MIDDLE AND UPPER DEVONIAN SHALES AND ADJACENT FACIES OF SOUTH-CENTRAL NEW YORK

BRENT K. DUGOLINSKY
State University College - Oneonta

GENERALIZED STRATIGRAPHY OF MIDDLE AND UPPER DEVONIAN SEDIMENTS OF NEW YORK

The Devonian section in New York is the standard reference section for eastern North America. Early workers recognized that major facies changes occur in the Middle and Upper Devonian sequence as a result of deposition of the Catskill delta. Consequently, older units originally mapped as formations or groups in a particular area were recognized as portions of major facies (Catskill, Chemung, Portage) cutting across time lines. Later workers concentrated on finding thin, widespread key beds within the thick deltaic sequence that are unaffected by rapid facies changes characteristic of rocks above and below. These key beds, which are believed to represent time planes, divide the deltaic sediments into several time-stratigraphic units.

The major facies, groups, formations, members, and key beds are illustrated on the Devonian correlation chart of New York (Rickard, 1975), a segment of which is shown in modified form in Figure 1. The field-trip participants, especially those not familiar with the Devonian stratigraphy of New York, will find it very useful to refer to this correlation chart to visualize facies changes, both vertically and horizontally, of units to be observed on this trip. Keep in mind that the vertical scale of the chart represents time, not thickness. Sedimentation rates are highly variable within the clastic units and show a general decrease from east to west within any given unit. The total thickness of Middle and Upper Devonian sediments included from the base of the Hamilton Group to the top of the West Falls Group decreases from over 5,000 feet at the Syracuse meridian to less than 1,000 feet at the eastern shore of Lake Erie. Figure 1 represents a classic example of the law of correlation of facies, which essentially states that within a given sedimentary cycle, the same succession of facies that occurs laterally also occurs in vertical succession.

The oldest time-stratigraphic unit which we will see on this trip, the Hamilton Group, is divided by 3 thin, persistent limestones (Stafford, Centerfield, and Menteth-Portland Point) into 4 formations: the Marcellus, Skaneateles, Ludlowville, and Moscow. Major east-west facies changes occur within the clastic interval above each key limestone bed. To the east the upper part of the black-shale facies (Marcellus and Skaneateles) is replaced by the lower part of the younger gray-shale/siltstone facies (Ludlowville and Moscow).

Thin limestones mapped as key beds in other intervals of the clastic wedge include the Tichenor Limestone (upper Ludlowville), the Tully Limestone, the Lodi and Genundewa Limestones (Genesee Group), and the Parrish Limestone (Sonyea Group). However, for the most part, the thick clastic wedge that developed from east to west during the Late Devonian can be more

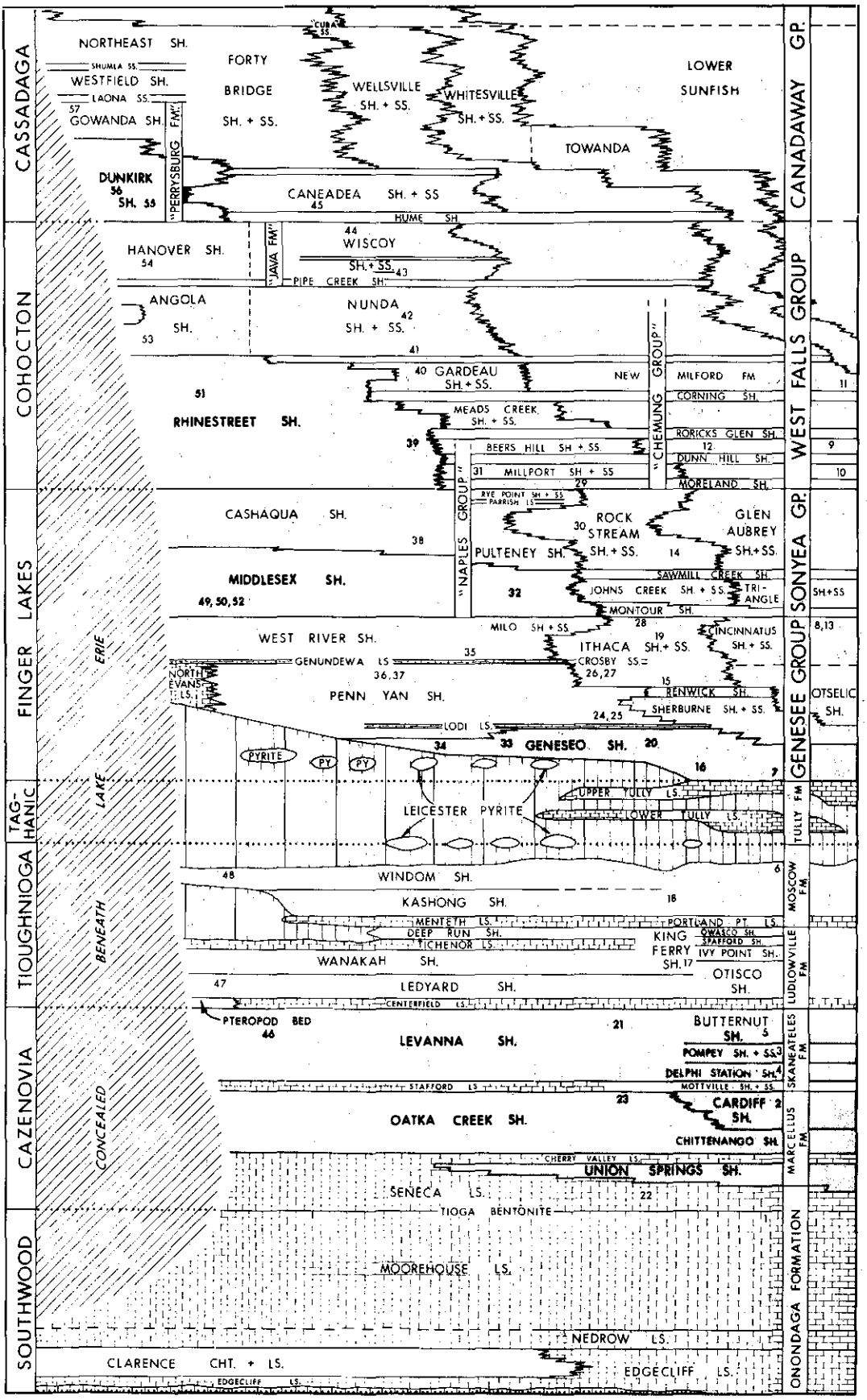

Fig. 1. Middle and Upper Devonian correlation chart for central and western New York (Modified from Rickard, 1975)

effectively divided across facies boundaries by tracing black-shale-tongues, and their eastward dark-gray-shale equivalents, across the state. The resulting stratigraphic framework has a black shale (Geneseo, Middlesex, Rhinestreet, Pipe Creek, Dunkirk) at the base of each thicker unit (Genesee, Sonyea, West Falls, Java, and Perrysburg, respectively). Although differences of opinion as to the rank of these major units (formation versus group) still exist, the concept of tracing black and dark-gray shales eastward into the clastic wedge appears to be accepted by most.

The base of the Genesee Group is defined by the black Geneseo Shale Formation, which extends from the Chenango valley northeast of Binghamton as far west as Erie County. Above the Geneseo Shale the clastics exhibit gross facies changes from east to west typical of most younger units as well. In the east, two units are mapped in the coarser facies: the Sherburne and Ithaca Formations, separated by the Renwick Shale. The Renwick merges westward with the Penn Yan Shale, which is the lower of two shales in the finer, westward facies. The West River Shale is separated from the older Penn Yan by the Genundewa Limestone.

The West River Shale of the Genesee Group is overlain in the west by the black Middlesex Shale of the Sonyea Group. The black-shale facies and a dark-gray eastern equivalent, the Montour Shale, define the base of the Sonyea. A second, younger dark shale, the Sawmill Creek Shale, defines the approximate eastward extent of the upper part of the Middlesex. Above the basal shale units, typical east-west facies changes occur, resulting in the mapping of an upper Rock Stream Siltstone and a lower Pulteney Shale in the east and a greenish-gray Cashaqua Shale in the west (Colton and deWitt, 1958).

The Cashaqua Shale is overlain in the west by the black Rhinestreet Shale of the West Falls Group. The Rhinestreet Shale defines the base of the West Falls from Lake Erie eastward to Seneca Lake. East of Seneca Lake, fingers of dark-gray shale define the eastern Rhinestreet equivalent (Sutton, 1963; Woodrow and Nugent, 1963).

The main purpose of this field trip is to observe the field relationships and subtle lithologic changes within and between the shales and adjacent facies in the "Catskill Delta" sequence and to interpret these characteristics in terms of the depositional environment. By the end of the trip, you should have a better understanding of why detailed mapping and identification of facies relationships remains complex and problematical in spite of exhaustive study by numerous workers for over a century.

REFERENCES CITED

Chute, N. E., 1970, Mineral industries in parts of Onondaga, Cortland, and Tompkins Counties, in Heaslip, W. G., ed.,New York State Geological Association Guidebook, 42nd Annual Meeting, Cortland, New York, p. E1-E27.

Colton, G. W. and de Witt, Wallace, 1958, Stratigraphy of the Sonyea Formation of Late Devonian age in western and central New York: U.S. Geol. Survey, Oil & Gas Inv. Ser. Chart OC-54,

Cornell University Department of Geology, 1959, Geology of the Cayuga Lake basin, in New York State Geological Association, 31st Annual Meeting, Ithaca, New York, (second edition), p. 26-36.

de Witt, Wallace and G. W. Colton, 1978, Physical stratigraphy of the Genesee Formation (Devonian) in western and central New York,: U. S. Geol. Survey Prof. Paper 1032-A, 22 p.

Dugolinsky, B. K., 1972, Sedimentation of the Upper Devonian Sonyea Group of south-central New York: M. S. thesis, (unpub.), Syracuse University, 120 p.

Grasso, T. X., 1978, Benthic communities of the Ludlowville and Moscow Formations (upper Hamilton Group) in the Tully Valley, Onondaga County, in Merriam, D. F., ed., New York State Geological Association Guidebook, 50th Annual Meeting, Syracuse, New York, p. 143-172.

Patchen, D. G. and B. K. Dugolinsky, 1979, Guidebook - Middle and Upper Devonian clastics: central and western New York State: U. S. Dept. Energy - Eastern Gas Shales Project, 170 p.

Rickard, L. V., 1975, Correlation of the Silurian and Devonian rocks in New York State: New York State Museum and Science Service, Map and Chart Series, No. 24, 16 p.

Sutton, R. G., 1963, Stratigraphy in the Apalachin and Binghamton quadrangles, in Coates, D. R., ed., Geology of south-central New York: New York State Geological Association Guidebook, 35th Annual Meeting, Binghamton, New York, p. 77-79.

Woodrow, D. L. and Nugent, R. C., 1963, Facies and the Rhinestreet Formation in South-Central New York: in Coates, D. R., ed., Geology of South-Central New York, New York State Geological Association Guidebook, 35th Annual Meeting, Binghamton, New York, p. 59-86.

ROAD LOG FOR MIDDLE AND UPPER DEVONIAN SHALES AND ADJACENT FACIES OF SOUTH-CENTRAL NEW YORK

STARTING POINT: Intersection of Rt. 434 (Vestal Parkway) and Bartle Drive (main) exit of SUNY Binghamton campus.

CUMULATIVE MILEAGE	MILES FROM LAST POINT	ROUTE DESCRIPTION
0.0	0.0	Turn left onto Rt. 434 and get in right lane.
0.1	0.1	Enter Rt. 201 on right.
0.7	0.6	Cross bridge over Susquehanna River.
1.0	0.3	Enter traffic circle and remain on Rt. 201 (N).
1.3	0.3	Overpass: 10'10" clearance
1.6	0.3	Bear left toward "Harry L" Drive.
2.0	0.4	Exit for Rt. 17 (W) toward Elmira and remain on Rt. 17 (W).
5.7	3.7	Town of Vestal (road sign)
10.5	4.8	Tioga County (road sign)
19.7	9.2	Leave Rt. 17 at Exit #64 for Owego and Rt. 96.
19.9	0.2	Turn left at end of exit toward Owego and cross bridge.
20.3	0.4	Turn right at yield sign and follow Rt. 96.
20.4	0.1	Turn right, staying on Rt. 96. Cross bridge into Owego and go through traffic light.
20.8	0.4	Turn right at light and then turn left immediately at next light, staying on Rt. 96.
21.1	0.3	Overpass: 12'7" clearance
21.2	0.1	Turn right onto East Avenue at traffic light.
21.3	0.1	Keep left at intersection of East and Prospect Streets, then keep left again for East Beecher Hill Road.
22.0	0.7	Park along road at STOP 1.

STOP 1. EAST BEECHER HILL ROADCUT, OWEGO, N. Y.

(Description partially from Woodrow and Nugent, 1963, and Patchen and Dugolinsky, 1979).

Exposures of Beers Hill and Roricks Glen Members of the Rhinestreet Formation. Elevation at bottom of exposure is 950'.

The Rhinestreet Shale defines the base of the West Falls Group from Lake Erie eastward to Seneca Lake. East of Seneca Lake workers at the University of Rochester under the direction of Robert Sutton have traced fingers of dark-gray shale that define the eastern Rhinestreet equivalent. In the area from Elmira to Binghamton, four dark shales and three intervening lighter colored shales and siltstones (including the Beers Hill Member exposed here) are defined as members of the Rhinestreet Formation (Sutton, 1963; Woodrow and Nugent, 1963).

The Roricks Glen is represented by scattered, very dark-gray shales at the upper end of the exposure. However, many of the darker shale layers have been covered and are difficult to locate. Also, the land above the roadcut is posted and it is therefore recommended that you limit your observations to the exposure along the road. Most of the exposure is in the Beers Hill Member, with flow rolls well developed in the section near the bottom of the hill, just above a landslide scar. Fossils are scarce, but worm burrows and trails (Fucoides graphica) are often found, particularly on the base of the thick, resistant coarser-grained beds. Flute casts, cross bedding and other current indicators are also found.

		Turn vehicle around whenever convenient and begin mileage from last point, heading back down East Beecher Hill Road.
22.8	0.8	Turn right (north) on Rt. 96 at traffic light.
23.0	0.2	Outcrop of Beers Hill Member of Rhinestreet Fm. is on the right.
24.1	1.1	Junction of Rts. 96 and 38. Continue north on Rt. 38. Beers Hill Member is outcrop on right.
31.5	7.4	Newark Valley
32.6	1.1	Outcrop of Sonyea Group extends east.
37.9	5.3	Berkshire
42.0	4.1	Richford
42.2	0.2	Turn left (west) on Rt. 79.
42.4	0.2	Park on right in parking area. With caution, walk across road to small stream and STOP 2.

STOP 2. RICHFORD, N. Y.

The base of the Middlesex Shale Member of the Sonyea Group may be seen exposed in the stream bed across the road from the parking area. The basal few feet of stream exposure is West River Shale, followed by brownish-black shale and siltstone of the Middlesex. Only a few feet are clearly exposed at this location.

Well-developed groove casts and burrows may be found on the base of silty beds. Most of a steep roadcut on the same side of the road as the parking area is covered, but a little digging will expose the Middlesex.

The Middlesex Shale gets progressively finer grained and darker farther west, towards the type section. This facies relationship is generally true for all Upper Devonian shale units.

		Continue west on Rt. 79.
44.5	2.1	Outcrop of Sonyea Group is on right.
47.0	2.5	Tompkins County
47.6	0.6	Caroline (road sign)
50.3	2.7	Slaterville Springs (sign)
52.3	2.0	West Slaterville
54.5	2.2	Turn right (north) on Landon Road and proceed up steep hill.
55.3	0.8	Turn left (west) on Snyder Hill Road at yield sign.
57.2	1.9	Turn right (north) on Quarry Road by old brick house.
57.6	0.4	Park where convenient and walk into quarry on left, STOP 3.

STOP 3. FINGER LAKES STONE CO. QUARRY, QUARRY ROAD, ITHACA, N. Y.

(Descriptions from Chute, 1970 and Dugolinsky, 1972)

The entire quarry exposure is within the Rock Stream Formation (previously named the Enfield Formation) of the Sonyea Group. Layers of sandstone alternate with layers of shale and siltstone. The Rock Stream has been interpreted as representing a shelf deposit (300-500 depth), althouch much shallower depths are likely. Its westward equivalent, the Cashaqua Shale, represents a slope and basin environments in deeper water.

Many of the silty and sandy beds pinch out rapidly. Fossils and sedimentary structures are very common and well developed. Sole marks may be best seen on the base of silty layers. Worm burrows are common. Excellent sole marks, including flute and groove casts, are usually most accessible on quarried slabs.

The quarry is presently operated by the Finger Lakes Stone Company. Slabs of sandstone are obtained without blasting by drilling holes on seams and separating them with wedges. The slabs are cut to the desired sizes in the mill by diamond and wire saws. Pieces with good joint surfaces are used for special surface effects. The stone is laid in various patterns with different finishes, as illustrated by the exterior of the company's office at the quarry.

		Return to vehicle and continue north on Quarry Road.
57.8	0.2	Turn left (west) on Ellis Hollow Road.
60.2	2.4	City of Ithaca. Ellis Hollow Road becomes Mitchell Street.
60.6	0.4	Merge right onto Rt. 336 at third stop sign.
60.9	0.3	Bear right onto Rt. 79 (end of Rt. 336). Follow Rt. 79 (East State St.) through city.
61.3	0.4	Bear right, staying on Rt. 79. Cornell University is on right.
62.1	0.8	Junction Rts. 13 and 34. Turn right (north). Continue through three traffic lights to a 4-lane expressway.
63.7	1.6	Exit for Rt. 34 and Stewart Park. Leave expressway and turn left at stop sign. Drive under Rt. 13. Continue north on Rt. 34. Cayuga Lake is on left.
69.1	5.4	South Lansing
69.4	0.3	Turn left on Rt. 348 toward King Ferry.
70.1	0.7	Turn left on Portland Point Road (at Cargill Salt sign).
71.6	1.5	Park near abandoned cement plant and walk north along RR tracks to STOP 4-A.

STOP 4-A. RAILROAD CUT BETWEEN SALT COMPANY AND ABANDONED CEMENT PLANT, NORTH OF ITHACA

Exposure of the King Ferry Shale of the Ludlowville Formation.

About 25 feet of the King Ferry Shale is exposed here, with a noticeable dip to the south. Many concretions may be seen in the siltstone beds, which are lighter colored than the shales. The darker shales are commonly cross-laminated. A coquina (fossil-rich layer) is evident at the base and top of the siltstone unit.

Much of the unusual weathering characteristics of this exposure is thought to be due to salt contamination from passing railroad cars coming from the salt plant just to the north of the exposure.

Return to the road and walk a short distance into the gorge to the east. The bus can turn around in a wide area across the culvert and wait at the mouth of Gulf Stream, STOP 4-B.

STOP 4-B. GULF STREAM (SHURGER GLEN)

Exposured are the upper King Ferry Shale, the Portland Point Limestone, Moscow Shale and Tully Limestone.

The upper King Ferry Shale of the Ludlowville Formation may be seen in the exposures in and below the lower falls in Gulf Stream. The overlying Portland Point Limestone, near the lip of the lower falls, is very fossiliferous. Note the peculiar curved fracture pattern in the shales just below the falls.

The lower falls may be scaled on the left side (facing upstream) with care, where the approximately 5 feet of Portland Point Limestone may be examined. The Portland Point is coarsely crystalline and weathers brown. Slickenslides may be observed in the lower 8 inches of the member.

Float at the base of the lower falls includes samples of Tully Limestone, which is finer-grained and less fossiliferous than the Portland Point limestone.

The Moscow shales overlie the Portland Point and are roughly 100 feet thick in this area. They are well exposed upstream from the lower falls. A nearly complete exposure of the entire 100 feet may be seen about 5 minutes upstream. The overlying Tully Limestone is visible at the top of the cliff exposure and forms the lip of the upper falls which is about another 20-minute walk farther upstream. Dark shales (Geneseo) may be seen in the float below the upper falls and are probably exposed above the upper falls. There is excellent joint control in the stream at and immediately below the upper falls.

The gray silty shale and siltstones of the Ludlowville and Moscow demonstrate a high diversity fauna and represents sediments deposited in a subtidal shelf-delta platform (Grasso, 1978).

Return to vehicle and proceed back up hill.

73.1	1.5	Turn right (south) on Rt. 34B.
73.8	0.7	Turn right onto Rt. 34 at Rogue's Harbor Inn.
78.4	4.6	Ithaca
79.4	1.0	Junction Rts. 13, 34, and 79. Turn right onto Rts. 13 and 34, before bridge, and enter expressway.
81.3	1.9	Junction Rts. 13, 34, 79, 89, and 96. Continue straight ahead.
83.1	1.8	Turn left into Buttermilk Falls State Park, STOP 5.

STOP 5. BUTTERMILK FALLS STATE PARK

A recent study (deWitt and Colton, 1978) has revealed that 14 feet of Renwick Shale are exposed at the base of the lower falls, overlain by 478 feet of Ithaca shales and sanstones, which in turn are overlain by 135 feet of West River Shale. The Renwick Shale is easily accessible here, particularly for large groups. Note the darker color of the shale with the interbedded lenticular silty beds exposed. The precise contact of the Renwick with the overlying Ithaca is not easy to pick out.

The Renwick here separates coarser-grained clastics: the underlying Sherburne and the overlying Ithaca Formation. Westward, the Renwick merges with the Penn Yan Shale, which is the lower of two shales in the finer western facies. A travertine deposit may be seen on the vertical exposures at the left of the main swimming pool (looking upstream). It is assumed that these deposits are very recent (post-glacial) and result from the deposition of materials in groundwater.

		Return to vehicle and exit park. Turn right onto Rts. 13 and 34.
84.9	1.8	Jct. Rts. 13, 34, 79, 89, and 96. Turn left (west) onto Rts. 79, 89, and 96.
85.4	0.5	Turn hard right onto Rt. 89 north.
86.8	1.4	Exposure of Ithaca Formation is on left.
89.9	3.1	Town of Ulysses
95.7	5.8	Park on left (before bridge) in Taughannock Falls State Park. Walk into gorge, using trail on the left bank. STOP 6.

STOP 6. TAUGHANNOCK FALLS STATE PARK

(Descriptions from Cornell University Department of Geology, 1959, and from deWitt and Colton, 1978).

Note: At 215 feet, Taughannock Falls is the highest falls in North America east of the Mississippi River.

The main falls is at the head of a deep post-glacial gorge one mile long, with walls from 200 to nearly 400 feet high. The falls is determined partly by the superior resistance of the Sherburne sandstones and partly by the jointing pattern within the rock units. The upper 90 feet of the Geneseo Shale is exposed in the gorge walls from the level of the plunge pool to a point marked by a change in lithology and color. Much of the Geneseo is covered with talus in places. The entire Penn Yan (about 80 feet thick at this locality), the overlying Sherburne (also about 80 feet thick) and the Renwick Shale (about 35 feet thick) are exposed here, along with the lower portion of the Ithaca. At the mouth of the gorge, near the lake, is the lower falls (about 15 feet high), over the resistant Tully Limestone, (also about 15 feet thick here), between the weak basal Geneseo shales above and the shales of the Moscow Formation below.

Both the Sherburne and the Renwick facies are lost only about 15 miles west of this location, where they merge into the Penn Yan Shale.

Note particularly the interfingering nature of the contact between the Tully and the overlying Geneseo, easily seen in the stream bed above the lower falls. This indicates that although there may be an unconformity at the top of the Tully Limestone farther west, there is none here.

Joint control is well developed, particularly within the Geneseo Shale, and is best seen in the cliffs below the main falls and in the stream bed just below the main falls. Alonite dikes, each less than one inch thick, are present in the stream bed beneath the main falls.

We are now on the northern flank of the Fir Tree Anticline and a slight northern dip may be seen easily if you look at the water flowing over the Tully Limestone, following a bedding plane, just above the lower falls where the stream bed is wide. En echelon fractures are well developed in the Tully Limestone exposed in the stream bed.

This gorge was used in pre-World War II days for sets in "western" movies and some of the wooden shacks precariously perched on the face of some of the cliffs were used to house the cameras during filming.

		Return to vehicle and continue north on Rt. 89.
96.9	1.2	Seneca County line
97.6	0.7	Frontenac Road and gorge to right

108.7	11.1	Turn left (west) on county road 138, just past shale quarry on left.
110.6	1.9	Jct. with Rt. 96. Turn right on Rt. 96 at stop sign.
112.4	1.8	Ovid
112.5	0.1	Turn right (north) at flashing traffic light, staying on Rt. 96.
115.0	2.5	Jct. with Rt. 414. Stay right on Rt. 414.
121.3	6.3	Fayette
121.9	0.6	Turn left on Poorman Road by Rapini's Fayette Motel.
122.2	0.3	Park by gate on left and walk into old quarry, STOP 7.

STOP 7. FAYETTE TOWN DUMP

(Description partly taken from Cornell University Department of Geology, 1959).

This quarry was originally operated by the Town of Fayette for road material and is now used as a dump. The upper 40 feet of the Levanna Shale and lower 20 feet of the Centerfield Limestone are exposed here. The Levanna is the upper member of the Skaneateles Formation whereas the overlying Centerfield Limestone is the basal unit of the Ludlowville Formation of the Hamilton Group.

We have observed the upper of two general facies within the Hamilton Group at Stops 4-A and 4-B: The Ludlowville and Moscow Formations. Here, we can see a different gross facies represented by the dark, fissile Levanna Shale Member of the Skaneateles Formation, which represents an anerobic, distal basin (Grasso, 1978). The overlying Centerfield Limestone separates this facies from the lighter colored, silty Ludlowville.

This is a good fossil-collecting site, particularly near the base of the Centerfield Limestone. Most common fossils are brachiopods, pelecypods, gastropods, plant fragment and fish remains. Mineral-filled fractures are common and asphaltic-filled fractures are occasionally found. Pyrite is commonly seen, particularly in the dark Levanna Shale. Large septarian concretions are seen in several layers within the Levanna Shale.

Return to vehicle. Turn around and head back toward village of Fayette.