STRATIGRAPHY AND PALEONTOLOGY - AROUND CAYUGA LAKE ONCE AGAIN

THOMAS X. GRASSO
Geoscience Department, Monroe Community College, Rochester, NY 14623-5780

JONATHAN W. HARRINGTON
Harrington Associates, Consulting Geologists, 390 Clark St. Ext., Groton, NY 13073

WILLIAM T. KIRCHGASSER
Department of Geology, State University College, Potsdam, NY 13676

INTRODUCTION

When the Association last met at Cornell on May 9. 1959, the three of us were soon to be graduate students at the University. The classic Devonian localities visited on Trip C were our formal introduction to a succession of rocks that has enlightened and challenged generations of students. Perhaps nowhere else in the State can such a variety of platform, slope and basin facies and faunas of the Catskill Delta be so profitably seen on a one-day excursion. Much progress has been made in understanding these rocks in the past 27 years and our purpose today is to retrace the route of Trip C in light of subsequent study. The advances in lithostratigraphy, paleoecology and goniatite and conodont biostratigraphy have been particularly notable. It seems especially appropriate that in the 150th Anniversary year of the founding of the New York State Geological Survey, we return to the geographic center of the Devonian outcrop and the succession described in the famed district reports of Vanuxem (1842) and Hall (1843).

The sequence of stops of the 1959 trip is followed and an optional stop (Stop 7) in the Renwick Member near Ithaca, has been added (Fig. 1). The stop descriptions in the 1959 Guidebook have been recast and revised where appropriate and discussions of economic and environmental factors have been added. Recent summaries with references to work since 1959 are Rickard (1975, 1981), Oliver and Klapper (1981), Woodrow and Sevon (1985) and Kirchgasser and others (1985).

Lower and Middle Devonian

The Devonian section in New York State begins mainly with carbonates (Helderberg Group and Onondaga Limestone) deposited during Early and Middle Devonian time, which are overlain by a thick, upward coarsening, regressive, clastic sequence that represents a westward migrating deltaic complex (Catskill Delta) constructed during later Middle and Late Devonian time.

The Lower Devonian Helderberg Group in the Cayuga Lake region is approximately 50 feet thick and represents a peritidal, lagoonal depositional setting. The nearly unfossiliferous Rondout is overlain by the low diversity Manlius Limestone containing the brachiopod *Howellella vanuxemi*, tentaculitids and some stromatoporids.

The overlying 4 feet of Oriskany Sandstone (Stops 4 & 5), resting uncomformably on the Helderberg Group, represents a transgressive, shallow water, high energy, near-shore environment. This inference is supported by the unit's coarse grain lithology and a fauna dominated by large, epifaunal, filter feeding brachiopods such as *Costispirifer arenosus*, *Hipparionyx proximus* and *Rensselaeria ovoides*. Gastropods (*Platyceras*) and bivalves are rare.

The Middle Devonian Onondaga Limestone, approximately 100 feet thick, disconformably overlies the Oriskany Sandstone and is characterized by a high diversity fauna dominated by corals, crinoids, brachiopods, and a variety of snails, bivalves, and trilobites. A low turbidity, relatively clear water, shallow shelf environment prevailed during Onondaga time in the Cayuga Lake region.

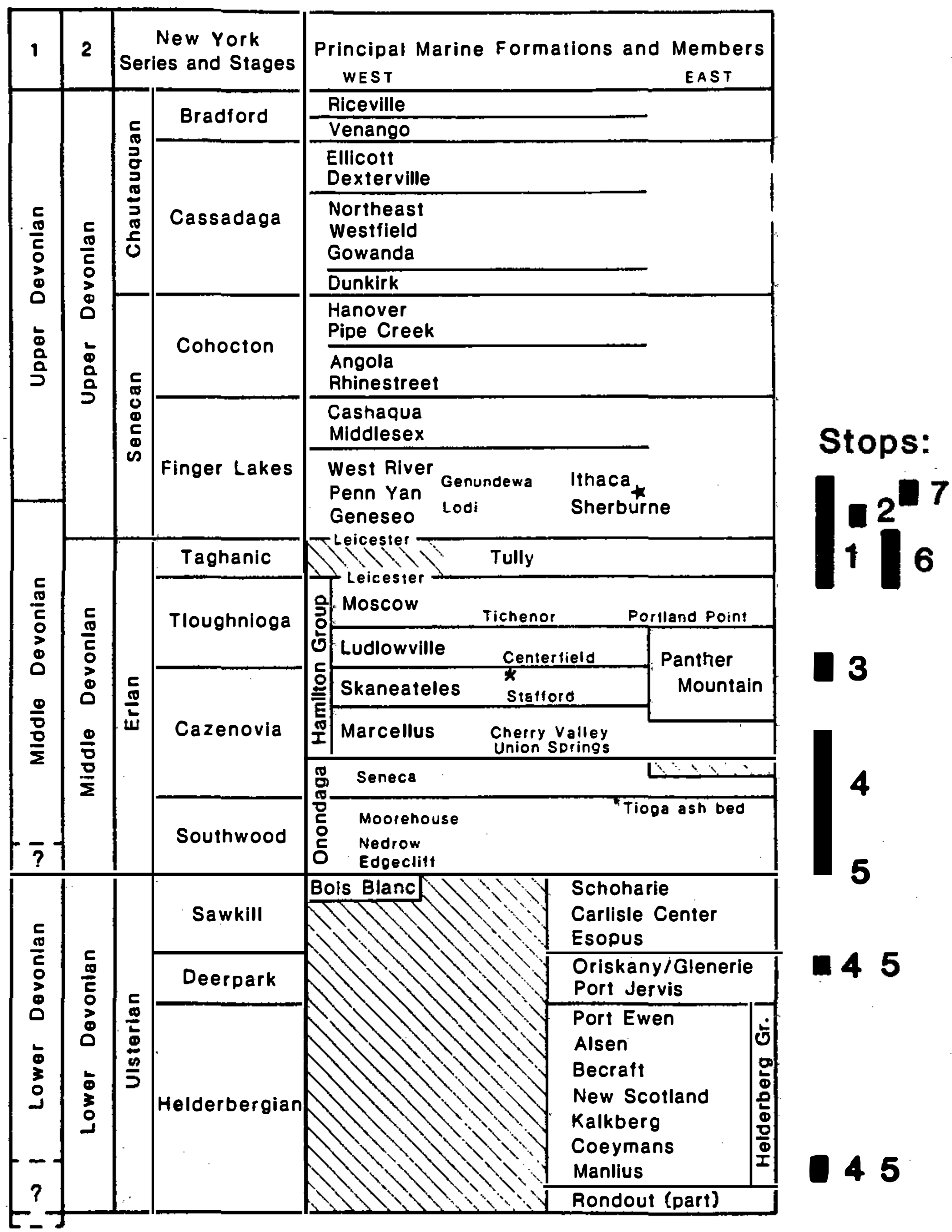

Fig. 1. Devonian section in New York with locations of field trip stops. Asterisk = Ledyard Member; Star = Renwick Member. From Kirchgasser and others (1985).

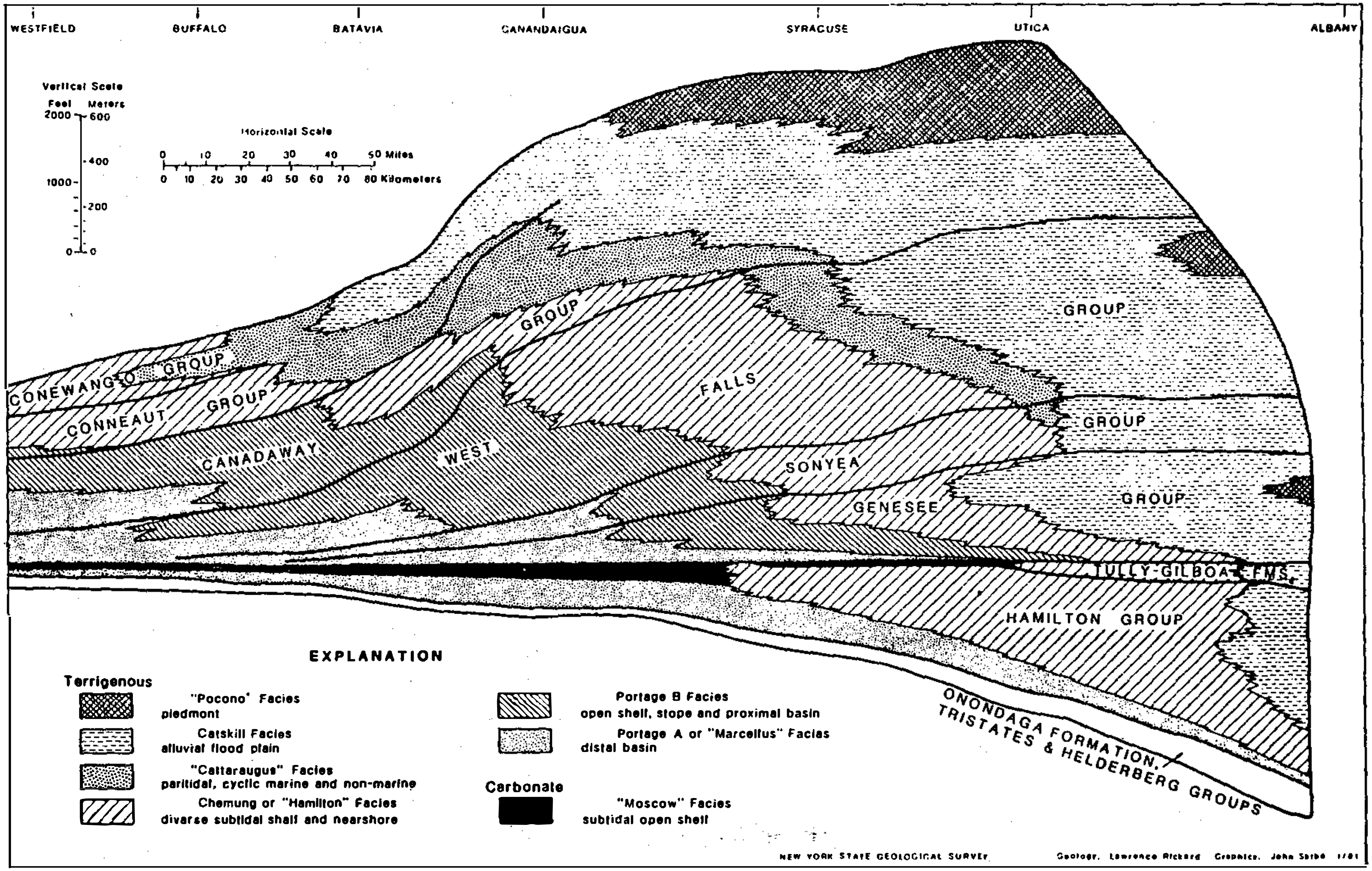

Fig. 2. Generalized stratigraphic cross section of New York Devonian. From Rickard (1981).

The Hamilton Group overlies the Onondaga Limestone and records the initial clastic influx of the Catskill wedge. Detrital sediments were derived from the Acadian landmass east and southeast of New York. The highly fossiliferous Hamilton shales, mudstones, and minor limestones of western New York pass eastward into thicker and coarser siltstones and sandstones in central New York. In the Catskill Mountain region of eastern New York the Hamilton Group consists primarily of non-marine red beds (Fig.2).

Although Lardner Vanuxem (1842) and James Hall (1843). in their monumental reports on the third and fourth geological districts respectively, laid the foundation for subsequent work, the general stratigraphic relationships of the Hamilton Group presently understood were first clarified by Cooper (1930, 1933).

Within the Hamilton Group are three geographically extensive carbonate horizons which serve as key beds. These relatively thin units, do not change facies laterally as rapidly as the synjacent units. They pierce the clastic wedge, subdividing the Hamilton into four units, in ascending order: the Marcellus, Skaneateles, Ludlowville, and Moscow Formations (Fig.1). The lowest of these carbonate units, the Stafford Member (west of Cayuga Lake) and the Mottville (east of Cayuga Lake) marks the base of the Skaneateles Formation and separates it from the underlying Marcellus Formation. The other Hamilton carbonate horizons that serve as formational boundaries are the Centerfield Member (Stop 3), between the Skaneateles asnd Ludlowville Formations, and the Tichenor Member (western New York) and the Portland Point Member (central and eastern New York), between the Ludlowville and Moscow Formations.

Since the carbonate horizons occur in a predominately clastic deltaic sequence, the assumption had been made that they represent brief episodes of transgressive maxima (McCave, 1973). The studies of Brett and Baird (1982, 1985), Baird and Brett (1983), Brett and others (1983), Grasso (1983, in press), Gray (1983,1985), Selleck (1983) and others indicate that these, as well as other Hamilton units, are parts of shallowing-upward or regressive sequences. Eustatic lowering of sea level may have been the causal agent for the Hamilton regressive cycles. Johnson and others (1985) recognize several such events in the Devonian of North America and elsewhere. The vertical succession of litho- and biofacies within the Mottville, Centerfield and Portland Point clearly indicate upward shallowing sequences. These units are in turn sandwiched between deeper water deposits above and below (in ascending order: Oatka Creek, Levanna, Ledyard and Kashong). Therefore, the time-equivalent units in the non-marine facies that correspond to the Mottville, etc., should be found at or near the top of the regressive tongues rather than at the base of transgressive tongues.

Hamilton paleogeography, as proposed by Brett and Baird (1985), consists of a western muddy shelf separated from an eastern predominately silty and sandy shelf by a centrally located, subsiding trough. The trough-axis trends from the northern Cayuga region southwest through the central Seneca Lake region. The basin also opens out or becomes wider in this direction. In general, as Hamilton stratigraphic units are traced from the west into the Seneca-Cayuga Lakes region, they become thicker, less carbonate rich, more shaley, and less fossiliferous. This has been well documented for the Centerfield Member by Gray (1985) and for the Portland Point Member by Baird (1979).

Middle and Upper Devonian

Tully Formation. The shallow water, moderately fossiliferous limestones of the Tully Formation record a major break in the Devonian succession, separating the platform sediments of the Hamilton Group described above from the transgressive-regressive cycles of clastic sediments of the later Devonian progradational phase of the delta (Fig.2). The Tully marks the beginning of a major transgressive event (Taghanic Onlap) following late Hamilton regression and erosion that culminated in the succeeding anoxic Geneseo black shale (Genesee Formation). This major mid-Devonian deepening event has been recognized around the world (House,1983; Johnson and others,1985). The stratigraphic complexities (disconformities, facies and thickness changes) and tectonic controls of sedimentation through the Tully interval have been documented in major studies by Johnson and Friedman (1969) and Heckel (1973).

A late Middle Devonian age for the Tully is indicated if the Middle/Upper Devonian conodont boundary recommended by the Devonian Subcommission (Ziegler and Werner, 1985) is accepted. However, there are historical and faunal arguments (Tully *Pharciceras*) for the boundary to be at the level of the Tully (House, 1982b; Kirchgasser and others, 1985; and Rickard, 1985) (Fig.3).

The conodont age of the Tully is Middle and Upper *varcus* Zone (Ziegler and others, 1976; Klapper, 1981). On the goniatite scale the occurrence of *Pharciceras amplexum* and *Phar.* sp. indicate a position low in the *Pharciceras* Stufe of the European standard (House, 1985; House and others, 1985; Kirchgasser and others, 1985).

The benthic fauna of the Tully, dominated by brachiopods and numbering some 250 species listed by Cooper and Williams (1935), is of predominantly Hamilton affinity and belongs to the provincial Eastern North American Faunal Realm. Species ranges through the Tully interval indicate a major turnover in the upper part associated with the major deepening event referred to above. The Tully-Geneseo transgression (Taghanic Onlap) resulted in the breakdown of faunal provinciality as western North American (Old World) elements entered the Appalachian Basin (Johnson, 1970,1971).

Genesee Formation - The Genesee Formation is the lowest of the major transgressive-regressive cycles of clastic facies that characterize the prograding post-Tully Catskill Delta (Fig.4). At Cayuga Lake the Genesee cycle consists of the transgressive Geneseo black shale member (distal basin facies) overlain by progradational siltstone facies of the Sherburne (Penn Yan in lower part) and Ithaca Members (proximal basin, slope and open shelf facies of the delta-front) interrupted by a second major transgressive black shale (Renwick Member).

A major correlation change since the 1959 meeting resulted from tracing of the Middlesex black shale. This initial transgressive tongue of the next cycle (Sonyea Formation) is equivalent to a level at the top of the Ithaca at Cayuga Lake (Sutton, 1959, 1965; deWitt and Colton, 1959, 1978). The Sherburne and Ithaca were shown to thin and interfinger basinward with the Penn Yan and West River shales (distal basin) of the Genesee Formation. They do not correlate with the western Portage or Naples beds (Cashaqua shale) of the post-Middlesex Sonyea Formation as was thought at the time of the 1959 meeting. The classic benthic Ithaca fauna and associated pelagic fauna (including goniatites and conodonts) are not contemporaneous with the pelagic Naples fauna of the Cashaqua but are older and distinct Genesee faunas (Kirchgasser, 1985).

Sections published in deWitt and Colton (1978) document the broad outline of correlations within the Genesee Formation. Further refinement has come from tracing of thin black shale, pyrite, shelly carbonate and siltstone horizons (some with goniatites, datable conodonts and distinct gamma-ray signatures) between the basin and delta-front (Figs.4 and 5). The facies shifts around the delta-front are complicated in detail and lithostratigraphic boundaries are difficult to draw. Some revisions based on work in progress by Gordan Baird and Carlton Brett are included here (Fig.5). Newly discovered is an interval in the upper Geneseo (Hubbard Quarry shale), between the Fir Tree (pyrite/inarticulate debris/siltstone) and Lodi horizons, that thickens and becomes more silty southward (shoreward) along Cayuga Lake. This interval has a bearing on the placement at Cayuga Lake of the Devonian Subcommission Middle/Upper Devonian boundary (see below).

Biostratigraphic work on the Genesee is well advanced (Fig.3) but much of the taxonomic documentation is unpublished and work on several of the faunas is incomplete. The goniatite sequence, initially outlined in a seminal paper by House (1962), correlates with the *Pharciceras* Stufe and lower *Manticoceras* Stufe (Fig. 3). In the Cayuga Lake region *Pharciceras* sp. (Fauna 13) occurs in the transition beds between the Tully and Geneseo (Fillmore Glen Mbr.) and *Epitornoceras* and *Ponticeras* enter high in the Geneseo (Fauna 14). *Ponticeras perlatum* ranges from the top of the Geneseo into the basal Sherburne (Lodi Limestone) and continues to the base of the Renwick (15). Above, in about the middle Ithaca, *Pont.* cf. *regale* (Fauna 16) is followed by *Koenenites* (17) with *Hoeninghausia* entering near the top of the member (17c). These Ithaca goniatites were previously thought to be representatives of *Manticoceras* from the Naples Fauna (Kirchgasser, 1985).

The conodont correlations of the Genesee have been refined since publication of a monograph by Huddle (1981) (Klapper,1981; Kirchgasser, and others, 1985). Elements indicating ages from the *hermanni-cristatus* to Lower *asymmetricus* Zones occur along the Hamilton-Geneseo disconformity west of the Tully outcrop (Fig. 3). The *disparilis* Zone fauna has been found at the top of the Geneseo Member at Seneca Lake (Fig. 5). Immediately above, in the Lodi Limestone (lowermost Sherburne or Penn Yan) the Lowermost *asymmetricus*

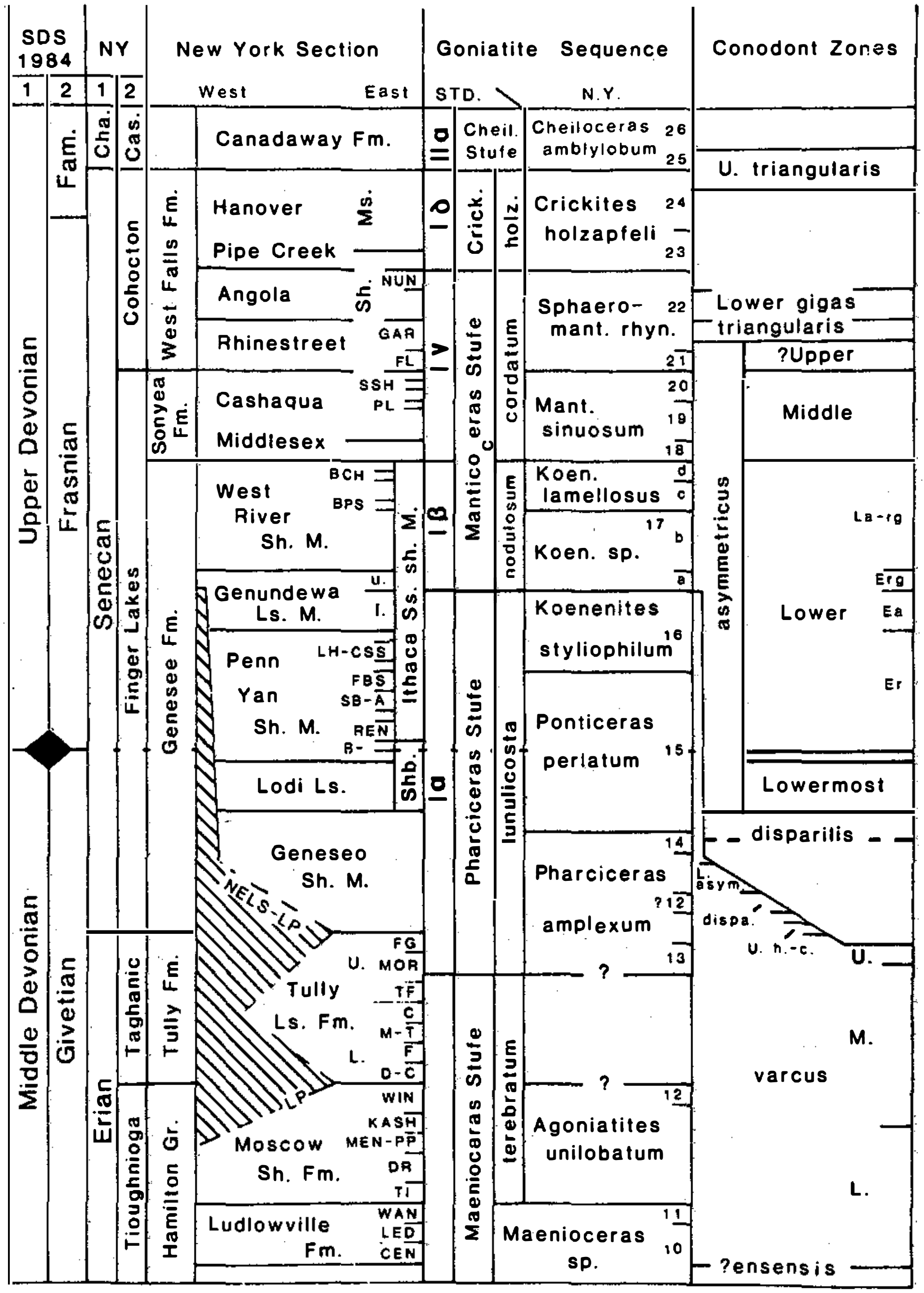

Fig.3. Goniatite (ammonoid) and conodont sequences around Middle/Upper Devonian boundary (diamond Symbol) proposed by the Devonian Subcommission. Shb.=Sherburne Member,B=black shale B, REN= Renwick Member. Modified from Kirchgasser and others (1985).

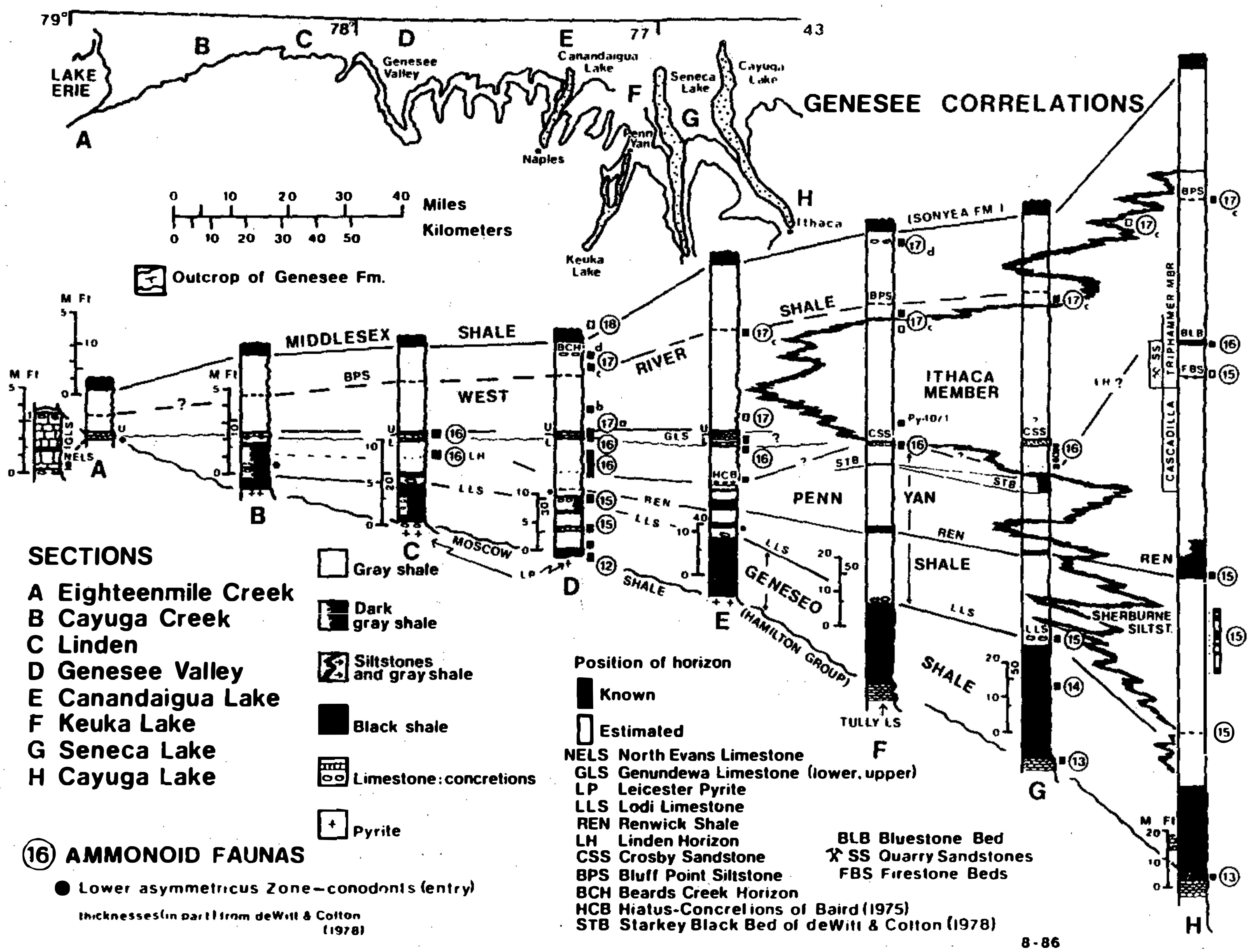

Fig.4. Genesee correlations. Modified from Kirchgasser(1985).

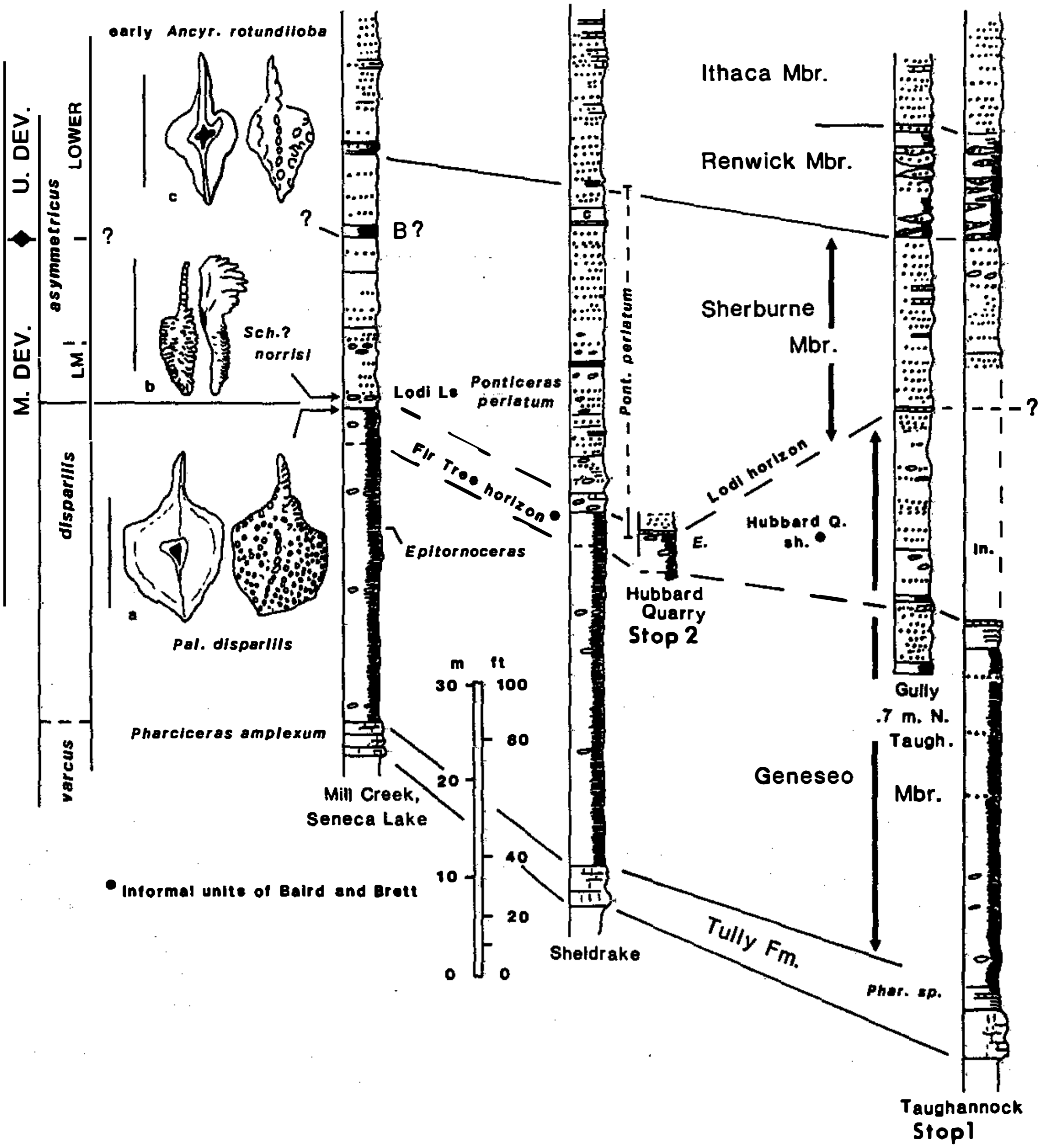

Fig.5. Lower Genesee correlations between Seneca and Cayuga Lakes. Modified from sections in deWitt and Colton (1978, Pl.3). Sketches of conodont species (scale=lmm) based on a. Ziegler and others (1975), b. G.Klapper (manuscript), c. Klapper (1985). (STOPS 1 and 2).

Zone fauna (with *Schmitognathus*? *norrisi*) occurs. The entry of *Ancyrodella rotundiloba* (Er or early *rotuniloba* form of Klapper, 1985), which marks the start of the lower *asymmetricus* Zone and is the international Middle/Upper Devonian boundary recommended by the Devonian Subcommission (Ziegler, 1985) has not been documented in the Seneca-Cayuga Lake section. However, based on its entry at the base of black shale B in the lower Penn Yan in the Honeoye Valley, its position must be high in the Sherburne (pre-Renwick).

Thayer (1974) identified several faunal associations in the delta-front facies of the Genesee Formation. The sparse fauna in the black shales is dominated by planktic styliolines and epiplanktic brachiopods, which, along with plant debris and cephalopods, settled on the anoxic bottom (*Styliolina*-brachiopod facies). Above the Geneso shale, the silty, firmer and more oxic bottom conditions of the regressive (prograding) Sherburne supported a fauna characterized by the branching tabulate coral *Cladochonus* and in the lower Renwick the brachiopod, *Warrenella* (*Cladochonus* facies). Above, in the black shales of the Renwick the delicate plumose coral *Plumalina* occurs (*Plumalina* facies). Above the Renwick, in the progradational complex of delta-front facies comprising the Ithaca Member, is the classic benthic Ithaca Fauna of Williams (1884) and Kindle (1896), subdivided into the *Ambocoela* and *Schizophoria*-strophomenid facies faunas. Within this sequence key transgressive or discontinuity horizons with conodonts and goniatites have been correlated with the faunal succession in the basin facies to the west (Kirchgasser, 1985). Thayer (1974) argued that the distribution of the benthic faunal associations around the delta-front was controlled by the relative rates of delta-progradation.

Economic and Environmental Geology

In the years since the NYSGA last met in Ithaca, the public preception of earth science and the utilization of geologic data has changed dramatically. Of paramount importance has been the implementation of the State Environmental Review Act of 1975. This legislation developed a systematic interdisciplinary approach to the consideration of the environmental factors concerning any proposed project. The review mechanism is an effective method to explore ways to minimize adverse environmental impacts. On a regular basis geologists serve as members of project teams preparing terrestrial resource impact assessment, especially in the areas of mining, real estate development, highway realignment, solid waste disposal and hydrogeology.

Mining activity is now regulated by the New York State Mined Land Reclamation Act of 1975. This legislation, administered by the Department of Environmental Conservation, was enacted to foster and encourage the development of the mining industry of the state, while preventing pollution associated with mining activity and assuring the reclamation of mined lands in such a manner as to render them suitable for future productive use. The Department of Transportation is responsible for evaluating the nature of materials and their processing in order to ensure the quality and uniformity of aggregate produced for state contracts.

We will visit commerical mining operations at Canoga (Stop 4) and at Portland Point (Stop 6), at which time the implementation of these regulations will be discussed.

As regional development has progressed in the Cayuga Lake area, the mining of materials required for construction has correspondingly developed. Local development has been necessary due to the relatively high costs of transporting such materials into the market area (in excess of $0.50/Ton/mile). Despite significant physical and structural constraints, the Cayuga Crushed Stone quarry, producing in the Tully Limestone at Portland Point, has been greatly expanded since 1959. Today, over 9 million dollars worth of concrete and bituminous material, and crushed limestone aggregate are produced annually. This quarry serves as the only source of rip rap for erosion abatement and stream control in the central Southern Tier. Likewise, the quarry at Canoga, now operated by Seneca Stone Company, has been expanded and deepened so that the entire sequence of Onondaga limestone is being processed in order to serve the Seneca Falls- Waterloo-Geneva area.

In 1970 the former Cayuga Rock Salt Company mine at Portland Point was acquired by Cargill Salt. This room-and-pillar mining operation has been renovated and expanded. Production has more than doubled -- from 450,000 Tons/year to over 1 million Tons/year. Until 1962 the International Salt Company operated brine wells at Myers about one mile north of the Cargill mine shaft. The danger of water invasion from this brining operation, and the presence of less deformed salt and better mining conditions below the 1800 foot level has required the development of a deeper production level. As production is now under Cayuga Lake (part of the State Waterway System), royalities of 1/4 million dollars / year are being paid to the State of New York.

In 1959 the primary natural gas exploration objectives in the region were Oriskany structural traps. Although these still hold some promise of production, the main emphasis in recent years has been the development of Medina/Queenston stratigraphic traps. These tight sand reservoirs, concentrated around the northern end of Cayuga Lake, include the Waterloo Field (1960), the Seneca Falls Field (1965) and the West Auburn Field (1959)(Fig.6). Depending on market conditions, the development and extention of these fields continues. With governmental support and financing, area educational institutions (such as the Union Springs School System and Wells College) have developed wells for onsite utilization.

In recent years, deep seismic surveys have evaluated the potential of overthrust production. Even with the present depressed market conditions, exploration continues at a significant level.

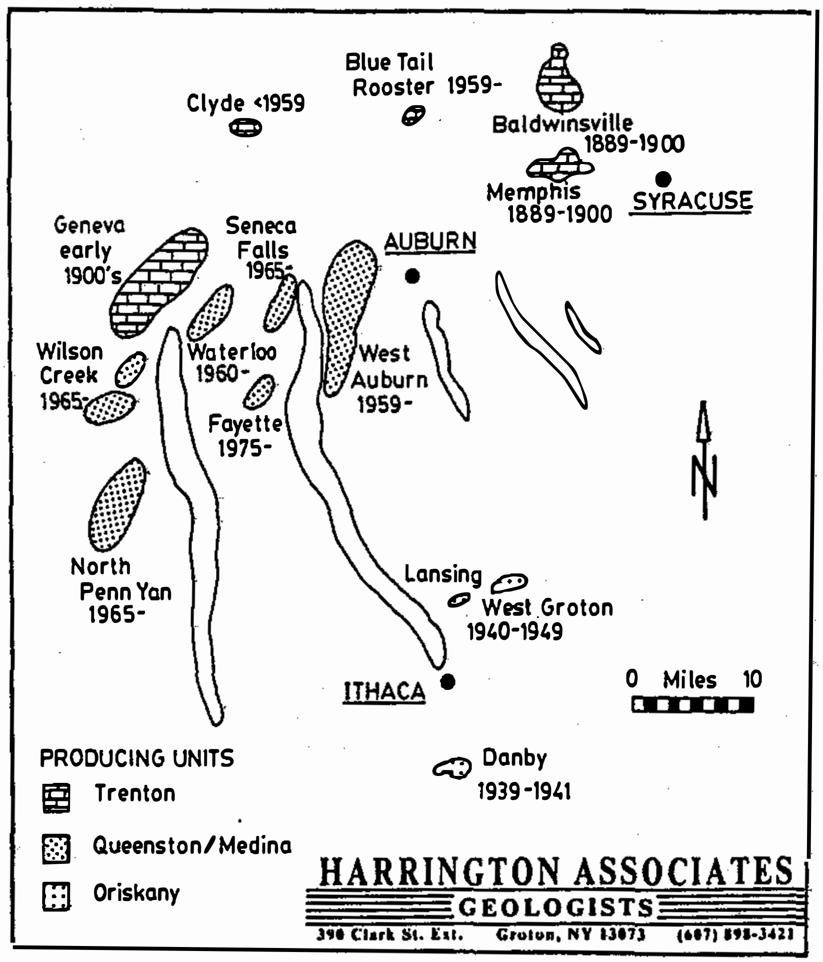

Fig. 6. Gas Fields of the eastern Finger Lakes region. Modified from Harrington Associates reports.

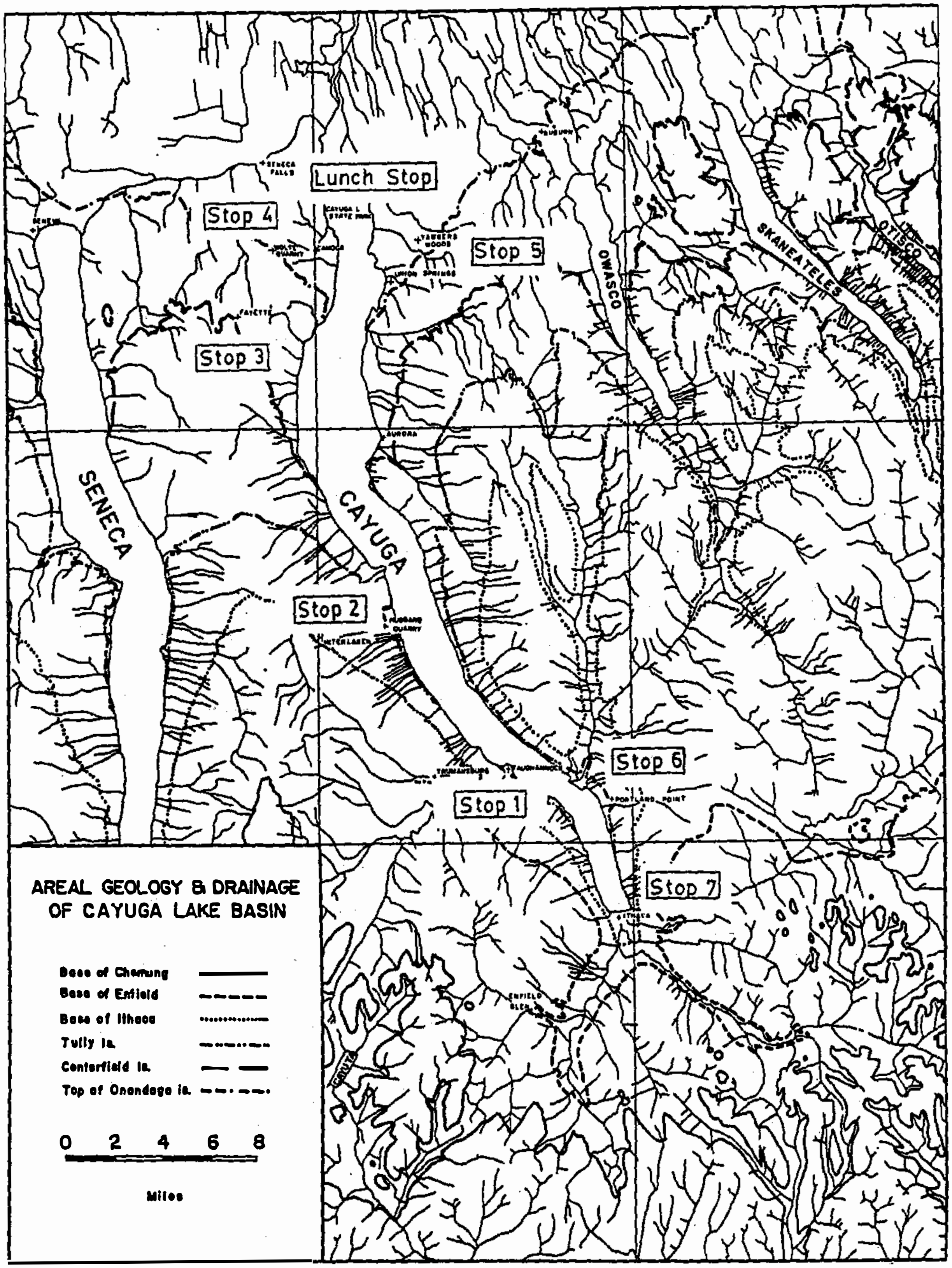

Fig. 7. Route Map for Trip Around Cayuga Lake. Modified after Cole and others (1959).

DESCRIPTION OF FIELD TRIP STOPS

STOP 1A. TULLY LIMESTONE SECTION, LOWER FALLS, TRUMANSBURG CREEK (FIG.8).

No Hammers. Collecting is not permitted in the State Park but will be possible at a similar section across the lake at Portland Point (Stop 6). Five beds of the TULLY FORMATION are exposed in the falls and embankment. The comments on lithologies and benthic faunas which follow are based primarily on data from Heckel (1973).

The contact between the CARPENTER FALLS and TAUGHANNOCK FALLS beds is a widespread discontinuity surface that marks a major lithologic and faunal break within the TULLY. The TULLY as a whole records a progressive rise in sea level (Taghanic Onlap) following late Hamilton erosion but the sedimentary controls are complicated by regional tectonism (Heckel, 1973). A major deepening even has been recognized worldwide at about this time (Middle *varcus* Zone) House (1985), Johnson and others (1985).

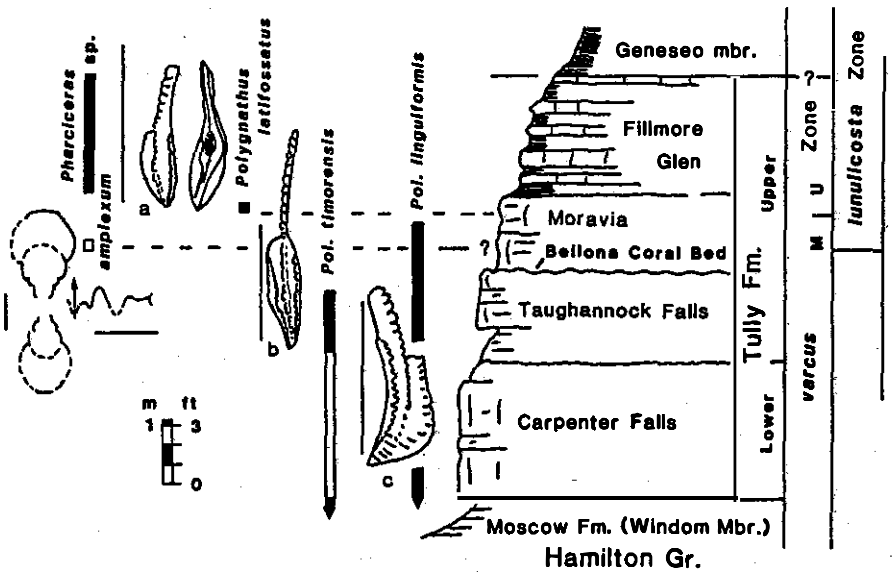

Fig.8. Tully Limestone section in Lower Falls of Taughannock Creek. Adapted from Ziegler and others (1976), Heckel (1973) and deWitt and Colton (1978). Goniatite ranges from Kirchgasser and House (1981); conodont ranges from Ziegler and others (1976) and Klapper (1981). Goniatite sketches based on House and Kirchgasser (manuscript). Conodont sketches a, c, based on Ziegler and others (1976), b. Klapper and others (1970).

The upper CARPENTER FALLS bed consists of thick-bedded burrowed calcilutites with some pelmatozoan calcarenites, which disconformably overlies the WINDOM SHALE of the MOSCOW (several eastern units of the lower TULLY are missing here). The diverse fauna is dominated by brachiopods, including *Emanuella, Schuchertella* and *Atrypa*; other fossils include trilobites, styliolines, tentaculites, auloporid corals and ostracods. The main *Hypothyridina* (*H. venustula*) bed of the TULLY occurs in this area at the base of the unit.

The TAUGHANNOCK FALLS BED (5 ft.) at the base of the Upper TULLY marks the start of a new depositional regime and the major faunal turnover in the TULLY. The bed consists of well-bedded burrowed skeletal calcilutite with the "knobbly zone" (re-entrant) in the lower part. The fauna is dominated by small horn corals, auloporid corals, styliolines, echinoderms and trilobites. Brachiopods and bryozoans are essentially restricted to the upper part of the bed (*Elytha fimbriata* Zone); Lower TULLY brachiopods are rare or absent. The BELLONA CORAL BED contains rugose, tabulate and auloporid corals including *Heliophyllum*, *Cystiphylloides*, *Favosites* and "*Heterophrentis*". The MORAVIA BED is a 4 foot ledge of wavy-bedded limestone lithologically and faunally similar to the TAUGHANNOCK FALLS BED.

The FILLMORE BED (6 feet) conformably overlies the MORAVIA BED and consists of interbedded dark shaley calcilutitic limestone and dark calcareous shale transitional to (but separated by a sharp conformable contact) the black GENESEO SHALE. The sparse planktic fauna of the FILLMORE GLEN, which reflects continued rise in sea-level and anoxic bottom conditions, includes styliolines, inarticulates, and rare goniatites.

The boundary between the Middle and Upper *varcus* Zones is near the top of the MORAVIA BED (Ziegler and others, 1976, Table 3; Klapper, 1981 fig. 2). The three elements illustrated in Fig.8 are the commmon *Polygnathus linguiformis*, *Pol. timorensis*, a *varcus*-type species, and *Pol. latifossatus* which indicates the start of the Upper *varcus* Zone. In the goniatite sequence, the *Pharciceras amplexum* horizon is near the base of the MORAVIA BED but specimens have not been reported from this locality (House, 1962, Kirchgasser and House, 1981). *Phar. amplexum* correlates with a position at the base of the *Pharciceras* Stufe (House and others 1985).

The controversy over the position of the TULLY with respect to the Middle/Upper Devonian boundary continues (Kirchgasser and others, 1985, Rickard, 1985). At the time of the 1959 meeting the mid-Genesee (GENUNDEWA LIMESTONE) boundary of Cooper and others (1942), where the goniatite *Manticoceras* enters, was the accepted position but since 1964, and until recently, the boundary has been placed around the TULLY (Kirchgasser, and others, 1985, Fig. 4). The boundary recommended by Devonian Subcommission (base of Lower *asymmetricus* Zone) is somewhere in the SHERBURNE and is well above the TULLY.

STOP 1B. TAUGHANNOCK FALLS OVERLOOK, GENESEE FORMATION (FIG. 9).

The main falls and amphitheater, at the head of a one mile long post-glacial gorge with 200 to nearly 400 foot high walls, display a spectacular but mostly inaccessible section in the upper GENESEO, SHERBURNE, RENWICK and lower ITHACA MEMBERS of the GENESEE FORMATION. The top of the falls (215 ft high) is controlled by resistant siltstones in the SHERBURNE MEMBER and by the jointing. The re-entrant at the crest of the falls remains virtually unchanged since the last major rockfall between 1888 and 1892. Near the base of the falls on the left are altered alnoite dikes in N-S joint planes.

About 90 feet of black GENESEO SHALE is exposed in the walls from the level of the plunge pool to the sharp contact with lighter colored shales and siltstones halfway up the falls. Contacts higher up are not easily defined in their fresh joint surfaces. Recent work by Gordan Baird and Carlton Brett shows that the contact at the top of the black shale band is not the same level as the GENESEO/SHERBURNE contact at Hubbard Quarry to the north (Stop 2) and at Seneca Lake to the west. In the gully .7 miles north of Taughannock (Fig.5), the FIR TREE HORIZON is just above the black shale contact. Above are the siltstones and shales of the HUBBARD QUARRY INTERVAL at the top of which is the LODI HORIZON, which defines the GENESEO/SHERBURNE contact (Stop 2). The HUBBARD QUARRY INTERVAL is a silty wedge at the top of the GENESEO MEMBER which intervenes at the south end of Cayuga Lake between the top of the black shale and the LODI. The FIR TREE and LODI HORIZONS have not been seen at Taughannock. The LODI, at the base of the SHERBURNE MEMBER, should be somewhere close to the lip of the falls.

The black shales and lenticular siltstones of the RENWICK MEMBER form a distinctive band in the walls above the level of the falls, and near the top are the lower siltstones of the ITHACA MEMBER. The RENWICK MEMBER, with the *Warrenella* beds at the base will be examined at Stop 7.

The goniatite (*Epitornoceras* and *Ponticeras*) and conodont distributions through the section in this region are illustrated in Fig. 5. The uppermost GENESEO MEMBER is in the *disparilis* Zone and the LODI has a Lowermost *asymmetricus* fauna. Datable conodonts have still to be recovered in this part of the Cayuga Lake section. The proposed Middle/Upper Devonian boundary at the base of the Lower *asymmetricus* Zone should occur at Taughannock somewhere in the SHERBURNE, above the lip of the falls and below the RENWICK.

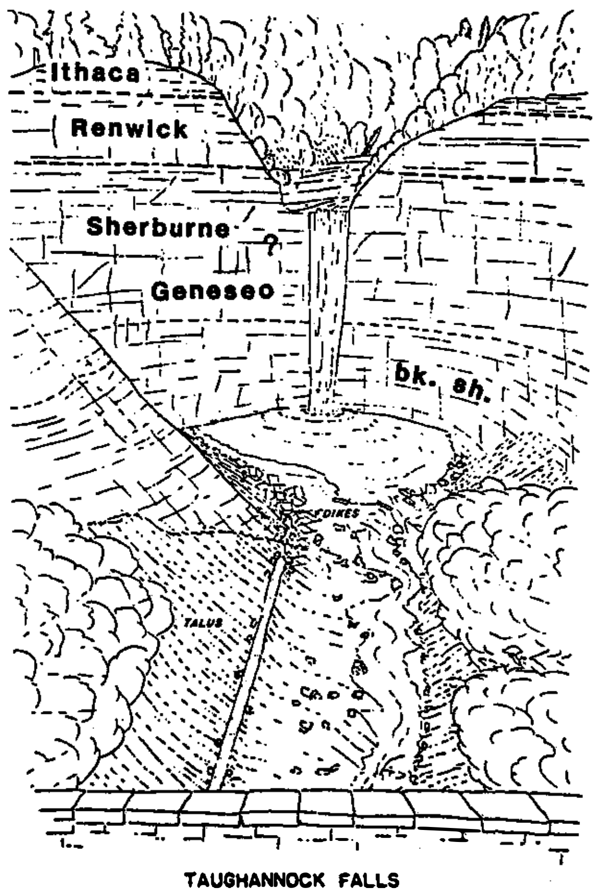

Fig.9. Overlook of Taughannock Falls. Modified from Cole and others (1959)

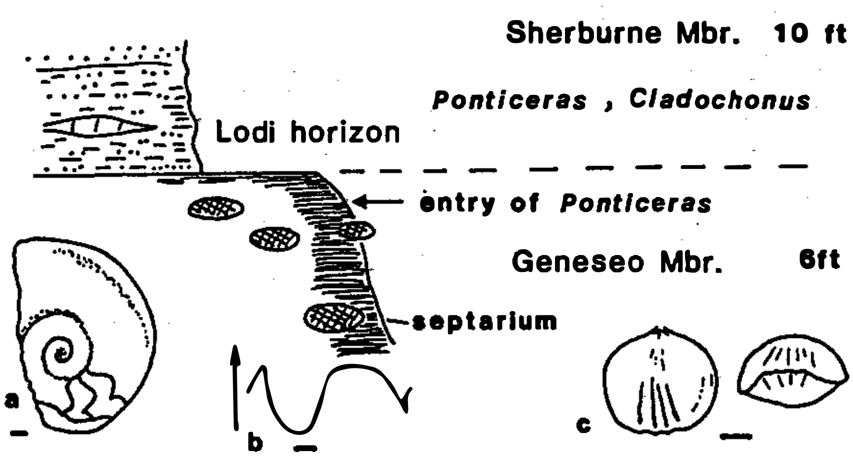

Fig.10. Upper Geneseo and lower Sherburne at Hubbard Quarry. Modified from Cole and others (1959). Sketches of fossils based on a. *Pont. perlatum* : Kirchgasser (1985), b. *Epitornoceras peracutum* : House and Kirchgasser manuscript), c. *Leiorhynchus quadracostatus*: Johnson (1970).

STOP 2. GENESEO, LODI LIMESTONE, SHERBURNE SECTION, HUBBARD QUARRY, (FIG.10).

The contact between the GENESEO and SHERBURNE MEMBERS is well exposed and accessible in the west wall of the quarry. The limey bands in the lower SHERBURNE are the LODI LIMESTONE, a horizon that defines the GENESEO/SHERBURNE contact.

The upper 12 feet of the GENESEO MEMBER at this locality are the HUBBARD QUARRY beds of Brett and Baird (personal communication, 1985), at the base of which is the FIR TREE Horizon, which here is a bedding plane of pyrite and inarticulate debris exposed at the back of the quarry.

The septarian concretions in the upper black shales of the GENESEO are mostly unfossiliferous but they contain "an interesting variety of minerals: barite, calcite, ankerite, quartz, marcasite, sphalerite, and galena, in order of decreasing abundance." (Cole and others, 1959).

The epiplanktic fauna of the GENESEO near the contact (*Styliolina*-brachiopod facies of Thayer, 1974) includes: Styliolina sp., *Barroisella spatulata, Orbiculoidea lodensis, Schizobolus truncatus, Leiorhynchus quadracostatus, Pterochaenia fragilis, Ponticeras perlatum, Epitornoceras peracutum,* fish and plant fragments. The clusters of *Leiorhynchus* are of special interest because the presence of this western North American genus is evidence of eastward faunal migration during the Taghanic Onlap (Johnson, 1970)

In the siltstones of the lower SHERBURNE MEMBER (and especially in the LODI horizon) the fauna is a mixed assemblage of the *Styliolina*-brachiopod facies and the benthic *Cladochonus* fauna of Thayer (1974), *Cladochonus* sp., *Leiorhynchus quadracostatus, Loxonema noe, Palaeotrochus praecursor, Panenka* sp., breviconic nautiloids and *Ponticeras perlatum* occur (Cole and others, 1959). This fauna is well developed at Seneca Lake and has been found in the LODI as far west as the Genesee Valley (Figs. 4,5). Presumably the LODI represents a period of reduced clastic influx or hiatus at the end of a transgressive phase. Cole and others (1959) correctly predicted that the LODI would correlate to the west below the level of the GENUNDEWA (*Styliolina*) LIMESTONE, the horizon with which it had been correlated earlier.

The goniatite *Ponticeras perlatum* enters near the top of the GENESEO and ranges through the SHERBURNE to the base of the RENWICK. Specimens may be seen in the black shales around the upper septarian horizon, where they occur with the large involute tornceratid *Epitornoceras peracutum*, and in the LODI horizon. In Europe these are *Pharciceras* Stufa genera. Huddle (1981) reported conodonts from the LODI at this locxality but the species were not zonally diagnostic. At Seneca Lake the GENESEO/SHERBURNE contact corresponds to the *disparilis*/Lowermost *asymmetrica* conodont Zone boundary, of the upper Middle Devonian (as defined by the Devonian Subcommission)(Fig.5).

STOP.3. FAYETTE TOWN QUARRY, CENTERFIELD LIMESTONE AND LEVANNA SHALE, FIG.11.

This quarry, operated by the town for road material, exposes the upper part of the LEVANNA MEMBER of the SKANEATELES FORMATION and the lower 20 feet of the overlying CENTERFIELD MEMBER of the LUDLOWVILLE FORMATION. Gray (1985) has carefully mapped the CENTERFIELD and subdivided it into several submembers based on detailed stratigraphic tracing of distinctive units. He has named the lower CENTERFIELD member, from Buffalo Creek to Owasco Lake, the YORK SUBMEMBER. The quarry is a good collecting site for the dark shale *Leiorhynchus* fauna of the LEVANNA and the more normal bottom *Tropidoleptus* (Hamilton) fauna of the CENTERFIELD.

The LEVANNA is a dark, almost black shale with a typical dark shale fauna of mostly *Leiorhynchus, Ambocoelia* and chonetids. Common forms include: *Leiorhynchus multicostus, Ambocoelia umbonata, Strophalosia truncata, Chonetes scitula, Orbiculoidea media, Nuculites, Styliolina fissurella, Tornoceras uniangulare, Lyrioceras, Palaeoneilo, Buchiola halli, Panenka, Pterochaenia fragilis, Bucanopsis leda, Euryzone rugulata, Geisonoceroides, Michelinoceras and Spyroceras.*

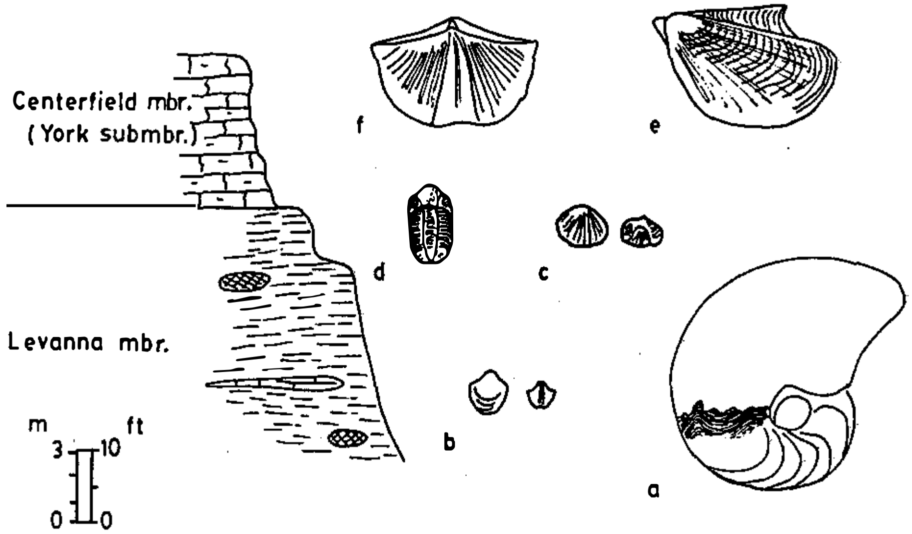

Fig.11. Section in Fayette Town Quarry. Modified after Cole and others (1959). Fossil sketches: a. *Agoniatites vanuxemi*, b. *Ambocoelia umbonata*, c. *Leiorhynchus multicosus*, d. *Phacops rana*, e.*Actinopteria decussata*, f. *Spinocyrtia granulosa.*

Terrestrial plants from lands to the east drifted into this area and their carbonized remains are not uncommon: *Drepanophycus* (lycopsid),*Hostimella, Loganiella* (psilopsids), and macerated pieces of the seed-fern *Eospermatopteris*. Fish remains, especially fragments of the armor plate of *Dinichthys halmodeus*, have been found.

Femow (1961) suggested that the LEVANNA was deposited in a relatively high stressed, low energy environment such as relatively deep dysaerobic water and, along with the UNION SPRINGS, OATKA CREEK and LEDYARD Members, may represent the deepest water conditions that existed in Hamilton time along the Cayuga Lake meridian. This is indicated by the fine, dark, carbonaceous aspect of the shale and by the paucity of a well developed, high diversity benthonic assemblage of larger, epifaunal invertebrate taxa.

In the lighter-colored, slightly calcareous, worm-riddled bands near the top of the LEVANNA, a more normal benthonic fauna occurs with *Phacops rana, Mucrospirifer, Mediospirifer* and chonetids. Large specimens of *Agoniatites vanuxemi* has also been found in these layers.

The limey bands record episodes of more aerobic water, thereby allowing the establishment of a more normal benthonic assemblage. Although free oxygen content was higher that the enclosing dark shales, it probably was not as high as that which prevailed during CENTERFIELD time.

The lighter-colored, slightly calcareous, drab-weathering YORK SUBMEMBER of the CENTERFIELD in the upper part of the quarry represents the lower part of the member, and is here rich in pelecypods such as *Aviculopecten princeps, Actinopteria decussata, Modiomorpha mytiloides,* and *Leiopteria*; and well-preserved brachiopods: *Meristella barrisi, Tropidoleptus carinatus, Spinocyrtia granulosa, Fimbrispirifer venustus,* and *Mediospirifer audaculus*. A few favositid and rugose corals may be found at or near the top of the unit.

The CENTERFIELD at this locality represents the start of a shallowing upward sequence that does not become fully developed because the section is incomplete. The shallowest facies (peak regression or core CENTERFIELD) at other localities in the Cayuga Lake region is found in the overlying VARICK SUBMEMBER (Gray, 1985). Above this the WHEELER GULLY SUBMEMBER represents a return to slightly deeper water conditions paralleling those that existed in the YORK SUBMEMBER, as discussed below. The overlying LEDYARD MEMBER above the CENTERFIELD mirrors the LEVANNA MEMBER.

The YORK SUBMEMBER represents a transitional environment between the deepest water LEVANNA below and the shallowest water VARICK above. Generally low energy conditions prevailed as indicated by the fine grained lithology. The diverse benthonic assemblage suggests well oxygenated water. The presence of an occasional trilobite, with well developed eyes, suggests deposition in the photic zone.

STOP 4A. SENECA STONE QUARRY, UPPER SECTION, CHERRY VALLEY/UNION SPRINGS. FIG.12. (Note: Permission must be obtained before visiting this quarry.)

In 1959 only the upper member of the ONONDAGA, the SENECA, was exposed at this location. The quarry had been worked off and on for at least a century, and at that time was being worked on a small scale by Warren Bros. Road Co. to provide crushed stone for bituminous paving. Subsequently purchased by Seneca Stone Corp., the quarry has been greatly enlarged and deepened. The entire ONONDAGA sequence, as well as the overlying UNION SPRINGS SHALE and CHERRY VALLEY LIMESTONE, and the underlying SPRINGVALE HORIZON, ORISKANY SANDSTONE, and uppermost MANLIUS, may now be seen.

Walk west along the upper bedding plane of the CHERRY VALLEY LIMESTONE. This unit has long been famous for its diverse and abundant cephalopods (Clark,1901; Flower,1936; and Rickard, 1952). *Agoniatites vanuxemi* and *Striacoceras typum* are common cephalopods at this locality. Other forms include the tabulate coral, *Aulopoa*, and the trilobite, *Proetus*. Please do not attempt to collect from the bedding surface. Loose blocks at the west end of the outcrop provide better collecting.

To the north a low angle thrust fault may be seen cutting the UNION SPRINGS BLACK SHALE and the upper portion of the ONONDAGA. Several structural depressions may also be seen in the quarry wall. These are sag structures produced by local solution of underlying bedded gypsum. These structures are well developed along the plateau front, near deep valleys where there has been deep ground water circulation (Phillips,1955). They are generally considered to be post-glacial in origin (Gilbert,1891; Fairchild, 1909)

Return to the bus and proceed to the quarry floor.

STOP 4B. SENECA STONE QUARRY,LOWER SECTION, ONONDAGA/ORISKANY/MANLIUS SECTION, FIG.12.

As we pass beneath the crushing plant the TIOGA METABENTONITE BED can be readily see. In 1959 this horizon was approximately one foot above the quarry floor. The TIOGA METABENTONITE provides an excellent time marker. Eastward from here it is found progressively nearer the top of the ONONDAGA, indicating the time-transgressive nature of the unit -- older in the east, younger in the west.

The floor of the main quarry is on the ORISKANY SANDSTONE and the overlying lowermost EDGECLIFF MEMBER of the ONONDAGA. The nodular phosphatic SPRINGVALE HORIZON may be observed , as may the uppermost beds of the MANLIUS FORMATION. The complete EDGECLIFF, NEDROW, MOOREHOUSE and SENECA MEMBERS of the ONONDAGA are exposed in the highwall. In the quarry floor loose blocks of EDGECLIFF and ORISKANY provide excellent collecting. Particularly abundant in the ORISKANY are the large brachiopods *Costispirifer arenosus*, *Acrospirifer murchisoni*, *Rensselaeria ovoides*, and *Hipparionyx proximus*.

To the west in Ontario the SPRINGVALE consists of a sandstone lithologically very similar to the ORISKANY (from which it was derived by reworking) and to the basal "Zone A" sandstone of the EDGE - CLIFF. No sandstone of SPRINGVALE age is present in New York (Hodgson, 1970). However, a nodular phosphatic horizon, representing very slow rates of sedimentation, is well developed here and at Yawgers Woods (Stop 5). Depending on the locality, this horizon rests either on the ORISKANY or on older Silurian dolomites.

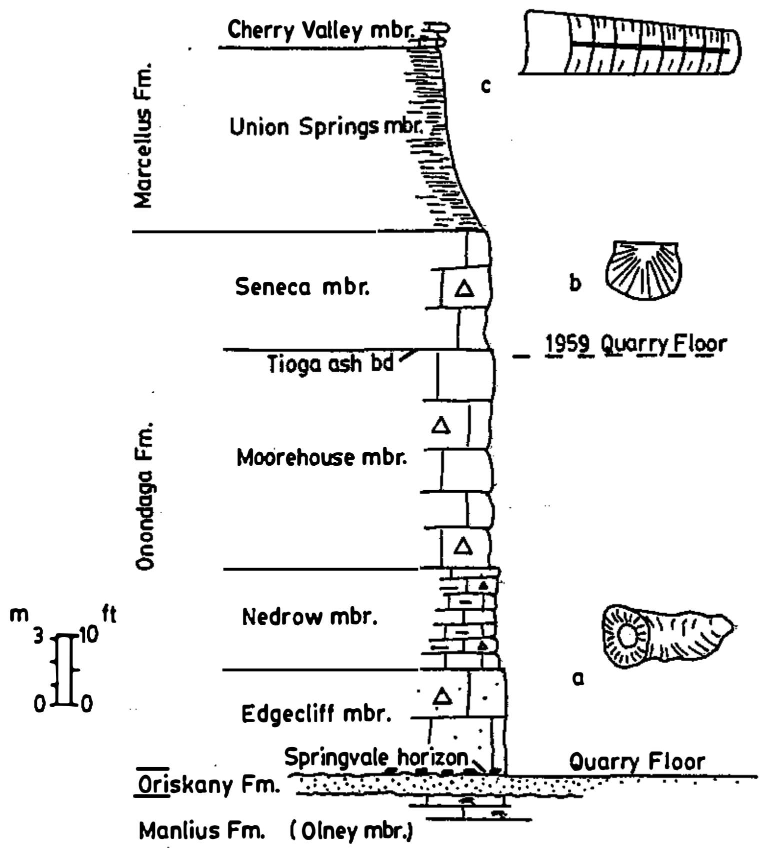

Fig.12. Section at Seneca Stone Quarry, Canoga. Modified after Cole and others (1959). Fossil sketches: a. *Amplexaphyllum*, b. *Chonetes lineatus*, c. *Striacoceras typum*. For additional illustrations see Figs. 11,13.

STOP 5. YAWGERS WOODS, MANLIUS/ORISKANY/ONONDAGA SECTION, FIG.13.

Here the resistant ORISKANY SANDSTONE, a single bed 4 feet thick, outcrops in the woods a half mile west of the road, where it forms a low escarpment facing west. A few feet of MANLIUS (ONLEY MEMBER) LIMESTONE limestone can be seen below it and one or two feet of the basal ONONDAGA (SPRINGVALE and EDGECLIFF) LIMESTONE rest on top.

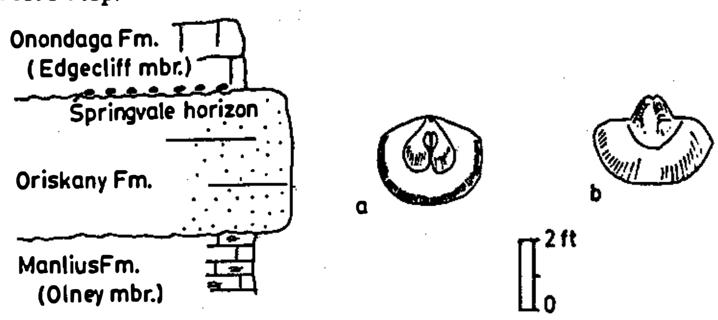

Fig. 13. Section at Yawgers Woods. Modified after Cole and others (1959).Fossil sketches: a. *Hipparionyx proximus*, interior, b. *Costispirifer arenosus*, interior.

In a creek less than 1000 yards to the south the ORISKANY is absent and the ONONDAGA lies directly and disconformably on the MANLIUS. In 1959, the ORISKANY was thought to be absent from the opposite side of the lake westward to Buffalo. Its distribution can now be extended west to the Canoga exposure (Stop 4). The sandy SPRINGVALE horizon in the base of the ONONDAGA has often been mistaken for the ORISKANY in the areas where the latter actually is lacking.

This and a nearby locality are among the oldest known and most famous of American Devonian fossil localities. It was visited as early as 1810 by DeWitt Clinton, later governor of the state, on his return to Albany from an expedition to explore the route of the then proposed Erie Canal (1817-1825). The quote below is extracted from Clinton's "Private Canal Journal" found in Campbell (1849, p. 167-168).

"August 12th., Sunday. We left Ithaca at five....... We dined at Henry Moore's tavern four miles from Cayuga Lake........... Moore is a Republican, as all emigrants from Suffolk county are...

About half-a-mile from his house, and three and-a-half from Cayuga Lake, there is on Lot 69 of the Cayuga Reservation, containing 240 acres and owned by him a ledge of rocks and stones extending a mile in a parallel direction with the lake. The higher stratum is composed of limestone (Onondaga), and the next adjoining one of sandstone (Oriskany) embedded with marine substances. There is but one stratum of sandstone, of the thickness of two or three feet, and below and beneath as well as above it there is limestone (lower ls. = Manlius). The sandstone contains several marine shells, which appear to be strange, and I should therefore pronounce them oceanic. There are littoral ones also, such as scallops (probably *Costispirifer arenosus*) and in one instance a periwinkle (*Platyceras*?) was found and sent to Peale's Museum in Philadelphia. One strange substance is larger than a scallop, and one is like a horse shoe in miniature (*Hipparionyx proximus*)...This collection of sandstone demonstrates the existence of the ocean here."

A few years later (1815), Clinton remarked of these fossils: "These petrifactions are worthy of a more minute examination. I have no doubt but that a very interesting set of shells might be made from this immense stratum of sandstone."

In 1819 David Thomas of Aurora noted that the fossils in the sandstone are mostly in the bottom of the bed, due to the "shells sinking more speedily than the sand" in the Flood, i.e., diatactic settling of the sedimentologists!

Benjamin Silliman sent some fossils from Yawgers Woods to Alexandre Brongniart in Paris in 1820. Brongniart was unable to name them: "...the sandstones of Cayuga, containing terebratulids which I shall perhaps be able, at some future time, to give you the exact name." By 1829, however, Brongniart was able to correlate, more or less correctly, "le gres blanc de Cayuga:" with sandstones of Devonian age in Europe, but it was many years before Conrad, Hall, and Vanuxem figured and described the fossils of the ORISKANY.

Fossils are scarce in the MANLIUS at this locality. The fauna is small, consisting of benthonic forms indicative of hypersaline conditions: *Howellella vanuxemi, Brachyprion varistriata, Schuchertella interstriata, Tentaculites, Leperditia alta.*

The fauna of the ORISKANY is characterized especially by large brachiopods in enormous numbers, with occasional pelecypods and gastropods but few other forms: *Costispirifer arenosus, Rensselaeria ovoides, Acrospirifer murchisoni, Hipparionyx proximus, Cosstellirostra peculiaris.*

Only the lowest one or two feet of the ONONDAGA LIMESTONE cap the ORISKANY at Yawgers Woods, representing the basal SPRINGVALE sand horizon (Zone A of Oliver, 1954), and the lowest beds of the EDGECLIFF MEMBER (Zone C of Oliver). Collecting is poor, but some loose blocks of the SPRINGVALE in the field at the east edge of the woods contain corals and the black, phosphatic sandy nodules characteristic of the SPRINGVALE. Purple fluorite is sometimes found in intradissepimental cavities in the corals. The SPRINGVALE represents weathered ORISKANY reworked by the westwardly-transgressing Onondaga sea.

STOP 6. PORTLAND POINT QUARRY. MOSCOW/TULLY/GENESEO SECTION. FIGS.14,15.

(Specific stops within this quarry will depend on the stage of operations at the time of our visit).

This quarry, the only commercial TULLY LIMESTONE mine in New York, contains one of the most fossiliferous exposures in the Cayuga Lake Basin. Over 100 species of corals, bryozoans, crinoids, brachiopods, pelecypods, gastropods, cephalopods, and trilobites, have been collected from the top few feet of the MOSCOW SHALE exposed in the quarry floor.

Until 1948 Penn-Dixie Cement Company operated a large cement plant on the Cayuga Lake shore. Cement was transported by barge up Cayuga Lake to the Erie Canal system. Limestone mined in this quarry was conveyed to the plant by aerial cableway. Since 1961 the mine has been operated by Cayuga Crushed Stone, Inc. Material is utilized for aggregate, concrete, bituminous material and rip rap. The level of mining and extent of operation has changed dramaticly since the 1959 NYSGA visit to this quarry. Reserves in the present mine are virtually exhausted. An extention of the mining operation is now being developed which will provide limestone to the southern Finger Lakes for the next 10 to 15 years. Limestone will be mined north of Portland Point Road, and will be transported over the road by conveyor belt to the existing crushing plant (Fig.14).

Of particular significance in this mine is the unusual thickness of glacial overburden and black shale that is economically stripped in order to remove limestone. In the southern portion of the mine, over 15 feet of glacial till and 40 feet of GENESEO SHALE must be stripped to remove 10 feet of capstone (a transitional sequence of interbedded limestone and shale - the FILLMORE MEMBER of Heckel(1973) and 19 feet of TULLY LIMESTONE. To control product quality the capstone must be isolated by selective mining. The favorable location of this quarry for marketing stone throughout the Southern Tier makes this extreme depth of stripping economically feasible. Most of the quarry floor is now occupied by spoil piles of GENESEO SHALE. This material will be backfilled against the highwall during reclamation. In the near future only in those areas mined prior to 1975 will bedrock exposure remain.

The quarry is situated on the crest of the Fir Tree (Portland Point) Anticline. The south limb of this fold is cut by a low-angle thrust fault overthrust to the northwest. On the east side of the quarry are several kimberlite dikes. These dikes, described by Sheldon, 1921; Martens, 1924; and Broughton, 1950, vary from 6" to 1'5" in width and strike parallel to the prominent N 5 W joint set. Glacial striae are exposed on TULLY LIMESTONE surfaces at the north end of the quarry.

The black, bituminous GENESEO SHALE is sparsely fossiliferous, but contains a mixture of pelagic marine fossils (*Orbiculoidae, Styliolina fissurella, linguloids, Paracardium, Leiopteria, Tornoceras uniangulare*), freshwater fish (*Dinichthys*, crossopterygian scales), and land plants (*Aneurophyton*).

The TULLY LIMESTONE is fossiliferous, but fossils are hard to extract. The guide fossil *Hypothyridina venustula* is found in clusters in the lower part of the basal CARPENTER FALLS MEMBER . The thin dark shaly BELLONA CORAL BED, in the upper part of the TULLY, is a widespread datum plane from Skaneateles Lake across the Cayuga Lake Basin nearly to the western limits of the Tully east of Canandaigua Lake. The corals of this zone--*Heliophyllum, Heterophrentis, Siphonophrentis, Cystiphylloides, Favosites*, and *Alveolites*, are not found in the TULLY outside of this bed, and represent a recurrence of Hamilton forms.

The upper 5 feet or so of the MOSCOW FORMATION (WINDOM MEMBER) exposed in the quarry floor, is very fossiliferous. The fauna is the typical normal shale *Tropidoleptus* fauna. Especially abundant or characteristic are: Corals - *Amplexiphyllum hamiltoniae, Bethanyphyllum robustum, Cystiphylloides americanum, Eridophyllum archiaci, Favosites hamiltoniae, Favosites turbinata, Favosites arbuscula, Heliophyllum halli, Heterophrentis spp., Stereolasma recta, Stewartophyllum intermittens, Trachypora vermiculosa (= T. romingeri, T. limbata* ; Bryozoa - *Fenestrellina spp. Fistulipora fruticosa, Fistulipora frurcata, Ptilopora striata, Polypora multiplex, Sulcoretepora incisurata, Taeniopora exigua* ; Brachiopods - *Athyris spiriferoides, Atrypa "reticularis" Mediospirifer audaculus, Camarotoechia sappho, Chonetes coronatus, Cryptonella planirostra, Cyrtina hamiltonensis, Douvillina inaequistriata, Elytha fimbriata, Megastrophia*

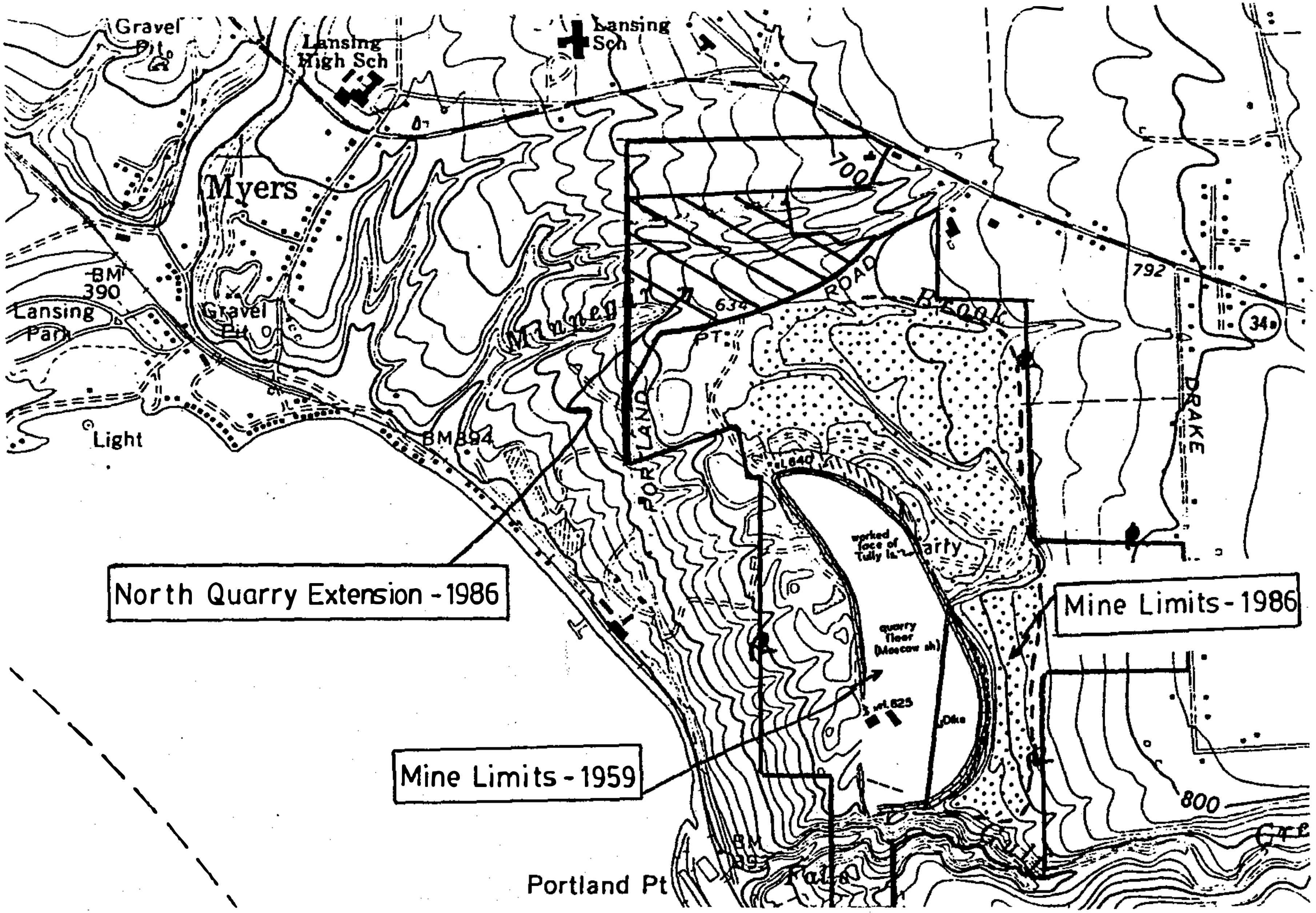

Fig. 14. Location and extent of mining. Cayuga Crushed Stone, Inc. Quarry. Portland Point. Enlarged portion of USGS Ludlowville 7.5 Quadrangle. Modified from Cole and others (1959) and Harrington Associates NYS-DEC and NYS-DOT Open File Reports (1982-86).

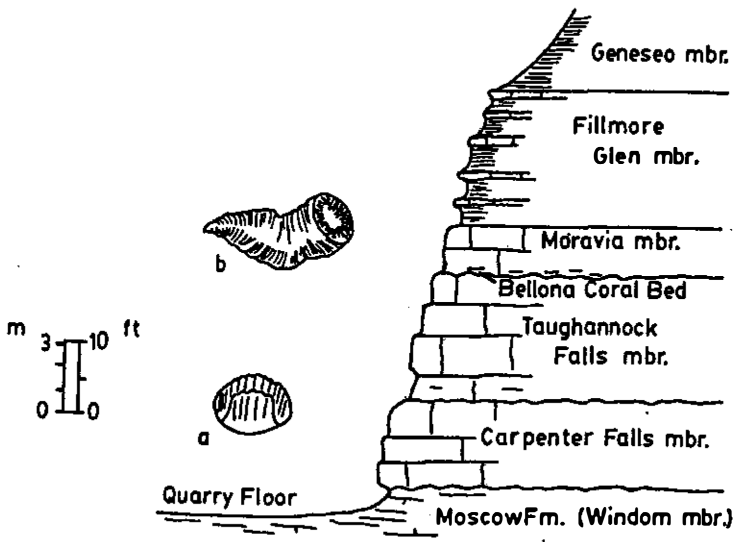

Fig. 15. Section at Cayuga Crushed Stone Quarry, Portland Point. Modified after Cole and others (1959) and Harrington Associates NYS-DOT Open File Reports (1984, 1985). Fossil sketches: a. *Hypothyridina venustula*, b. *Heliophyllum halli*, both =.5X.

concava, Mucrospirifer mucronatus, Pholidostrophia nacrea, Protoleptostrophia perplana, Rhipidomella vanuxemi, Spinocyrtia granulosa, Spinocyrtia marcyi, Stropheodonta demissa, Tropidoleptus carinatus; Gastropods - *Naticonema lineata, Platyceras erectum;* Pelecypods - *Actinopteria boydii, Actinopteria decussata, Aviculopecten princeps, Cypricardella bellistriata, Grammysia arcuaata, Leiopteria greeni, Lyriopecten interradiata, Modiomorpha mytiloides, Goniophora hamilltoniae, Palaaeoneilo muta, Plethomytilus oviforme;* Cephalopods - *Michelinoceras sp., Nephriticerina juvenis, Spyroceras sp.;* Trilobites - *Dechenella rowi, Dipleura dekayi, Greennops boothi, Phacops rana.*

STOP 7. RENWICK SECTION. STEWART PARK ACCESS TO ROUTE 13N. FIG.16.

A continuous section through the RENWICK MEMBER of the GENESEE FORMATION is accessible on the south side of the access road above Lake Street. The section begins close to the base of the RENWICK but the contact with the underlying SHERBURNE siltstones is not exposed.

In the vicinity of Ithaca, the RENWICK MEMBER, as defined by deWitt and Colton (1978), consists of sparsely fossiliferous brownish-black and dark gray shale interbedded with gray silty shale and siltones (some with sole marks) and siltstone-filled scour channels. The RENWICK records a transgression between major stages of delta progradation (SHERBURNE and ITHACA).

The well-known WARRENELLA LAEVIS BEDS (Zone) (Williams 1884; Kindle 1906) which characterize the SHERBURNE/RENWICK transition in this area are well displayed here. This emigrant brachipod from western North America is an important faunal marker around Cayuga Lake but has not been reported farther west in New York. At the foot of Ithaca Falls, in nearby Fall Creek, Williams (1884)and Kindle (1896) describe a diverse fauna from the *laevis* interval, including the goniatite *Ponticeras perlatum* (highest occurence of the species) but the fauna here is rather sparse and goniatites have not been seen.

Above the *laevis* beds are a series of transgressive/regressive cycles marked by black shale band interbedded with siltstones, some with sole markings. The distinctive interval of scour channels (channel-fillings). Interpreted by Williams (1881) as iceberg scratchings, is well displayed. de Witt and Colton report channels in this region up to 3 feet deep and 30 feet wide. Scant data indicate southwest trends for the channels and current flow from east to west but with some eastward flow as well (de Witt and Colton 1978, p. A12).

The scour channel interval contains the famous *Plumalina* beds with the delicate fern-like fronds "called *Lycopodites vanuxemi* by Dawson, but considered to be allied with the graptolites and named *Plumalina plumaria* by Hall..." (Williams, 1881). They are now thought to be either hydroid corals or alcyonarian corals (Sass and Rock, 1975).

At the top of the section are dark shales with *Lingula* and *Leiorhynchus*. In the early classifications of the section around Ithaca the dark *Lingula* shales of the ITHACA beds included all of what is now called

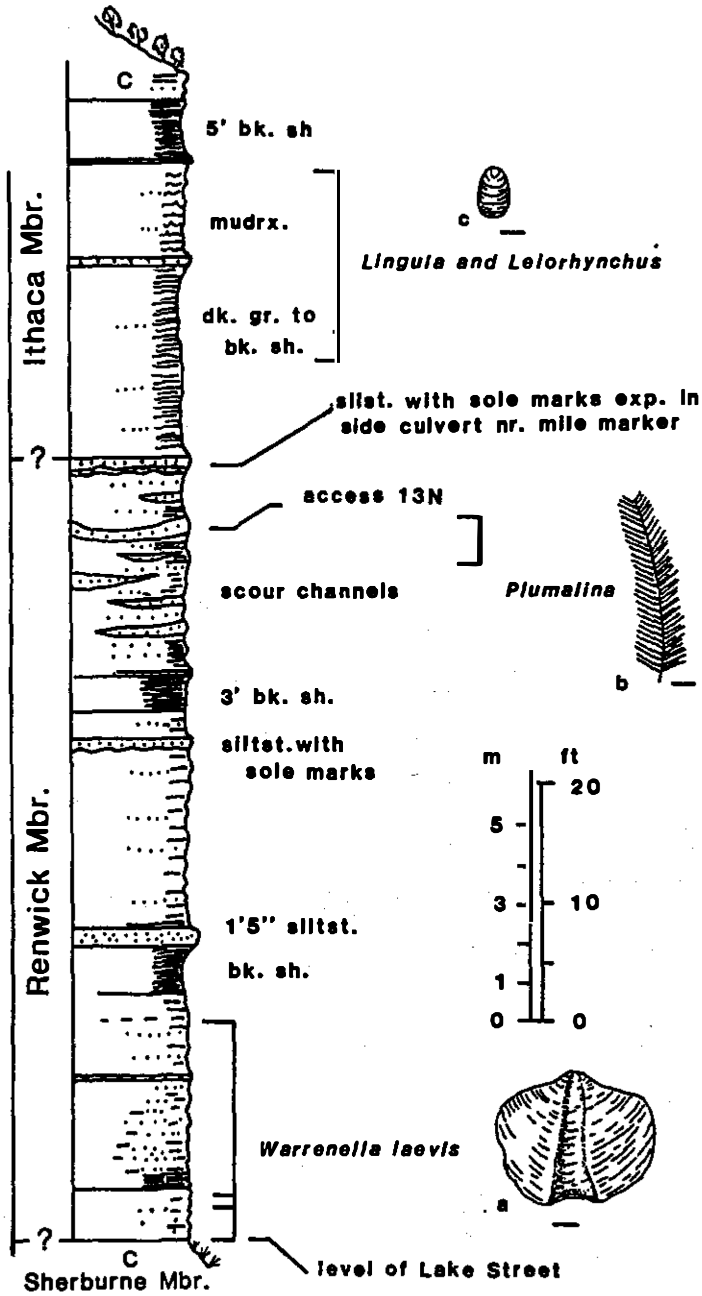

Fig. 16. Section in lower Renwick Member along Stewart Park access to Rte 13N, above Lake Street intersection, Ithaca, N.Y. Fossil sketches based on Palmer and Brann (1966): a. *Warrenellla laevis*, b. *Plumalina plumaria*, c. *Lingula complanata*

RENWICK. The RENWICK/ITHACA boundary remains poorly defined. deWitt and Colton recognize 60 feet at the nearby type locality at Renwick Brook, which would place the contact near the top of the scour channel interval.

Exposures farther east along Rte. 13 are in the ITHACA MEMBER. The section around the cloverleaf at the Cayuga Heights exit has been examined but no lithologic or faunal horizons have been found which can be correlated to particular horizons in the gorge sections at Fall Creek, Cascadilla Creek, and farther south. It may be possible to tie the sections together by correlating conodont horizons, if Klapper's subdivision of the Lower *asymmetricus* Zone can be recognized. Further work on the paleoecology (Thayer,1974) and biostratigraphy (Kirchgasser,1985) of ITHACA MEMBER must include taxonomic revision of the faunas, particularly the brachiopods.

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ROAD LOG FOR TRIP AROUND CAYUGA LAKE

CUMULATIVE MILEAGE	MILES FROM LAST POINT	ROUTE DESCRIPTION
0.0		Mileage begins at intersection of Rtes 13, 89, & 96,.i.e. at the "Octopus"; turn hard right onto Rte 89 N.
0.5	0.5	Cayuga Inlet on right (home of Cornell Crew).
1.2	0.7	Exposure of Sherburne Formation on left.
4.3	3.1	Glenwood
5.5	1.2	View across Cayuga Lake at Portland Point (Firtree Point) Anticline.
8.8	3.3	Willow Creek. At this locality deWitt and Colton (1978) measures 11 feet of Geneseo, 88 feet of Penn Yan, 78 feet of Sherburne and 8 feet of Renwick.The Tully Limestone forms a waterfall just east of the road.
9.1	3.6	Taughannock Falls State Park. Park in small lot on left (before bridge). Follow path to stream.

STOP 1A TAUGHANNOCK FALLS STATE PARK,LOWER FALLS-MOSCOW SHALE/TULLY LIMESTONE/GENESEO SHALE.

		Return to bus. Proceed north on Rte 89. Note modern delta being deposited at the south of Trumansburg Creek.
9.6	0.5	Bear left onto Taughannock Falls Road. Follow signs to Falls overlook.
9.8	0.2	Travelling over a series of hanging deltas.
10.3	0.5	Turn left into parking lot at Falls Overlook.(Restrooms are available at the east end of the parking lot).

STOP1B TAUGHANNOCK FALLS STATE PARK,FALLS OVERLOOK, GENESEE FORMATION.

		Return to bus. Turn left and proceed west on Taughannock Falls Road.
11.	0.7	Turn right. Follow sign to Rte 96 (Taughannock Park Road). Bear left along the west side of the stream. The Ithaca Formation is exposed in the stream bed. Note the mature nature of the upper portion of Trumansburg Creek.

12.2	1.2	Turn right onto Rte 96.
12.9	0.7	Enter Village of Trumansburg
14.9	2.0	View east of the glaciated upland.
16.5	1.6	Enter Hamlet of Covert.
20.4	3.9	Village of Interlaken.
20.6	0.2	Junction of 96A
20.7	0.1	Turn right onto Detour Rte 89 (Cayuga Street)
22.0	1.3	Turn left onto Rte 89.
22.6	0.6	Park on right side of road

STOP 2 HUBBARD QUARRY. GENESEO/LODI/SHERBURNE.

		Return to bus. Proceed north on Rte 89.
27.0	3.6	Groves Creek on right with water falls over Tully Limestone. Note elevation of Tully compared to its elevation at Taughannock State Park. Excellent fossil collecting in the upper Moscow below falls.
33.1	6.1	Turn left onto Ernsberger Road.
35.4	2.3	Turn right at junction of Rte 414.
38.1	2.7	Enter Town of Fayette.
38.7	0.6	Turn left on Poorman Road. Offshore bar of Glacial Lake Dana to the south.
39.0	0.3	Turn left into Fayette Town Quarry.

STOP 3 FAYETTE TOWN QUARRY.CENTERFIELD/LEVANNA.

		Return to bus. Turn right and proceed east on Poorman Road.
39.3	0.3	Turn left onto Rte 414.
41.9	2.6	Turn right (east) on to Canoga Road.
42.2	0.3	Bear right on Reed Road.
43.0	0.8	Pass entrance to Seneca Stone Quarry. This will be Stop 4. We will return to this point after lunch.
43.8	0.8	Turn left (north) at T-intersection.
44.1	0.3	Bear right.
44.8	0.7	Take left fork.

45.0	0.2	Turn left onto Rte 89 North at Canoga.
46.8	1.8	Enter Village of Seneca Falls. To the left was the site of Cayuga Bridge.

Cayuga Bridge crossed Cayuga Lake as part of the Great Western Turnpike before what is now US Route 20 was built skirting the north end of the lake. Cayuga Bridge was constructed of wood and joined Bridgeport on the westside of the lake with the village of Cayuga on the east shore. Construction commenced in May 1799 and was completed in September 1800, by the Manhattan Company of New York for $150,000. Its length was 1 mile, and at the time of its completion it was the longest bridge in North America, and perhaps the world. A traveller remarked in 1800 that only 5 years ago "the Indians possessed the shores of the lake, imbosomed in almost impenetrable woods." The first bridge was built on mud sills, the second on piles, the third and last was erected in 1833. It burned sometime thereafter.

48.1	1.3	LUNCH STOP - CAYUGA LAKE STATE PARK
		Return to bus. Turn left and proceed south on Rte 89 to Canoga.
51.4	3.3	Turn left on Canoga Road.
52.4	1.0	Bear left.
53.7	1.3	Turn right at intersection onto Reed Road.
54.5	0.8	Turn right into Seneca Stone Quarry

STOP 4 - SENECA STONE QUARRY, MANLIUS/ORISKANY/ONONDAGA/UNION SPRINGS/CHERRY VALLEY.

		Return to bus. Leave quarry turning left onto Reed Road.
57.6	3.1	Return to Canoga and turn right (north) onto Rte 89.
63.0	5.4	Driving along top of glacial offshore bar.
63.8	0.8	Cross the Cayuga-Seneca Canal.

This canal, extending from the old Erie Canal at Montezuma to Cayuga and Seneca Lakes, was constructed in 1826-28. It was enlarged during 1847-62. In 1918 it became part of the Barge Canal System by canalization of the Seneca River.

65.5	1.7	Turn right (east) onto Rte 20.
65.8	0.3	On the right is the Montezuma Wildlife Refuge. This swamp is a remnant of proglacial Lake Iroquois.
67.3	1.5	Cross Seneca River.
67.4	0.1	Cross line of the old Cayuga-Seneca Canal.
67.5	0.1	Turn right (south) onto Rte 90.
67.8	0.3	Excellent drumlin on left.
69.1	1.3	On right is the bed of the old Cayuga-Seneca canal.

70.0	0.9	Enter the Village of Cayuga.
70.5	0.5	Turn left (east) at blinker light (West Genesee St).At the foot of the street to the right was the eastern end of Cayuga Bridge.
71.0	0.5	Passing through drumlin field.
72.9	1.9	Enter the West Auburn Gas Field.

First drilled in 1959, the productive horizon in this field is the Ordovician Queenston formation. Throughout most of New York State this unit consists of a sequence of shales with very low effective porosity. An exception exists in the Auburn area where fine-grained sandstones possessing sufficient porosities for gas production occupy approximately 40 feet of the upper portion of the formation.

At present, the major producer in the area is Miller Brewing Company with over 50 wells being utilized to provide gas for their bottling plant at Sennet, New York. To the south, stepout wells have been drilled to provide onsite gas at Union Springs and at Aurora.

72.9	1.0	Cross railroad tracks at Relius.
73.4	0.5	Turn right (south) onto Oakwood Road.
74.4	1.0	On the east is the "Lot 69" Oriskany/Onondaga locality . See discussion for Stop 5.
75.9	1.5	Enter Oakwood. Quarry in the Onondaga is on the right. At stop sign bear right (west) onto Rte 326
78.0	2.1	Turn right onto deadend lane (Weed Road). Outcrop is in the woods west of lane.

STOP 5 YAWGERS WOODS, MANLIUS/ORISKANY/ONANDAGA.

Return to bus. Proceed west on Rte 326.

80.1	2.1	Turn left (south) onto Rte 90.
80.3	0.2	Village of Union Springs. On right is the Union Springs High School gas well. This well,a stepout of the Queenston West Auburn Field,provides much of the energy utilized by the school.
82.1	1.8	On the left in the old Union Springs Quarry is exposed the Cherry Valley/Union Springs/Onondaga sequence. Note old quarrymen's houses constructed of Onondaga Limestone on the right.
83.4	1.3	Passing the site of Cayuga Castle, "Goi-o-Gouen", a principal Cayuga Indian village destroyed in the Sullivan Campaign September 23, 1779. This was also the site of an early Jesuit Mission.
85.4	2.0	Enter the Hamlet of Levana. The type exposure of the Levana Shale is in the cliff along the lake shore.
87.3	1.9	Enter Village of Aurora.
87.7	0.4	On the right is the Aurora Inn (1833).

88.3	0.6	Wells College. On the right is Glen Park, built (1852), home of Henry Wells, founder of American Express (1850), Wells Fargo (1852) and Wells College (1868).
89.0	0.7	On left pass Popular Ridge Road , which leads to Moonshine Falls, an excellent exposure of Ledyard Shale and Centerfield Limestone.
95.9	6.9	Enter Village of King Ferry.
96.4	0.5	Turn right (south) onto Rte 34B.
99.2	2.8	Tompkins County Line.
99.9	0.7	Enter Village of Lake Ridge.
105.9	6.0	View south to Ithaca, with the Portage Escarpment in the distance.
106.4	0.5	Cross Salmon Creek, an excellent example of barbed drainage produced by stream diversion.
107.5	1.1	Enter Village of South Lansing
107.7	0.2	Turn right onto Portland Point Road. (at Cargill Salt sign). The salt mine is at the foot of the hill.
108.1	0.4	Turn left into Portland Point Quarry.

STOP 6 PORTLAND POINT QUARRY.MOSCOW/TULLY/GENESO

		Return to bus. Turn right onto Portland Point Road.
108.5	0.4	Turn right onto Rte 34B.
108.9	0.4	Turn right (south) onto Rte 34. On corner is Rogues Harbour Inn (1830).
		Return to Ithaca (6 miles) via Rte 34.
114.9	6.0	Park near the underpass of Rte 13 and walk to roadcut along Stewart Avenue access road to Rte 13N, above Lake Street(Rte 34).

STOP 7.(OPTIONAL). ROUTE 13 ROADCUT. RENWICK/ITHACA.

End of Field Trip