker's Falls lies upstream from the road; the stream bed is just N of the

Total Mileage	Miles from Last Stop	
		parking area across Rt. NY91. (Location 2ac Heckel, 1973)
---	---	Continue along Rt. NY91
52.0	3.4	Turn L onto Rt. NY80
56.1	4.1	Junction Rt. NY281
56.2	0.1	Turn L onto Rt. I81 South ramp entrance (Do Not enter Rt. 81, Stay R on Lake Rd.)
57.5	1.3	Stay L
58.9	1.4	Turn L towards Song Mountain
59.0	0.1	Turn R onto Gulf Rd. (sign reads Song Valley - Otisco Rd.)
60.2	1.2	Turn R onto Otisco Valley Rd.
64.7	4.5	Turn L onto Sawmill Rd.
65.3	0.6	Turn R onto W. Valley Rd. The lower and upper Tully members are exposed along the banks of the ravine above the falls seen dead ahead from Sawmill Rd. (Bucktail Falls, location 1h Heckel, 1973).
67.2	1.9	Turn sharply to L and continue up W Valley Rd. Viewing the NE shore of Otisco Lake observe the recut delta deposits where post-glacial streams debauche into the lake.
67.6	.4	Turn R onto Stanton Rd.
68.3	.7	Turn R onto Becker Rd.
70.0	1.7	Stay L
70.1	0.1	Turn L onto an unnamed road
70.4	.3	Turn L onto Rt. 41
70.5	.1	Stop 3 Borodino Mound Complex. (location Qys, Middle Quarry, Heckel, 1973)
73.8	3.3	Turn R onto Woodworth Rd. (no street sign, Pine

Total Mileage	Miles from Last Stop	
		Tree grove on corner
74.3	.5	Stop 4 Intersection with Bacon Rd., park on roadside. This last outcrop is approximately 0.7 miles along Bacon Rd. in the 3rd ravine that is crossed. (location 6s Heckel, 1973)
---	---	Continue along Woodworth Rd.
75.6	1.3	Turn R onto Nunnery Rd.
75.8	0.2	Intersection with Rt. NY41, turn L towards Brordino, Marcellus and Syracuse (approximately 30 minutes to the city boundary).