PALEOENVIRONMENTS OF THE MARCELLUS AND LOWER SKANEATELES FORMATIONS OF THE OTSEGO COUNTY REGION (MIDDLE DEVONIAN)

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INTRODUCTION

The Devonian System in New York State varies from carbonates below (Helderbergian, Ulsterian and lowest Erian Series) to coarse continental clastics at the top (Chautauquan Series), and represents a westward migrating deltaic complex built during Middle and Late Devonian time.

This deltaic complex, the Catskill Delta, is today represented by a wedge of sedimentary rock that thickens and coarsens eastward. The clastic wedge is pierced at several horizons by relatively thin, but geographically widespread, lithologically distinct units that do not change facies as rapidly as the rocks above or below. Serving as time planes, these key beds subdivide the clastic wedge into a number of major time-stratigraphic units.

Three carbonate keybeds in the lower portion of the wedge serve to subdivide the lowest time stratigraphic unit, the Hamilton Group (Middle Devonian), into four formations; which are from oldest to youngest, the Marcellus, Skaneatelus, Ludlowville and Moscow Formations.

The Middle Devonian Hamilton Group of New York State is structurally simple and highly fossiliferous, thereby lending itself to detailed stratigraphic, paleontologic, and paleoecologic studies. In eastern New York it consists of approximately 1,650 feet of shale, siltstones, and sandstones in the Unadilla Valley, 1950 feet in the Susquehanna Valley and 2,285 feet near Richmondville (Cooper 1933).

The Marcellus Formation in the Otsego County region thickens eastward from about 600 feet in the Unadilla Valley, to nearly 820 feet in the Richmondville area in western Schoharie County. The base of the Mottville Member is generally taken to be the top of the Marcellus Formation east of the Cayuga Lake meridian. However, east of the Unadilla Valley, the Mottville loses its identity, thereby making the boundary between the Upper Marcellus and Lower Skaneateles almost impossible to delineate with precision. Therefore, criteria to determine the exact thickness of the Marcellus Formation across most of Otsego County is lacking.

The senior author, using the Mottville Member as a datum, obtained a dip of approximately 85 feet per mile to the southwest for the Lower Hamilton in the Unadilla Valley. Cooper (1933) indicates steeper dips of 90-100 feet to the southwest in the Susquehanna Valley and 100-137 feet per mile to the southwest in the Schoharie Valley.

PREVIOUS WORK

Lardner Vanusem (1842) in his report on the third geological district of New York laid the foundation for all later work in central and eastern New York west of the Catskills. Prosser (1895, 1899) furthered our knowledge of Middle and Upper Devonian rocks in central and eastern New York (Chenango Co. to Albany Co.). Grabau (1906) included some remarks on Hamilton strata in the Schoharie Valley to the east of the present region of study. The stratigraphic relations of the Hamilton Group as now understood were first clarified by Cooper's classic papers (1930, 1933). Rickard and Zenger (1964) provided the first detailed geologic maps of the Richfield Springs and Cooperstown Quadrangles and Rickard (1975) summarizes recent correlations for the New York Devonian.

During earlier investigations dealing with the facies and faunal control of the different sediment phases of the classic "Catskill Delta", the cyclic repetition of these phases was also recognized (Chadwick, 1933; Rich, 1951; Rickard, 1964; Wolff, 1965).

Through the use of faunal associations (Cooper, 1930, 1933) and thickening rates as well as the earlier descriptions of faunal and sediment features, various correlation and environmental subdivisions were extended. This has been particularly so for the transgressive units (McCave, 1968; Wolff, 1969; Johnson & Friedman, 1969), and for the growing evidence for the tectonic control of many depositional phases through contemporaneous uplift or subsidence for various parts of the Devonian basin in New York and Pennsylvania (Fletcher, 1963; Wolff, 1965, 1969; Sutton, <u>et al.</u>, 1970; Walker, 1971; McCabe, 1973) and the recognition of the "Catskill Delta" as a tectonic deltaic complex (Friedman and Johnson, 1969).

With some modification, these phases and their inferred depositional environments within the Marcellus Formation in this area are indicated in Figure 1.

STRATIGRAPHY

General

The regional and local tectonic control of the depositional phases was outlined by Wolff (1969) and McCave (1973). Of significance is the Adirondack axis, which continues to act as a submarine barrier (arch) in this region during most of the period associated with the deposition of the Hamilton Group. The area between Richmondville and Schoharie Valley separates two marine basins and acts as a local shoal which enables the winnowing of marine sands during the short transgressive intervals; McCave (1973) reports four other sediment highs west of this region. These shoals permit the development of linear, en-echelon lenses of sand as "offshore bars" and separate the open marine platform and slope environments west of this area (the stops of this field trip) with the more restricted marine, lagoonal, and marginal channel and sand flat environments east of here (Wolff, 1969).

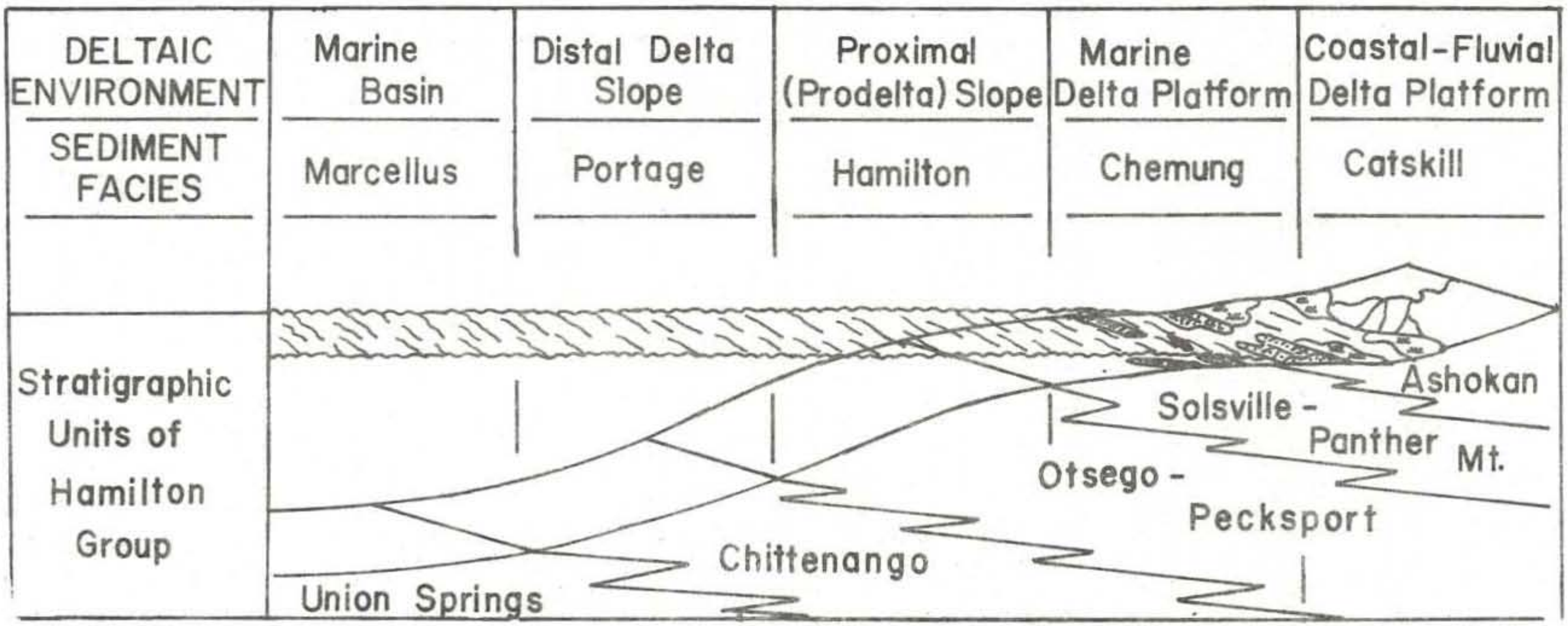

Fig. 1. Depositional environments and formation equivalents of the Marcellus

The features associated with the sediment facies of Rickard (1975) are described below. The modification for the Marcellus Formation is to divide these phases into the categories originally described by Rickard (1964), making the following associations: Marcellus=Cleveland, Portage=Chagrin, Hamilton=Big Bend, Chemung=Smethport. The alluvial associations (Catskill) will not be seen on this trip and are not included.

A. Marcellus Facies (Union Springs-Chittenango Members). The principle feature is the thin-bedded black, fissile, calcareous shales with thin bedded black micrite or micrite concretions. The sediments were deposited or precipitated in an anaerobic environment below wave base. The strata are sparsely fossiliferous, consisting of low diversity pelagic and epipelagic types.

B. Portage Facies (Lower Pecksport, Lower Solsville, Upper Bridgewater). Here the fissile laminated shales grade into massive laminated mudstones and thin-bedded homogeneous siltstones (distal turbidites). The proportion of micrite decreases rapidly vertically through the section. The deposits are not as deep since the sparse fauna now includes benthic as well as epipelagic and pelagic types.

C. Hamilton Facies, Otsego. The major lithology is knobby, irregular-bedded dark gray mudstone (from burrowing) with some siltstones or fine-grained gray sandstones (proximal turbidites). The sandstones become planar crossbedded and laminated higher in the section, and ball and pillow structures become more common. The sandstones exhibit scour and fill contacts and some ripples within the associated gray shales. This environment is now below and within the zone of wave base and includes a moderately diverse fauna of benthic and epipelagic types.

D. Chemung Facies Upper Solsville, Upper Pecksport, Mottville, Delphi Station, Panther Mt. Now the lithology and contacts become more variable and discontinuous. Thick sets of gray-light gray, medium-grained crossbedded sandstones are interbedded with horizontal bedded siltstones and dark gray shales. The important structures include low angle planar crossbedding, oscillation and current ripples and megaripples, scour and fill structures, burrow mottles, current lineation, and horizontal laminations. Coquinites are common in this area, but are uncommon south of Albany where pebble beds are more characteristic. This is a shallow marine environment near or within the zone of breaking waves (onshore-offshore transport). It contains a highly diverse fauna of brachiopods, pelecypods, worms, and plant fragments.

The sediment structure associated with the Mottville horizon (emphasized in the road log) indicate the presence of a sandy, well agitated marine platform with low angle crossbedding and low amplitude ripples. The crests of the current structures trend northwest and southwest while current lineation and crossbedding trend west and northeast. This suggests a west-northwest current system with a northeast-southwest onshore-offshore component.

Marcellus Formation

Although considerably revised since Hall (1839) first named the Marcellus, this formation has long been recognized as basal Hamilton. Cooper (1930) was able to subdivide it into a number of members based on stratigraphic position and lithology.

Due to facies changes within the Marcellus and overlying Skaneateles Formations it seems best to subdivide these formations differently between western and eastern Otsego County. The stratigraphic sections in Figure 2 reveal this variance in subdivision along with the position and thickness of exposed units for each of the field trip stops.

Union Springs Member. The Union Springs Member (Cooper 1930) consists of 25 to 35 feet of black fissile shales and thin black limestones lying between the Cherry Valley Member above and the Onondaga Limestone below. The dominant fauna of the Union Springs (Plate 1) is not a diverse one, consisting primarily of planktonic or epiplanktonic forms of cephalopods (Tornoceras sp., Agoniatites nodiferus), the pteropod Styliolina fissurella, the possibly epiplanktonic, "Leiorhynchus" limitaris and the hitchhiking bivalve Lunulicardium (Nye, et al. 1975). The Union Springs is best exposed at Cox's Ravine just Northwest of Cherry Valley - Stop 8.

Cherry Valley Member. The Cherry Valley Limestone has long been famous for its contained cephalopods. Originally known as the Agoniate Limestone (Vanuxem 1842), Clarke (1903) first applied the geographic name by which it is presently known. Sandwiched between the weak Chittenango Shale above and Union Springs Shale below this 5 feet of hard resistant limestone forms waterfalls and terraces. The type section is at Cox's Ravine, .7 miles northwest of Cherry Valley (Stop 8). An orange-red iron stain is characteristic of the Cherry Valley in outcrop.

The high diversity of cephalopods, nearly 30 species across the state, has been documented for many years (Clarke,1901; Flower, 1936; Rickard, 1952). The precise age of the Cherry Valley Limestone is in dispute as correlations with the European Eifelian-Givetian boundary have not been resolved (Rickard, 1975). Agoniatites vanuxemi and Striacoceras typum are common cephalopods. Other forms found include the tabulate coral Aulopora and the trilobite Proetus haldemani. (Plate 2-3)

Chittenango Member. The Chittenango Shale (Cooper, 1930) is a black, fissile, nearly barren shale totaling approximately 150 feet. Concretions, many septarian, occur throughout the unit. Styliolina fissurella and small tentaculitids are the only conspicuous fossils. The Chittenango will not be examined on the trip.

Bridgewater Member. This name was applied by Cooper (1930) to the shales between the Chittenango Member and Solsville Member. It was

Large bivalve mollusks and mostly pedunculate brachiopods dominate the assemblage. Minor constituent taxa include mobile epifaunal gastropods and trilobites. The problematical ichnofossil Taonurus is also very abundant.

The fauna is dominated by filter feeders (73%), while deposit feeders account for 15% of the assemblage and mobile carnivores, scavengers, and grazers (mostly gastropods and trilobites) account for roughly 12%.

The bivalves include the epibyssate Limoptera, Mytilarca, Cornellites, and Pseudaviculompecten, the endobyssate Modiomorpha, Actinodesma (Glyptodesma), Goniophoia, and Cimitaria and the mobile infaunal suspension feeding Grammysia and Cypricardella.

Camarotoechia, Mucrospirifer, Paraspirifer, Mediospirifer, and Tropidoleptus are the dominant brachiopods.

Vagrant benthonic forms include gastropods Bembexia and Paleozygopleura (Loxonema), and the trilobites Greenops and Dipleura. The relatively high frequency of gastropods may be indirect evidence of abundant plant growth.

In summation, the community is characterized by fixed and free, epifaunal filter feeders, and mobile and fixed, infaunal filter feeding bivalves. Vagrant benthonics are strikingly conspicuous.

Lithologically the lower Delphi Station is a calcareous arenaceous shale and siltstone or subgraywacke. Some areas contain megaripples with low angle planar crossbedding 6-8 feet long and 1-6 inches thick.

The inferred environment of the Limoptera Community was closer to shore than the previously described types, probably inhabiting the middle delta platform. Current activity was moderate to high, normal marine conditions prevailed, and the substrate was probably stable and firm. Sufficient organic detritus was in suspension and in the substrate to support the varied adaptive types described above.

Analogs are probably represented by a blend of McGhee's (1976) Leptodesma-Tylothyris and Atrypa-Cypricardella Communities and the Bellerophon Community of Bowen, et al. (op. cit.)

Portions or all of the Panther Mountain and Solsville Members are also representative of the middle delta platform in this area. The weakly developed Limoptera Community in these units, if present at all, may be due to greater rates of sedimentation from time to time on the middle delta platform. Portions of these units, especially the Solsville, may represent the unstable, shifting, substrates of the near shore delta platform.

ACKNOWLEDGEMENTS

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PLATE 1

2a

2b

3a

3b

4

1a

1b

1c

UNION SPRINGS

Fig. 1a-1c "Leiorhynchus" limitare
Fig. 2a-2b Lunulicardium marcellense
Fig. 3a-3b **Styliolina fissurella**
Fig. 4 **Agoniatites nodiferis**

PLATE 2

1

2a

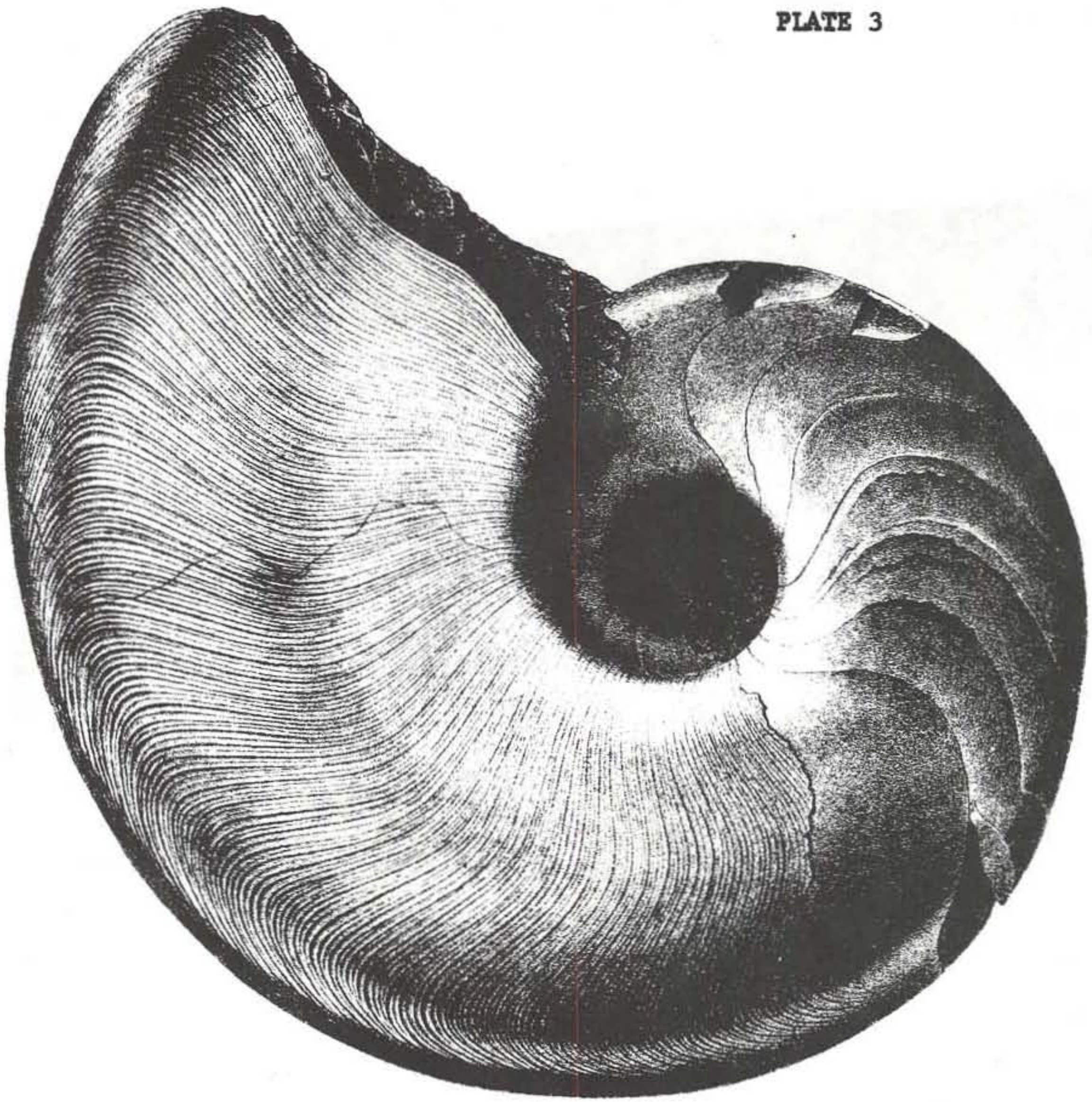
3

2b

CHERRY VALLEY

Fig. 1 Aulopora sp.
Fig. 2a-2b Striacoceras typum
Fig. 3 Proetus haldemani

PLATE 3



1a

1b

Fig. 1a-1b Agoniatites vanuxemi

PLATE 4

2a 2b

1a 1b

3a 4a

3b 4b

5b

5a

OTSEGO

Fig. 1a-1b	Rhipidomella vanuxemi	Fig. 4a-4b	**Mucrospirirer mucronatus**
Fig. 2a-2b	Chonetes coronatus	Fig. 5a-5b	**"Leiorhynchus" multicostum**
Fig. 3a-3b	Athyris cora		

PLATE 5

SOLSVILLE

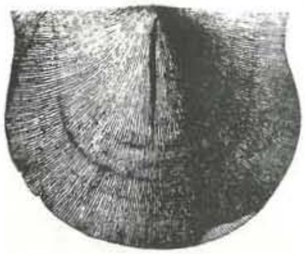
Fig. 1a-1b	Protoleptostrophia perplana
Fig. 2	Goniophora hamiltonensis
Fig. 3a-3b	Modiomorpha subalta
Fig. 4	Actinopteria bodyi
Fig. 5a-5b	Cornellites flabellum

PLATE 6

Solsville

Fig. 1a-1b	Gosselettia triqueter
Fig. 2	G. oviformis
Fig. 3a-3b	Nephriticeras sp.

PLATE 5



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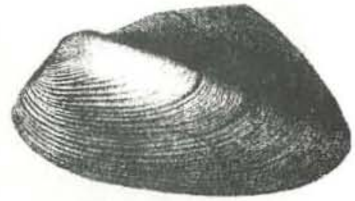

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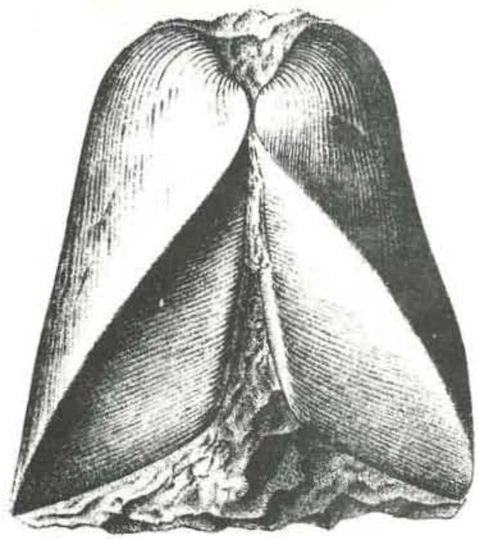

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4

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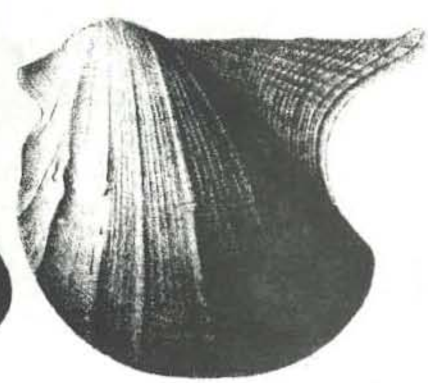

5b

PLATE 6

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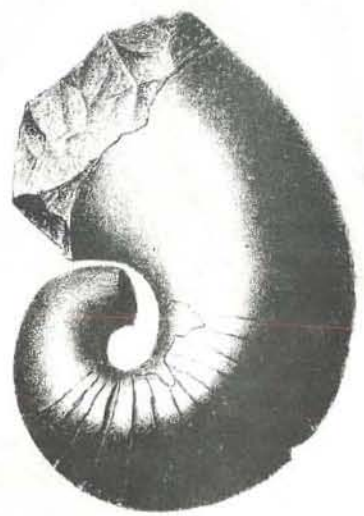
2

1b



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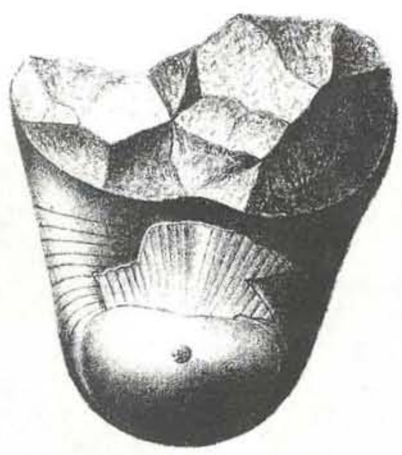

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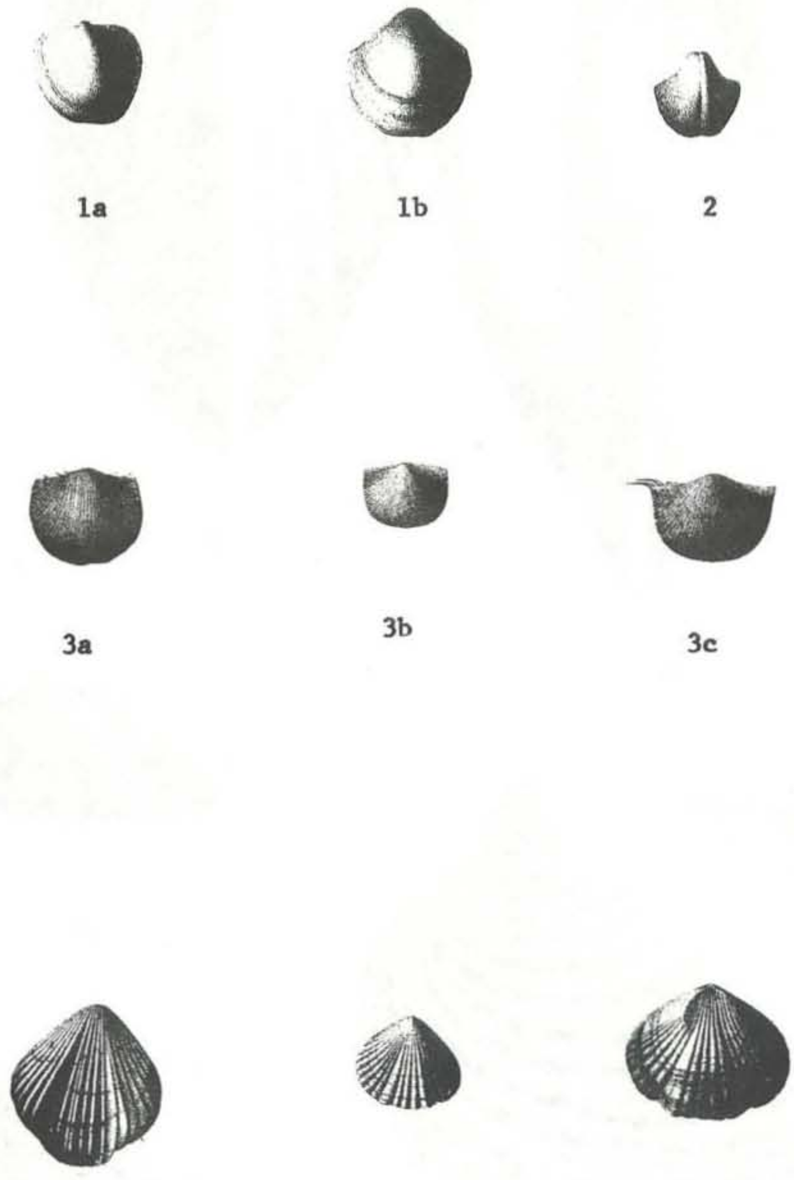
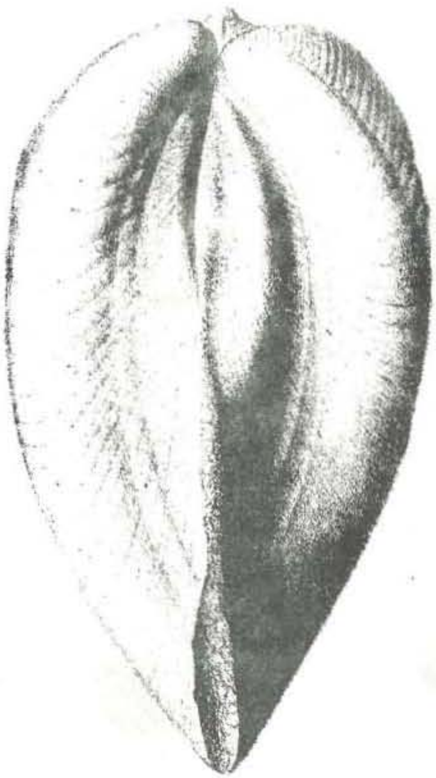
PLATE 7



PECKSPORT

Fig. 1a-1b Ambocoelia praeumbona
Fig. 2 A. umbonata
Fig. 3a-3c Chonetes scitula
Fig. 4a-4c "Leiorhynchus" laura

PLATE 8



1b

1a

2a

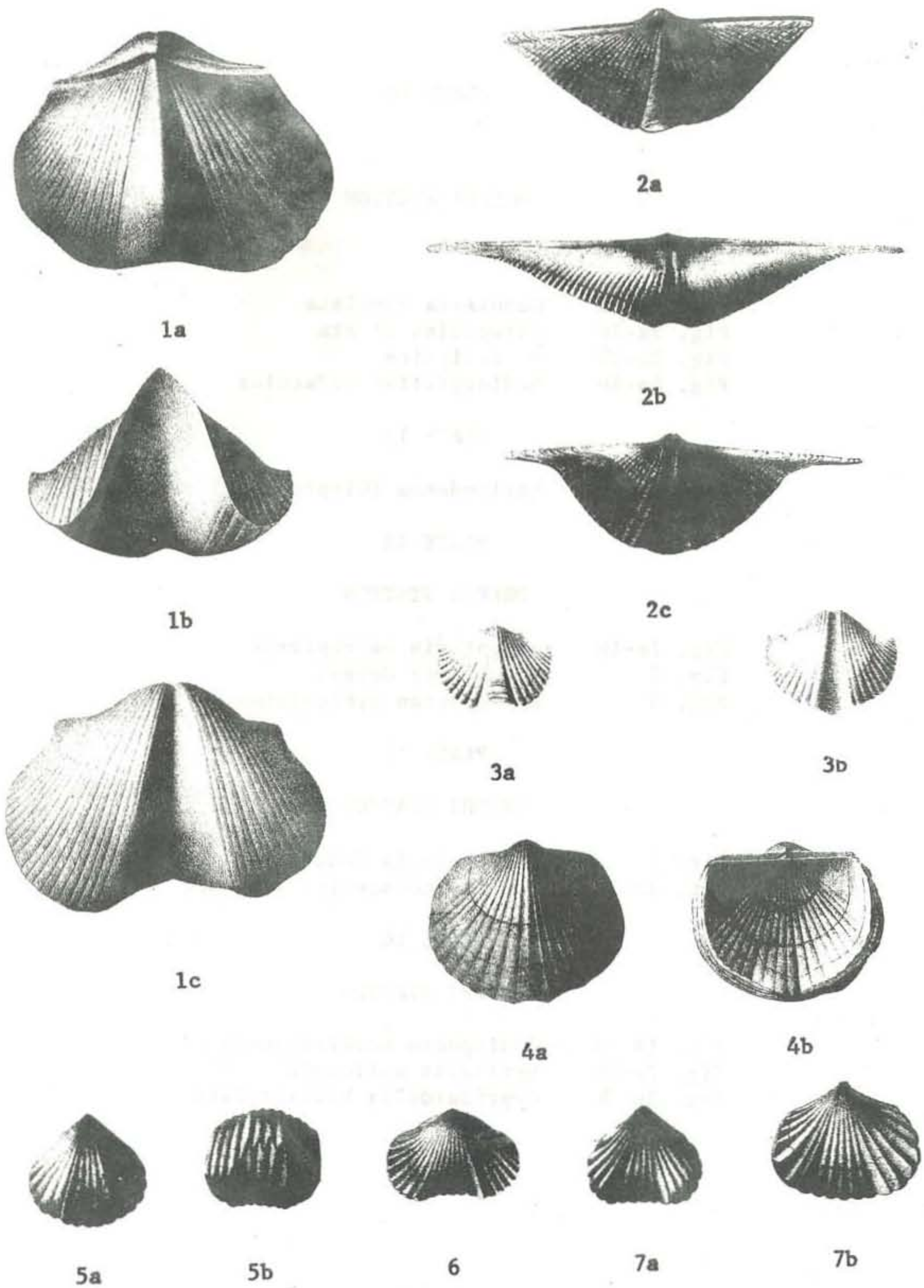
1c

2b

PECKSPORT

Fig. 1a-1c Grammysia alveata
Fig. 2a-2b Cypricardella bellistriata

PLATE 9



MOTTVILLE

Fig. 1a-1c Paraspirifer acuminatus
Fig. 2a-2c Mucrospirifer mucronatus
Fig. 3a-3b Allanella (Spirifer) tullius
Fig. 4a-4b Tropidoleptus carinatus
Fig. 5a-5b "Camarotechia" congregata
Fig. 6 "C." horsfordi
Fig. 7a-7b "C." sappho

PLATE 10

DELPHI STATION

Fig. 1a-1b	Conularia undulata
Fig. 2a-2b	Paracyclas lirata
Fig. 3a-3b	P. elliptica
Fig. 4a-4b	Mediospirifer audaculus

PLATE 11

Fig. 1a-1b	Actinodesma (Glyptodesma) erectum

PLATE 12

DELPHI STATION

Fig. 1a-1b	Limopteria macropteria
Fig. 2	Leiopteria dekayi
Fig. 3	Lyriopecten orbiculatus

PLATE 13

DELPHI STATION

Fig. 1	Actinopteria decussata
Fig. 2a-2b	Pseudaviculopecten princeps

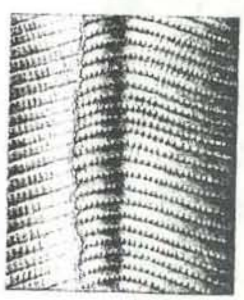
PLATE 14

DELPHI STATION

Fig. 1a-1d	Goniophora hamiltonensis
Fig. 2a-2b	Mytilarca oviformis
Fig. 3a-3b	Cypricardella bellistriata

PLATE 10

1a



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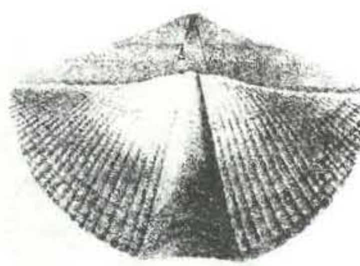
2a

2b

3a

3b



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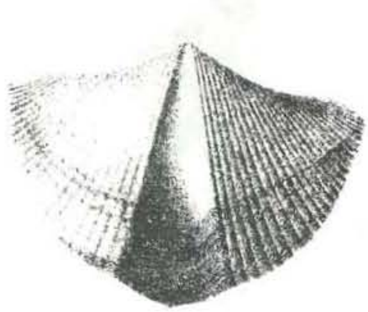

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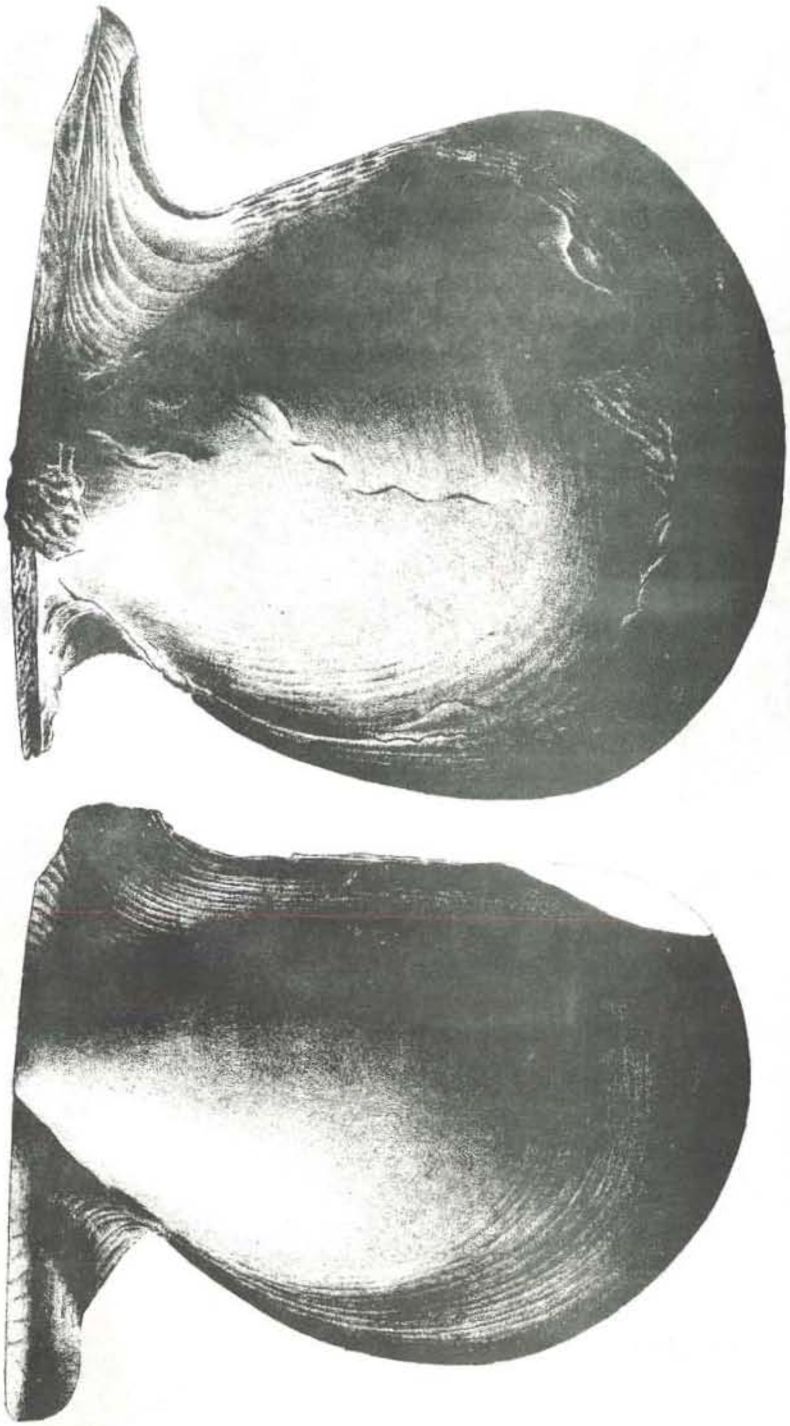
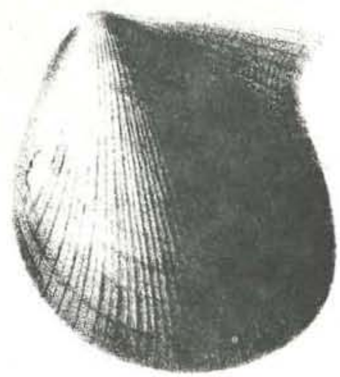
PLATE 11



1a 1b

PLATE 12

1a



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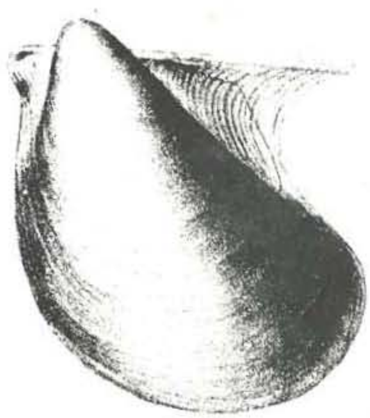

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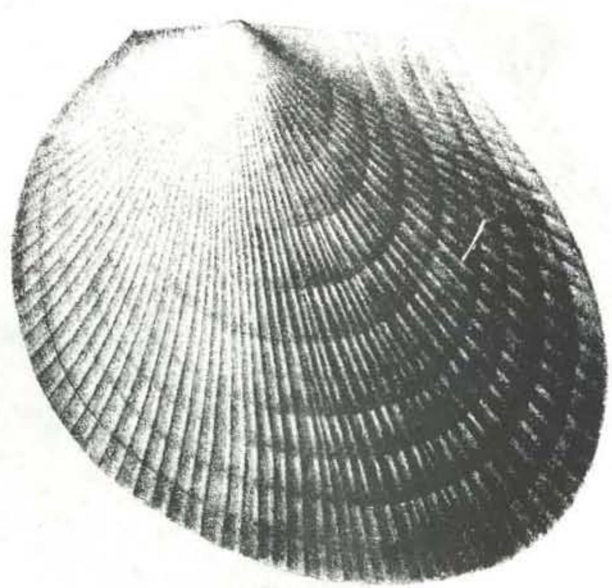

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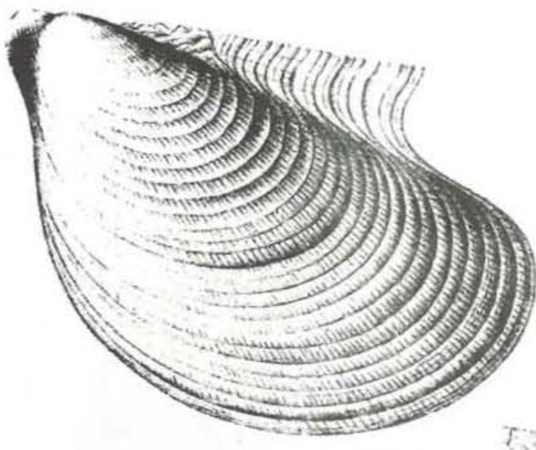
PLATE 13



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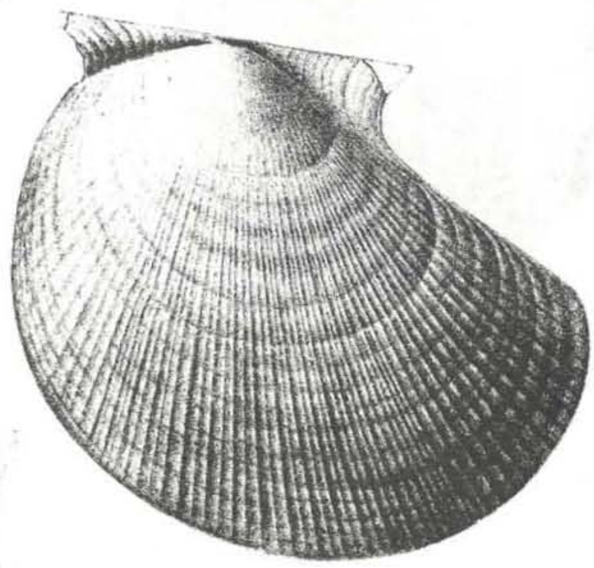

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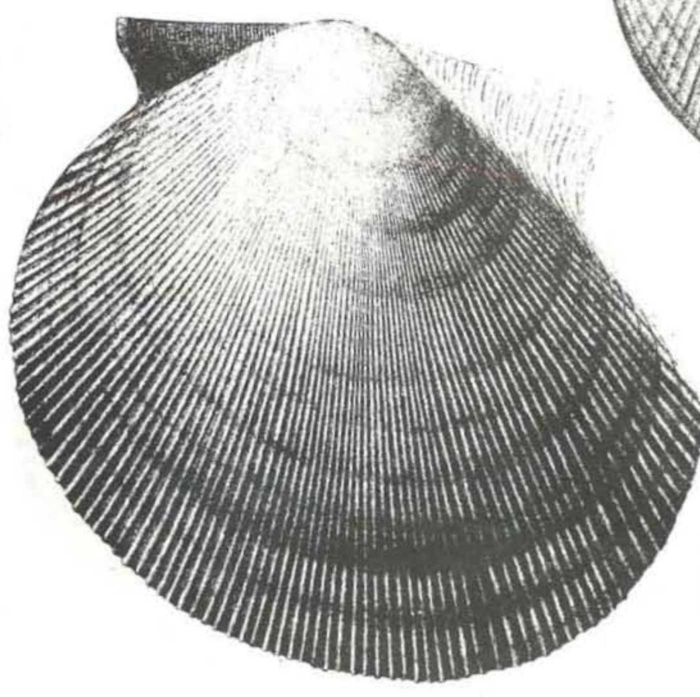

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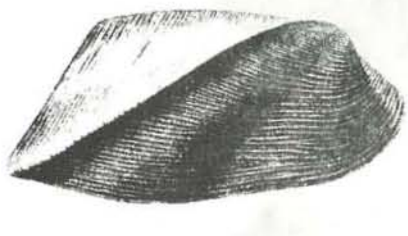
PLATE 14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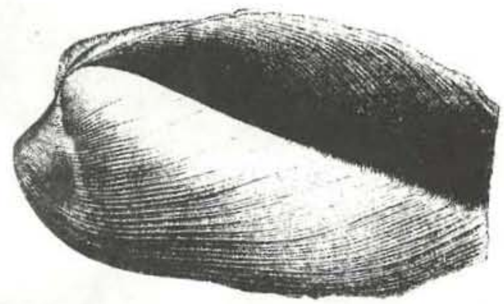
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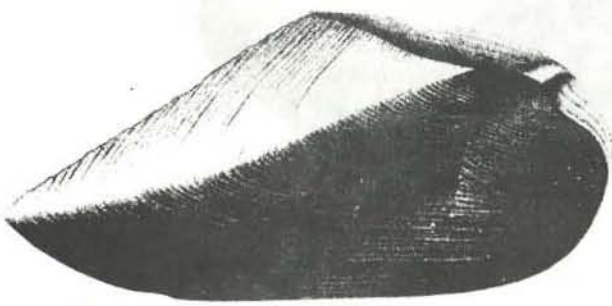
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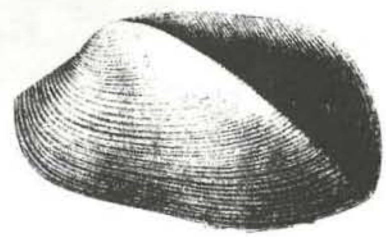

1d

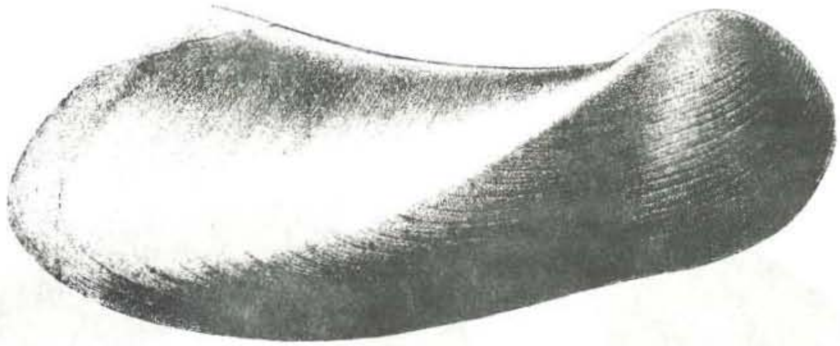

2a


2b


3a


3b

PLATE 15



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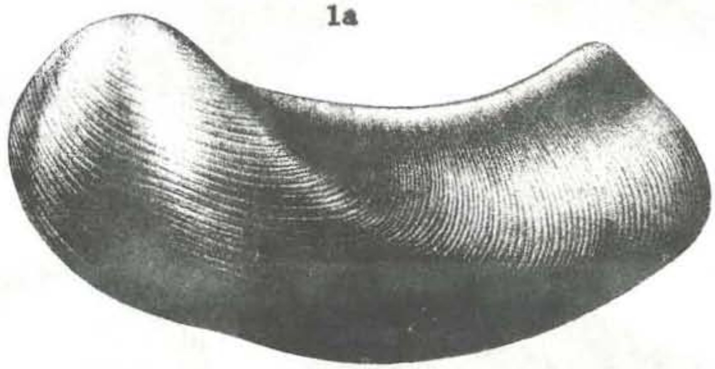

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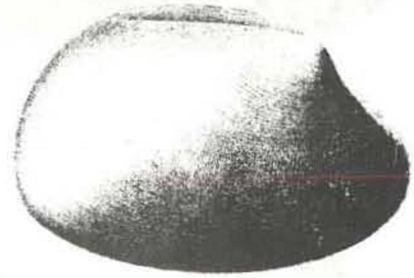

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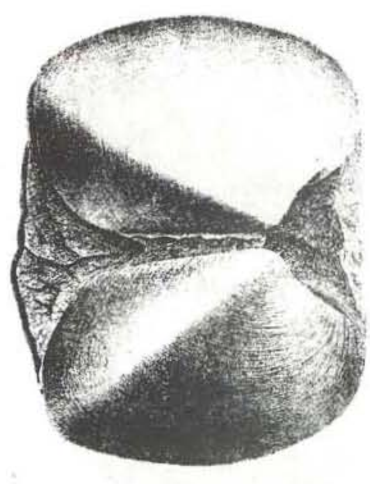


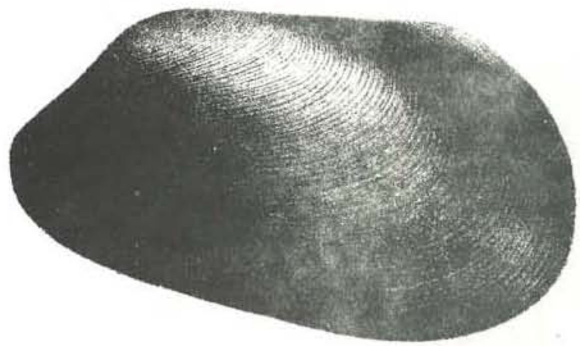
2a

2c

DELPHI STATION

Fig. 1a-1b Cimitaria recurva
Fig. 2a-2c Cypricardella tenuistriata

PLATE 16



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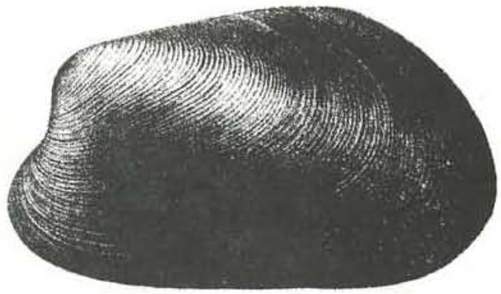

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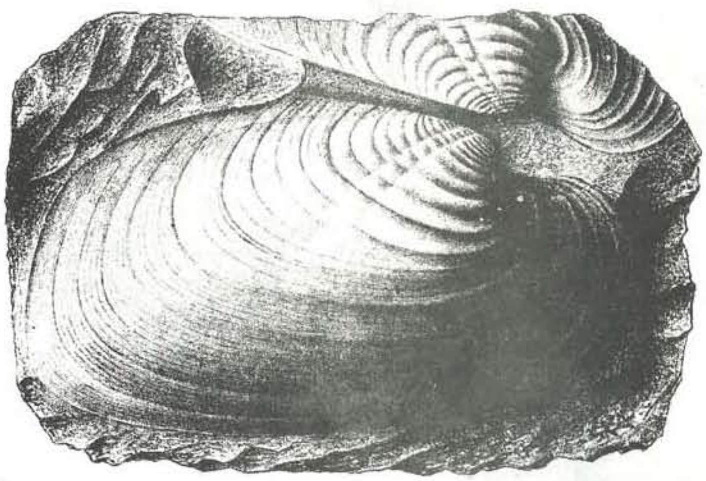
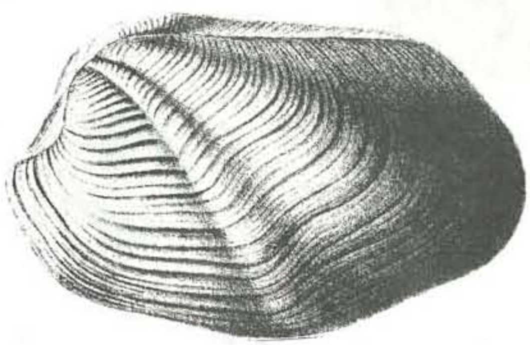


2a

3a



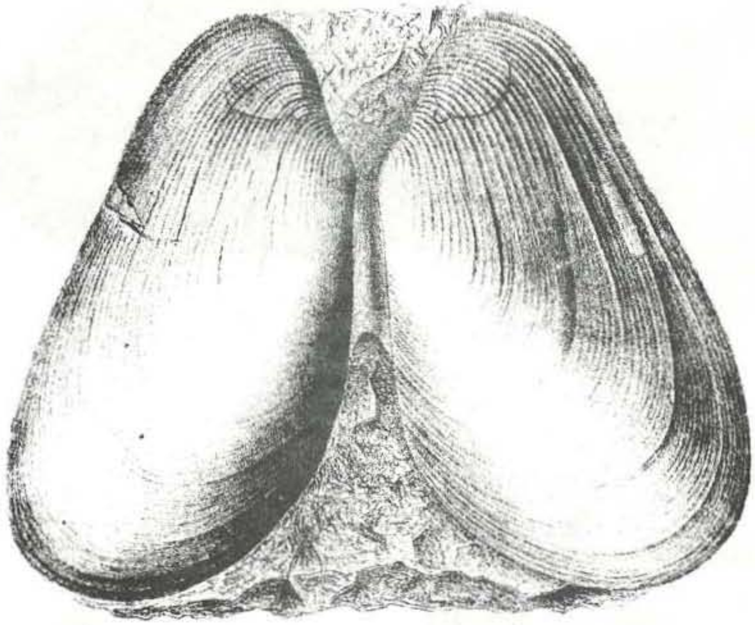
2b

3b

DELPHI STATION

Fig. 1a-1b Modiomorpha sp.
Fig. 2a-2b Grammysia bisulcata
Fig. 3a-3b Modiomorpha concentrica

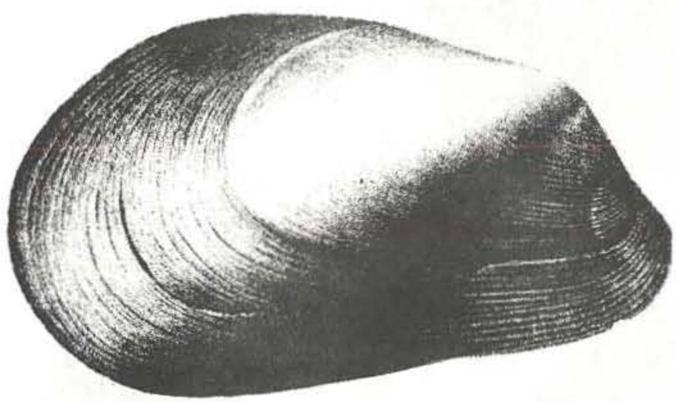
PLATE 17



1a

2a

2b



1b

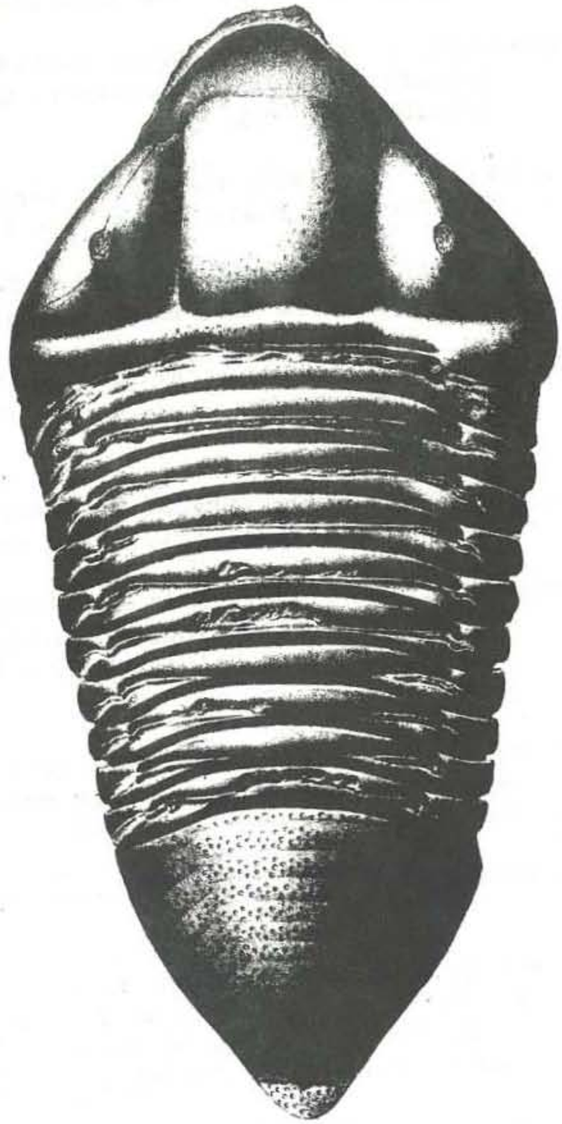
2c

DELPHI STATION

Fig. 1a-1b Modiomorpha mytiloidea
Fig. 2a-2c Bembexia sulcomarginata

PLATE 18

1a



1b

2

DELPHI STATION

Fig. 1a-1b Dipleura dekayi
Fig. 2 Greenops boothi

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1000
1296
Sharon
1500
2000

ROAD LOG

NOTE: Quadrangles referred to are 7 1/2 minute. Mileage from Oneonta to Stop 1 and that from Stop 10 back to Oneonta are approximate.

Miles from last point	Cumulative Miles	
0.0	0.0	Oneonta-proceed West on NY 7
2.0	2.0	Enter West End
0.5	2.5	Jct. NY 23-proceed West on NY 23
2.0	4.5	Jct. NY 205-proceed West on NY 23
2.0	6.5	West Oneonta-proceed West on NY 23
14.0	20.5	Enter Morris
0.5	21.0	Jct. NY 51-proceed West on NY 23
8.0	29.0	Enter South New Berlin
0.3	29.3	Jct. NY 7-turn right (North)
8.0	37.3	Enter New Berlin-proceed North on NY 8
12.0	49.3	Jct. South Beaver Creek Road-turn left (West)
6.0	55.3	Enter Village of Brookfield
0.2	55.5	Jct. Main Street (Skaneateles Tpk.)-turn right (East)
0.1	55.6	Jct. North Beaver Creek Road-turn left (North)
1.8	57.4	STOP 1 - Road cut on West side Beaver Creek Road about 2 mi. North of Village of Brookfield. (Brookfield Quad.)

Units Exposed: Mottville (1' - Elev. top 1500'), Delphi Station Mbr. (45').

Here the Mottville represents the Camarotoechia-Mucrospirifer Community and delta front sand environment.

The overlying Delphi Station indicates a median delta platform environment. The *Limoptera* Community is well represented here. Fossils are extremely abundant.

---	---	Return South on Beaver Creek Road
1.8	59.2	Enter Brookfield
0.2	59.4	Jct. Main St. (Skaneateles Tpk.) turn left (East)
0.5	59.9	Jct. Dugway Road turn right (South)
1.6	61.5	Jct. Button Falls Road at Five Corners turn left (East)
1.5	63.0	STOP 2 - Button Falls - Falls on Button Creek down from Button Falls Road on the West side of the Unadilla Valley about 1 1/2 mi. SW of Leonardsville (Brookfield Quad.)

Units Exposed: Solsville (8' - Elev. top 1200'), Pecksport (90'), Mottville (10' - Elev. top - 1300'), Delphi Station (7').

The lithology, sedimentary structures and fauna of the Upper Pecksport assign it to the distal (outer) platform. The slightly sorted sands, sinuous and linguoid ripples, and lag concentrate conquinites of the Mottville probably represent a period of reworking or transgression forming the delta front sands. Camarotoechia and Mucrospirifer also occur in the upper Pecksport and probably represents the same community as the Mottville.

---	---	Proceed E on Button Falls Road
0.5	63.5	Jct. NY 8 turn left (North)
0.2	63.7	Solsville Ss. on left and in abandoned quarry
1.0	64.7	Enter Leonardsville
0.2	64.9	Jct. Huey Road - turn right (East)
0.2	65.1	Cross Unadilla River
0.7	65.8	Jct. Otsego Co. Road 18 - turn left (North)
1.2	67.0	Jct. Otsego Co. Rd. 21 (Skaneateles Tpk.) at Lloydsville-turn right (East)
3.4	70.4	Plainfield Center
0.2	70.6	Sharp curve to left (North)
0.4	71.0	STOP 3 - Plainfield Center Quarry just West of Otsego Co. Rd. 21; .3 mi. N of Plainfield Center (Unadilla Forks Quad.)

Units Exposed: Solsville (10' - Elev. top 1620'), Pecksport (80'), Mottville (5' - Elev. top 1700').

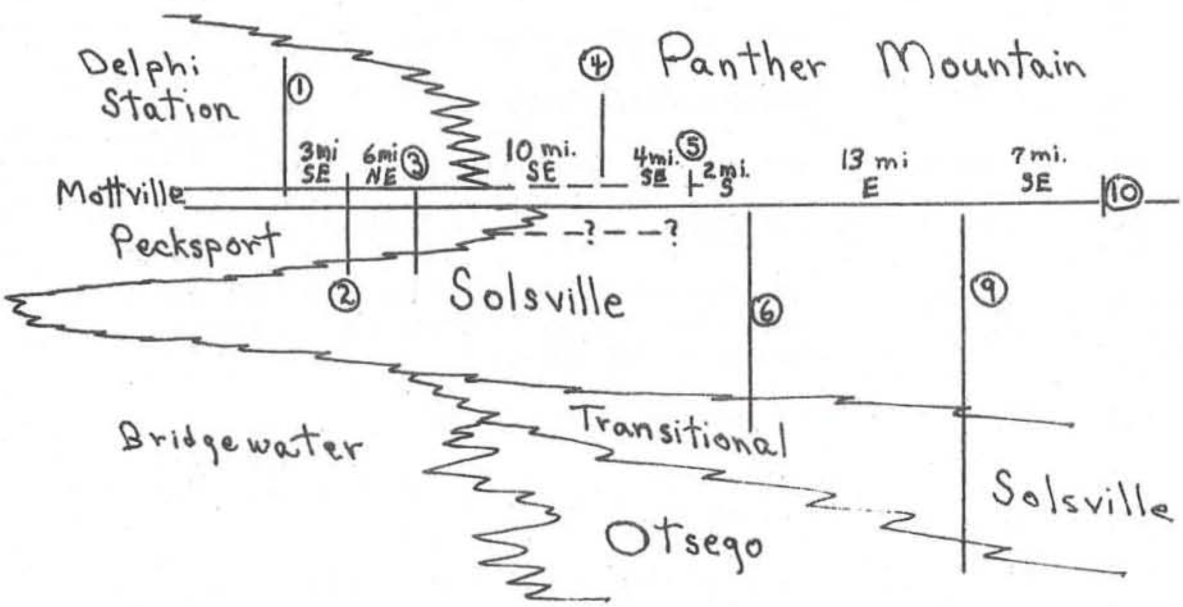
The Pecksport is here a horizontal to irregular bedded siltstone exhibiting some ripples, burrowing, and cross laminations of the distal (outer) delta platform or in part delta front sands. The Mottville caps the quarry and contains a 5 inch basal conquinite horizon. Large scale, low angle, crossbeds and ripples 1-2 inches thick and trending N 40°E as well as SW are present. Dipolar crossbeds suggest a series of migrating ripples deposited during a period of winnowing and re-working of the delta front sands on the distal (outer) delta platform.

---	---	Proceed N on Co. Rd. 21
0.05	71.05	Pecksport in abandoned quarry
0.05	71.1	Solsville top on left
0.9	72.0	Jct. NY 51 turn left (North)
1.6	73.6	Enter West Winfield
0.5	74.1	Jct. US 20 turn right (East)
10.3	84.4	Enter Richfield Springs
0.7	85.1	Jct. NY 167 Proceed East on US 20
0.8	85.9	Village water supply reservoirs on right
0.2	86.1	Jct. Allens Lake Road (Otsego Co. Rd. 26) turn right (South) - first right after Fountain View Motel.
1.7	87.8	Allen Lake on right
0.5	88.3	Jct. Otsego Co. Rd. 26 - turn right (West) toward Fly Creek
0.3	88.6	Curve to left (South) at "Walnut Grove" sign
2.1	90.7	Jct. Twelve Thousand Road - turn right (West) (sign to "Fieldstone Farm")
0.5	91.2	Solsville Member on right in pasture
0.2	91.4	STOP 4 - Twelve Thousand Rd. Quarry 1.5 mi. NE of Twelve Thousand - (Richfield Springs Quad.)

Units Exposed: Panther Mountain (22') or Delphi Station - Mottville interval.

About 22' of dark gray shales and siltstones are exposed here. The lithology and fauna are very similar to the Delphi Station at STOP 1. The assemblage is interpreted as being representative of the Limoptera Community with abundant sessile epifaunal and infaunal filter feeders, mobile infaunal types, non-sessile epifaunal filter feeders and vagrant benthonics.

The top of the quarry is approximately 40' above the Solsville exposed in the pasture .2 mi. to the east. If this exposure is equivalent to the lower Delphi Station, then the Mottville must lie below the floor of the quarry and very near the top of the Solsville. The top of the Solsville must therefore be getting younger eastward from the Brookfield Valley (STOP 1). A high diversity assemblage everywhere occurs above the Mottville from Central New York to Otsego County near below. Therefore, it would seem that the assemblage exposed here is indeed the lower Delphi Station. However, one cannot discount the possibility that a community similar to the Limoptera of the lower Delphi occurs somewhat earlier in time to the east. If we accept this interpretation, the Mottville would be at the top or just above the top of the quarry at this stop. The former interpretation is illustrated below.



---	---	Return east on Twelve Thousand Rd.
0.7	92.1	Jct. Otsego Co. Rd. 26-turn left (North)
2.5	94.6	Jct. Allens Lake Road (Otsego Co. Rd. 27)-proceed straight (East) Otsego Co. Rd. 27
0.9	95.5	Sharp bend to the Southeast

1.1	96.6	Jct. NY 80 turn right (South) and continue along West side of Otsego Lake
1.7	98.3	Hickory Grove Inn on right
0.9	99.2	Five Mile Point
0.1	99.3	Jct. Mohican Canyon Road (Otsego Co. Rd. 28) turn right (West)
---	---	Exposures of Otsego Shale along Mohican Canyon Rd.
0.7	100.0	Pierstown - turn left (South) on Otsego Co. Rd. 28
0.6	100.6	Solsville Sandstone on right
0.5	101.1	<u>STOP 5</u> - Roadcut about 1 mi. South of Pierstown (Richfield Springs Quad.)

<u>Units Exposed</u>: Panther Mountain (15')

This exposure lies approximately 45' above the top of the Solsville. The fauna contains <u>Paraspirifer</u>,large <u>Tropidoleptus</u>, and <u>Camarotoechia</u> in coquinite lenses. This may be the Mottville equivalent. The environment is delta platform.

---	---	Proceed South on Otsego Co. Rd. 28
2.2	103.3	Jct. NY 80-turn left (North)
0.1	103.4	<u>STOP 6</u> - Leatherstocking Falls on Leatherstocking Creek up from NY 80 about 2 mi. North of Cooperstown (Cooperstown Quad.)

<u>Units Exposed</u>: Solsville (100')

The upper portion of the transitional Solsville occurs in the lower part of the falls, while the true Solsville forms the lip. Fossils are rare. A marine delta platform environment is represented by the upper Solsville. Some massive, horizontal bedded and low angle crossbedded sands at the very top of the exposure may represent the Mottville horizon, although this conclusion is very tenuous at best.

---	---	Proceed North on NY 80
1.0	104.4	Three Mile Point - LUNCH STOP
---	---	Return South on NY 80
2.8	107.2	Enter Cooperstown

0.6	107.8	NY 80 turns to the right proceed straight on Lake St.
0.3	108.1	End of Lake St. - turn right (South) on River St.
0.1	108.2	Jct. Main St. - turn left (East) The Clinton-Sullivan Campaign (1779) embarked from this point down the Susquehanna. General Clinton's troops built a dam at the mouth of Otsego Lake, which when broken cleared out the upper portion of the Susquehanna, thereby allowing easier passage of his army on rafts. Clinton's army joined Sullivan's near Elmira to begin a retaliatory campaign against the western Iroquois (Seneca's) in the Finger Lakes-Genesee Region as a reprisal for the Iroquois-Tory attacks on settlements in and near the Mohawk Valley. (Cherry Valley Massacre)
0.2	108.4	Bend to North
0.1	108.5	Jct. Dugway Rd. (County Rd. #31) take left fork onto Dugway
4.2	112.7	<u>STOP 7</u> - Roadcut on Dugway about 4 mi. North of Cooperstown. (Richfield Springs Quad.)

<u>Units Exposed</u>: Otsego 20'

This outcrop contains the massive to thin bedded dark gray shales and arenaceous shales typical of the Otsego. The fauna is of moderate to low diversity of attached and free epifaunal filter feeders. These are the rocks that yield the definite fauna of Cooper (1933). The environment represented is outermost delta platform on upper prodelta slope. <u>Mucrospirifer</u> and <u>Chonetes</u>, unattached epifaunal filter feeders, are very abundant and were adapted to the soft substrates of this environment.

---	---	Proceed North on Dugway (County Rd. #31)
0.5	113.2	Bend in road to the East
1.9	115.1	Glimmerglass State Park on left
4.0	119.1	East Springfield - Jct. US 20 turn right (East)
0.5	119.6	Jct. Otsego Co. Rd. #54 - (Old US 20) Cherry Valley - turn right (South)
3.3	122.9	<u>STOP 8</u> - Cox's Ravine - .5 mi. West of Cherry Valley on County Rd. #54. (East Springfield Quad.)

Units Exposed: Union Spring (21'), Cherry Valley (5'), Chittenango (7')

The Cherry Valley Limestone forms the lip of the falls and is divisible into a lower and upper division. The Agoniatites nodiferus and Werneroceras plebeiforme Zone occur in the upper Union Springs about 2 feet below the Cherry Valley.

The Cherry Valley Limestone may not always represent a euxinic basin deposit but may represent oscillations of the O-Eh surface sometimes above the sediment - water interface and sometimes below or coincident with that interface. If below the sediment water interface, benthonic forms could become established. (Cottrell 1972, personal communication).

---	---	Proceed east on Otsego Co. Rd. 54
0.4	123.3	Enter Cherry Valley
		This was the site of the Cherry Valley Massacre. On the morning of November 11, 1778 a band of Tories and Indians under the infamous Mohawk chieftain Joseph Brant and the Tory Captain Walter Butler attacked the village, resulting in the dealths of 48 or more residents, mostly women and children. This and other attacks on frontier outposts precipitated the Clinton-Sullivan campaign of 1779.
0.3	123.6	Jct. NY 166 - turn right (South)
3.8	127.4	Enter Roseboom
0.2	127.6	Jct. NY 165 - turn left (East)
1.7	129.3	Enter Pleasant Brook - proceed E on NY 165
3.0	132.3	Enter South Valley - proceed E on NY 165
2.0	134.3	STOP 9 - Roadcut on NY 165 up Weaver Hill 2 mi. East of South Valley (South Valley Quad.)

Units Exposed: Solsville (250'), Otsego (50')

A nearly complete section of Solsville is exposed here. The lower portions of the section represent prodelta slope and outer (distal) delta platform deposits. The upper part of the exposure represents the middle or inner (proximal) delta platform environment.

---	---	Proceed East on NY 165
1.2	135.5	Enter Schoharie County

1.4	136.9	Enter Dorloo
0.3	137.2	Jct. Schoharie Co. Rd. 33 (West Richmondville Road) - turn right (South)
5.1	142.3	Enter West Richmondville, cross railroad
0.1	142.4	Jct. NY 7 - turn left (East)
1.9	144.3	Enter Richmondville
0.9	145.2	Jct. Depot St. and NY 10 - turn left (North on Depot St.)
0.1	145.3	STOP 10 - Railroad cut on Delaware and Hudson Railroad at old depot station. (Richmondville Quad.)

Unit Exposed: Solsville (6')

This outcrop consists of 1-3 inch horizontal and planar cross-bedded and laminated subgraywackes contained within a set of large (1-2 ft.) ripples. The sandstones are not as sorted as those of other stops. Brachiopod coquinites occur in lenses near the base and at the top of the section. The Solsville here probably represents a nearshore zone of the inner (proximal) delta platform.

0.4	145.7	Return to NY 7 - turn right (West)
33.0	177.7	Proceed on NY 7 back to Oneonta