FIELD ILLUSTRATIONS OF GEOLOGIC FEATURES IN THE UPPER SUSQUEHANNA VALLEY AND ADJACENT MOHAWK REGION

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Introduction

The outcrops and surficial features observed on this trip have been selected (1) to show students the change in lower Paleozoic stratigraphy through time (2) to illustrate several sedimentary and topographic features (3) to help students gain a better understanding of the geologic framework of this area.

The trip starts at the large Upper Devonian flood plain channel behind the F.W. Miller Science Building on the Hartwick College campus in Oneonta and ends in Precambrian garnet gneiss six miles east of Canajoharie. Progressively older beds are exposed to the north because of three factors: the gentle southerly dip of the beds, the erosion by the Mohawk river and the uplift, tilting and erosion of large fault blocks associated with normal faults in the Adirondack Mountains which extend into the Mohawk Valley.

The clastic sediments are the result of the Middle Ordovician Taconian Orogeny (470-435 m.y. ago) and the Middle and Late Devonian Acadian Orogeny (385-355 m.y.ago). Both of these times of crustal unrest and uplift east of the Hudson River and in New England provided an influx of clays, silts and sands into the Ordovician and Devonian seas which occupied the area of this field trip. The carbonate rocks were deposited by these seas during periods of quiescence between orogenies.

Geologic History of the Area

(Modified from Fisher, 1965)

During Precambrian time a thick sequence of geosynclinal sediments was deposited. The geosyncline was folded and regionally metamorphosed into a mountain range during the Grenville Orogeny (1,100 m.y. ago). For the next 500 million years the area was eroded and the mountains were beveled down exposing the metamorphic rocks in roots of the eroded mountains.

By Late Cambrian time these Precambrian metamorphic rocks were covered by transgressing shallow seas which deposited the Little Falls sandy dolostones and dolostones forming a nonconformity. The Precambrian gneiss and Late Cambrian dolostone are exposed in a railroad cut six miles east of Canajoharie along the Mohawk River.

Shallow seas continued to deposit dolomitic rocks into Early Ordovician time. The Chuctanunda Creek Dolostone exposed in the gorge of Canajoharie Creek represents deposition at this time. After deposition of this dolostone the seas withdrew.

In Middle Ordovician time shallow seas again covered the area and deposited the Kings Falls and Sugar River argillaceous limestones on top of the Lower Ordovician Chuctanunda Creek Dolostone forming a disconformity. The thin beds of black shale in the limestones reflect crustal unrest many miles to the east in the area of the present Taconic Mountains. This was the beginning pulse of the Taconic Orogeny. A thick black shale, the Canajoharie Shale, which overlies the limestones represents increased unrest during the Taconic Orogeny. These Early and Middle Ordovician sediments are well exposed in the gorge of Canajoharie Creek.

During Late Middle Ordovician time there was extensive erosion of the mountains. The detritus was deposited to the west as a thick sequence of shales and sandstones which are exposed in a few scattered outcrops between Sharon Springs and Canajoharie. The best exposure is just north of Sharon Springs.

Throughout most of Silurian time this area was emergent. If there are any Silurian rocks present, they are not exposed along the field trip route.

In Early Devonian time shallow seas encroached into the area and deposited a thick sequence of limestones (Helderberg Group) which are exposed north of Cherry Valley along Route 20 east to Sharon Springs.

Later in Early Devonian time there was uplift and erosion which resulted in the deposition of the Esopus Shale and Carlisle calcareous siltstone. This uplift was followed by another period of submergence when the Onondaga Limestone was deposited. These three formations are exposed on Route 166 north of Cherry Valley .25 mile south of Route 20.

During Middle and Late Devonian time the Acadian Orogeny was taking place in New England. This mountain building episode provided a vast supply of sediments which formed the thick sequence of sandstone, siltstone and shale which are exposed between Cherry Valley and Oneonta. These sediments were deposited as part of the extensive Catskill delta and flood plain deposits.

Since Late Devonian time the area has been subjected to erosion and the development of the Mohawk River, the Susquehanna River and their tributaries. In the Pleistocene, glaciers moved into the area. The ice enlarged the river valleys and deposited morainic material in the valleys. Some of this material was reworked by later advances of the ice to form drumlins or was redeposited by meltwater to form kame terraces along the valley walls. The area is currently being drained by the Mohawk River which joins the Hudson River north of Albany and the Susquehanna River and its tributaries which flows south through Pennsylvania and enters the Atlantic Ocean in Chesapeake Bay.

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STRATIGRAPHIC SECTION OF FORMATIONS ON TRIP

(adapted from Rickard and Zenger, 1964 and Fisher, 1965)

	Thickness	
Upper Devonian (Senecan Series)		
Oneonta Formation	200'	Stop 1
Gilboa Formation	460'	Stop 2
Middle Devonian (Erian Series)		
Cooperstown Shale	410'	Drove by (after stop 2)
Portland Point Limestone	5-6'	Not observed
Panther Mountain Formation	800'	Not observed
Solsville Sandstone	290'	Not observed
Otsego Shale	260'	Not observed
Chittenango Shale	150'	Stop 5
Cherry Valley Limestone	5'	Stop 5
Union Springs Shale	25'	Stop 5
Onondaga Limestone	120'	Stop 3
Lower Devonian (Ulsterian Series)		
Rickard Hill Limestone (Schoharie)	0-1'	? Stop 3 ?
- ? disconformity ? -		
Carlisle Center Shale	10-40'	Stop 3
- ? disconformity ? -		
Escopus Shale	0-20'	Stop 3
- ? disconformity ? -		
Oriskany Sandstone	0-2'	Not present
- unconformity -		
Lower Devonian (Helderbergian Series)		
Kalkberg Limestone	15-50'	Stop 6
Coeymans Limestone	90-100'	Stop 7
Manlius Limestone (lower Thacher member)	30-40'	Stop 4
Upper Silurian (Cayugan Series)		
Cobleskill Limestone	10-12'	Not observed
- ? disconformity ? -		
Brayman Shale	100-200'	Not observed
Vernon Shale	0-80'	Not observed
- unconformity -		
Middle Silurian (Niagaran Series)		
Herkimer Sandstone	0-40'	Not observed
Kirkland Hematite	0-2'	Not observed
- ? disconformity ? -		

Willowvale Shale	0-30'	Not observed
- ? disconformity ? -		
Sauquoit Formation	0-130'	Not observed
Oneida Conglomerate	0-15'	Not observed
- unconformity -		

Middle Ordovician (Mohawkian Series)

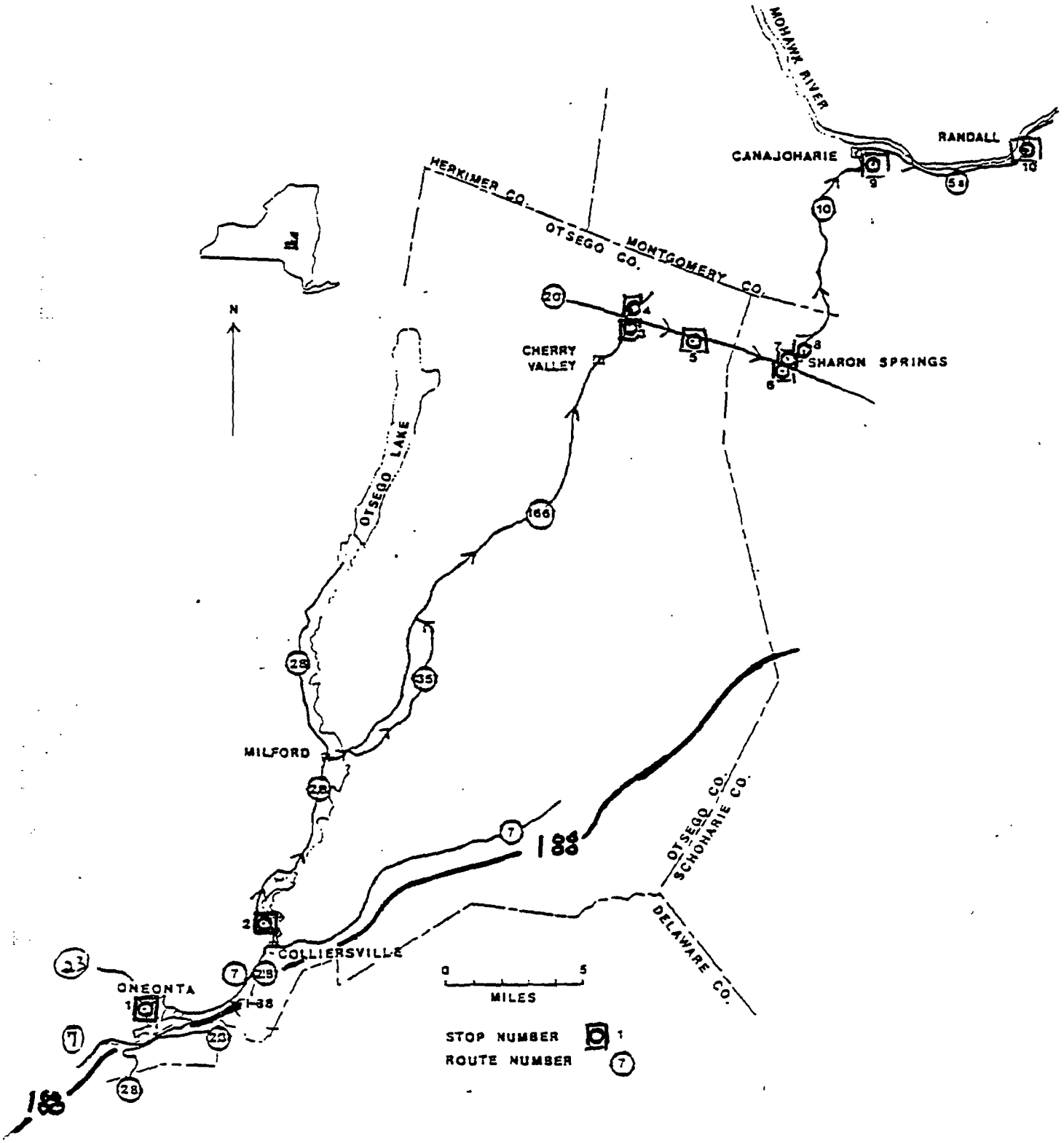
Frankfort Shale	500-800'	Just past stop 8
Canajoharie Shale	200' (?)	Stop 9
Sugar River Limestone	15'	Stop 9
Kings Falls Limestone		
- unconformity -		

Lower Ordovician (Canadian Series)

Chuctanunda Creek Dolostone	20'	Stop 9
Tribes Hill Limestone	100'	Not observed

Upper Cambrian (Croixian Series)

Little Falls Dolostone	500'	Stop 10
- unconformity -		
Precambrian gneisses	?	Stop 10


MOHAWK RIVER
RANDALL
CANAJOHARIE
HERKIMER CO.
OTSEGO CO.
MONTGOMERY CO.
N
CHERRY VALLEY
SHARON SPRINGS
OTSEGO LAKE
MILFORD
COLLIERSVILLE
ONEONTA
I-88
OTSEGO CO.
SCHOHARIE CO.
DELAWARE CO.
0 5
MILES
STOP NUMBER 1
ROUTE NUMBER 7

ROAD LOG

GEOLOGIC SETTING OF UPPER SUSQUEHANNA AND ADJACENT MOHAWK REGION

Updated 8/28/98

Cumulative Mileage	Route Description
0.0	ASSEMBLY POINT: Upper Devonian Outcrop (250 feet long, 15 feet high) next to Miller Science Building (West end of Arnold Hall Parking Lot). Drive up main entrance (two brick pillars). Either left or right fork will bring you to Arnold Hall Parking Lot and Miller Science Building.
	Departure: At 10:00 a.m. (or until group arrives from Binghamton)
	Stop 1 Upper Devonian Oneonta Formation
	This outcrop consists of dark grey shales, thinly bedded siltstones and sandstones. A massive sandstone which fills in part of a Devonian stream channel is well exposed for about 150 feet at the left end of the outcrop. There is an erosion surface between the underlying shale and the overlying massive sandstone. This surface which marks the bottom of the channel rises stratigraphically to the right. Interference ripple marks are exposed just below the road level. Plant materials are abundant in some layers. A few galena crystals about 1mm across have been found in the thinly bedded sandstone.
	Trilobites, marine pelecypods and brachiopods of the Gilboa Formation have been found in beds stratigraphically 75 feet below this outcrop, and marine fossils are found in thinly bedded siltstones and shales stratigraphically 200 feet below stop 1. This outcrop is next to Nick's Diner on Chestnut Street. We probably will not stop here today.
	A clean sandstone which shows extensive trough-type cross bedding overlies this outcrop.

Stop 1A is about 200 feet higher in elevation. Follow the road to the Ernest B. Wright Observatory.

Red mudstones and shales with root casts, worm burrows and ripple marks are exposed at the top of the hill just below the Ernest B. Wright Observatory which houses a 16" telescope.

The view down the valley is looking southeast to Mr. Utsayantha in Stamford (about 30 miles map distance). The broad U-shaped valley is the result of a Pleistocene glaciation. The Susquehanna River flows in from the north (out of your view) and through the city of Oneonta. The terraces on either side of the valley are kame terraces. Red beds are exposed near the top of the hills across the valley.

LEAVE STOP 1A AND GO BACK DOWN HARTWICK DRIVE TO WEST STREET AT THE MAIN ENTRANCE TO HARTWICK COLLEGE. (.5 miles)

TURN RIGHT (SOUTH) ON WEST STREET and continue going down hill. (For .2 miles)

TURN LEFT (EAST) ONTO CENTER STREET which is immediately past the Lutheran Church. (This is called "crash corner" for obvious reasons.)

CONTINUE ON CENTER STREET FOR .6 MILE TO WALLING AVE. TURN RIGHT (SOUTH). Walling Ave. is the first street to the right immediately after your cross Oneonta Creek at the entrance to the park.

Set Odometer Here
0.0

TURN LEFT (EAST) AT FRIENDLY ICE CREAM. You are now on Main Street and Route 7 And 28. (Stay on this road for 4.8 miles to Colliersville.)

0.1

Fox Hospital on your right.

1.2	Small kettle hole on right. This has been partially filled in to make a parking lot.
1.7	View to right showing kame terraces across valley.
2.3	Access to I88 (continue going straight)
3.2	On right (South) across valley gravel pit in delta Kame.
4.9	TURN LEFT (NORTH) ONTO ROUTE 28 IN COLLIERSVILLE AT JUNCTION OF ROUTE 28 AND 7.
5.4	Stop sign; turn left (North)
5.8	STOP 2 Stop directly next to dam at Goodyear Lake. There is parking on right (East) side of the road.
	The Upper Devonian Gilboa Formation with horizontal sandstones and siltstones is exposed here. The well developed flowrolls are of interest. It is apparent that these are primary structures (formed while the sediment was still "soft"), rather than secondary structures (formed after lithification), but there is some question as to Their origin. There are brachiopods, bryozoans, crinoids and pelecypods in some layers.
8.4	Outcrop of Middle Devonian Cooperstown Shale at curve in road. Good view ahead of broad U-shaped valley. The Susquehanna River flows south from its headwaters in Otsego Lake (Cooperstown) in this valley.
10.7	Spring 1998 Tornado damage on hillside to west.
13.3	TURN RIGHT (EAST) IN MILFORD ONTO ROUTE 166.
14.0	Cross Susquehanna River. Clays indicate a glacial Lake occupied this area. Grass now covers the glacial clays.

14.2	TURN RIGHT ONTO OTSEGO COUNTY 35 and take metal bridge over Cherry Valley Creek.
14.3	Bear left at junction
18.1	Old Church on right
18.7	Westville Cemetery on left.
19.7	TURN LEFT (WEST) AND CROSS CHERRY VALLEY CREEK. After crossing the creek, NOTE THE EXCELLENT hummocky morainic deposits showing numerous kettle holes and knob and kettle topography.
20.6	TURN RIGHT (NORTH) AND GO NORTH ONTO ROUTE 166.
22.4	OTSEGO 52
29.5	Town of Roseboom. Rte 165 – Rte 66
33.1	Cherry Valley Massacre Monument
33.3	Cherry Valley – The town was settled about 1740. On November 11, 1778 over 40 people were killed by Tories and Native Americans in the infamous Cherry Valley Massacre.
33.7	Limestone Bldgs. Route #166 verge left
35.4	STOP 3 (Pull off road to left and park in Highway Department gravel and salt storage area.) Topographically this spot is a break in the Helderberg escarpment. Fairchild interpreted this as a glacial spillway formed at a time when ice filled most of the Mohawk Valley. Meltwater was blocked from draining north and "spilled over" the escarpment eroding the valley (Fairchild, 1925). Fleischer (personal communication) feels that the valley is the result of glacial scouring of a through valley.

Three formations are exposed here. The lowest formation (exposed about .1 mile down the

road) is the Esopus Shale. This is overlain by the Carlisle Center calcareous siltstone which contains numerous worm burrows Toanurus cauda-galli (Rickard and Zenger, 1964). About .1 mile south along the road the Carlisle Center siltstone is overlain by the Middle Devonian Onandaga Limestone which contains crinoids, corals, and brachiopods.

The upper part of the Onondaga contains abundant chert. Jointing is very obvious at this outcrop.

LEAVE STOP 3 AND CONTINUE GOING STRAIGHT AHEAD AND GO UNDER ROUTE 20.

36.3 STOP 4 The Lower Devonian Manlius Formation (lower Thacher Member) crops out on the right. This laminated micrite contains some ostracods, teentaculitids and stromatoporids. Some mud cracks are present. This is the intertidal facies of LaPorte, 1967. The Coeymans Formation rests on top of the Manlius Formation.

TURN AROUND AND GO SOUTH TO ROUTE 20 EAST.

GO EAST ON ROUTE 20 FOR 2.6 MILES

TURN RIGHT OFF OF ROUTE 20 ONTO BLACKTOP ROAD AND PROCEED TO THE OUTCROP VISIBLE TO THE RIGHT.

STOP 5 Three Middle Devonian formations are exposed here. The lower most formation is the Union Springs Shale which is a black fissile shale containing calcareous concretions. There is a thin limestone near the top of the shale. This is overlain by the Cherry Valley Limestone which is about 7 feet thick and contains a cephalopod fauna. More than 100 feet of thejet-black Fissile Chittenango Shale rests on top of the Cherry Valley Limestone. At the east end (left) of the outcrop the Union Springs Shale has been broken up and sheared indicating some minor faulting.

	RETURN TO ROUTE 20 AND CONTINUE GOING EAST.
Reset Odometer	
0.0	Schoharie County Line. Reset Odometer to 0.0
1.7	STOP 6 Pull off the road and stop at down-going slope of hill. The Lower Devonian Kalkberg Limestone is exposed in a fresh outcrop. This is a medium grained thin to medium bedded limestone with abundant chert. There are numerous brachiopods, bryozoans, some corals and trilobite fragments. A 2" thick layer of bentonite is exposed near the eastern end of the outcrop (at the east end of grassy field below outcrop there is a small creek that disappears into a sink hold in the limestones.)
2.2	IN SHARON SPRINGS TURN LEFT (NORTH) AT STOPLIGHT ONTO ROUTE 10 AND PROCEED NORTH FOR .1 MILE TO OLD QUARRY NEXT TO BOWLING ALLEY.
2.3	STOP 7 (in old quarry) The Lower Devonian Coeymans Formation consists of a coarse grained, thickly bedded limestone with abundant brachiopods, crinoids and corals.
	LEAVE THE QUARRY AND PROCEED DOWN THE HILL.
2.9	STOP 8 (STOP AT PARK NEXT TO OLD (BATHS) Stop to look at springs and tufa deposits in the city park at the north end of the village of Sharon Springs. There is a strong odor of H2S from the spring water. This is probably caused by the water passing through the underlying thick black shales.
3.1	Upper Middle Ordovocian Shales and Sandstones Exposed in cliff at left.
4.9	Montgomery County Line
5.9	Two drumlins are in view to the left.

11.6 IN CANAJOHARIE TURN RIGHT AT THE FIRST STOPLIGHT ONTO MONTGOMERY STREET.

11.7 CROSS OVER CANAJOHARIE CREEK AND TURN RIGHT ONTO MOYER STREET. CONTINUE ON MOYER STREET. SIGN FOR WINTERGREEN PARK.

12.0 TURN RIGHT ONTO FLORAL AVENUE AND PROCEED TO THE TURN-AROUND AT END OF ROAD.

12.2 STOP 9 Four Lower and Middle Ordovician Formations are exposed in Canajoharie gorge. The lower most formation is the Chuctanunda Creek Dolostone. This is unfossiliferous except for the "hippopotami backs" which are dolomitized hemispherical stromatolites (algal mounds) (Park and Fisher, 1969). Large potholes have formed in the dolostone (Canajoharie is the Iroquois name for the "Pot that washes itself") (Park and Fisher, 1969).

The Middle Ordovician Kings falls and Sugar River black limestones overlay the dolostone, forming a disconformity. These limestones and the thin black shales in them contain abundant trilobite fragments, bryozoans, brachipods and crinoids.

The limestones are overlain by more than 100 feet of Middle Ordovician Canajoharie Shale.

12.4 RETURN TO JUNCTION OF FLORAL AVENUE AND MOYER STREETS. TURN LEFT AND GO DOWN HILL.

12.7 CROSS MONTGOMERY STREET AND GO ONTO MITCHELL STREET (WHICH IS 30 FEET LEFT AND PARALLEL TO CANAJOHARIE CREEK).

12.8 CROSS RAILROAD TRACKS AND TURN RIGHT ONTO ROUTE 5S AT THE BEECHNUT FACTORY. Continue on Route 5S.

En route to the next stop note the cliffs of Upper Cambrian Little Falls Dolostone.

19.3 STOP 10 Rusty weathering Precambrian garnet gneiss exposed along the south side of the road and in railroad cut.

FOLLOW THE FOOT PATH AT THE EAST END OF THE OUTCROP TO THE RAILROAD CUT. BEWARE OF POISON IVY ALONG PATH AND AT RAILROAD CUT.

The folded Precambrian gneiss is overlain by the Upper Cambrian Little falls Dolostone. The Dolostone is brecciated for several feet above the contact with the gneiss. Apparently there was movement along the unconformity during Ordovician time when the normal faults in the Adirondack Mountains and the Mohawk River Valley were formed. There are also good exposures of the gneiss north of this outcrop across the Mohawk River along Route 5 (5.4 miles east of Palatine Bridge).

PROCEED EAST TO OBSERVE THE FAULT-LINE SCARP OF NOSES FAULT FROM THE VEHICLES.

Overpass of Route 5S over the railroad tracks. Note that west of the Noses faulty-line scarp the Mohawk Rive Valley has steep cliffs of Little falls Dolostone. These are caused by the down cutting of the Mohawk River on the upthrown western side of the fault. East of the fault-line scarp on the downthrown side of the fault-line scarp there are no cliffs.

20.3 END OF TRIP AT RANDALL.
Note: Time may not permit us to stop at all of the Stops. Depending upon the interest of the group, certain stops may be omitted.

(Total Distance 60 miles)