BIOSTRATIGRAPHY AND PALEOECOLOGY OF THE WINDOM SHALE MEMBER (MOSCOW FORMATION) IN ERIE COUNTY, NY.

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INTRODUCTION

The exposures of Hamilton strata along Lake Erie shore and in various creek beds in Erie County south of Buffalo are among the best-known and most thoroughly-studied Middle Devonian fossiliferous sequences in the world. The monumental studies of James Hall and A. W. Grabau (1898, 1899) provided a solid background for numerous later studies. Yet, in over a century of study, many biostratigraphic and paleoecological problems remain uninvestigated.

Recently, an exceptionally large and complete section of the Windom Shale (Moscow Formation) has been exposed in the shale quarries of Penn Dixie Cement Co. near Bayview, N.Y. This outcrop provides an excellent opportunity for detailed study of the fossil horizons of this upper Hamilton unit. Discovery of several new and little-known horizons at this quarry have led to the present restudy of biostratigraphy of the Windom in Erie County.

STRATIGRAPHY

From its type locality at Smokes Creek near Windom, Erie County N.Y., the Windom Member can be traced eastward nearly 200 miles to the vicinity of Skaneateles Lake (see Rickard, 1964) where the unit becomes sandy and grades into the Cooperstown shales and sandstones. Over most of this interval the Windom is a grey, calcareous shale. It is fossiliferous throughout most of its thickness and contains a characteristic "Moscow Facies" suite fossils.

In Erie County the Windom ranges from 9 to 50 ft. in thickness and is composed dominantly of soft, fissile medium-gray shale with thin bands of fossiliferous limestone. Thin calcareous beds containing abundant fossils occur only at the base and a few feet from the top of the Windom, intervening between these is a mass of nearly barren, grey shale 2 to 30 ft. thick. The presence of an undescribed pyritized assemblage of brachiopods and mollusks in the upper portion of this "barren interval" suggests a recurrence of the "Cleveland" (black shale) facies conditions (similar to those under which the Ledyard Shale of the Ludlowville Formation was deposited) existed in Erie County during the interval represented by the "barren" shales. The fossiliferous beds above and below suggest the occurrence of shallow, normal marine conditions during the early and late depositional phases of the Windom in Erie County.

DESCRIPTION OF FOSSIL HORIZONS OF THE WINDOM

The Windom shale member at the Penn Dixie Quarry, Bayview, N.Y. can be subdivided into six different units. In the following section each of these units, its characteristic fossils and paleoecology are described in stratigraphic sequence. The data are summarized in Figure 1.

Unit 1. Ambocoelia Bed

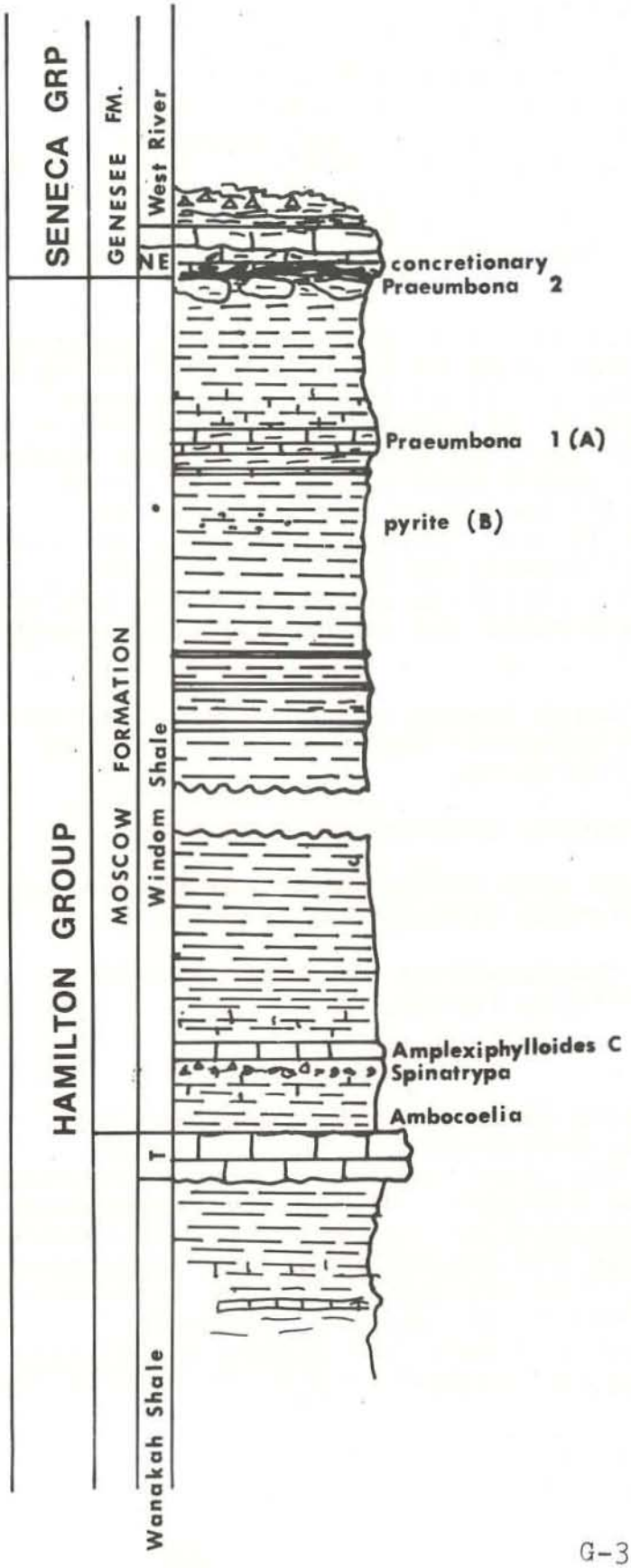
In much of western New York the base of the Windom Shale has been defined as the zone of abundant Ambocoelia umbonata (brachiopod). In places in Genesee County this species occurs abundantly throughout the lower half of the Windom, but in Erie County it generally is plentiful only in the lower 2-6 ft. The Ambocoelia bed consists of soft, fissile, grey shale. Its fauna, dominated by Ambocoelia umbonata, several species of chœnetid brachiopods, Athyris spiriferoides, Protoleptostrophia perplana, and Stereolasma rectum, is very similar to that of the upper Wanakah. Ambocoelia occurs as "sheets" of very high density (several hundred individuals per square foot).

The preservation of fossils in the Ambocoelia bed is fairly good. A majority of the brachiopods (over 60 percent) are articulated and delicate, marginal spines of choenetids are generally intact. However, the fossils are often highly compressed. This suggests deposition of soft, soupy mud in a low energy environment followed by considerable compaction.

In addition to the main Ambocoelia fauna, the basal beds of the Windom often contain an assemblage of highly worn fossil fragments, limestone pebbles, and phosphatic nodules. This previously undescribed occurrence is discussed in greater detail in the other paper in this guidebook by the author.

Unit 2. Spinatrypa spinosa bed

Immediately overlying the Ambocoelia bed in western Erie County is a slightly to very calcareous band (1-6 in. thick) containing extremely abundant fossils. The brachiopod Spinatrypa spinosa occurs abundantly in this thin band and in western New York is almost entirely restricted to this unit. Atrypa reticularis and Mediospirifer audaculus occur with Spinatrypa in almost equal numbers. From the South Branch of Smokes Creek east to Buffalo Creek, this horizon is represented by a thin band of limestone composed of crinoid pluricolumnals and brachiopods. At Cazenovia Creek the tabulate coral Pleurodictyum americanum is a fairly common associate of the brachiopods and the association suggests a recurrence of the Wanakah Pleurodictyum bed fauna; whereas, at Penn Dixie quarry near Bayview and in the vicinity of Eighteenmile Creek, the brachiopod



North Evans: Crinoidal, bone bed limestone, grades up into shale; conodonts and arthrodire plates abundant in lowest layer; the limestone here rests uncomformably on a concretionary limestone in the upper Windom. Elsewhere the two are separated by about two feet of black and grey shale.

Upper Windom ("Praeumbona bed"): The upper portion of the Windom Shale is composed of soft fissile grey shale and on the whoel it is not very fossiliferous; however, a 6 inch calcareous bed marked A contains abundant brachiopods and trilobites; Ambocoelia praumbona is particularly common here and nowhere else in the Hamilton Group. Some pyritized fossils including pelecypods, gastropods, and cephalopods have been obtained from the shale (B) about two feet below the "Praeumbona bed". The remainder of the Windom down to about three feet from the base is barren of fossils.

Lower Windom (Trilobite beds): About 2 feet from the base of the member occur grey calcareous layers (C) which are richly fossiliferous and contain trilobites Phacops, rugose corals, and brachiopods.

Coral Layer: The lowest shale is very soft and friable; large rugose corals and Atrypid brachiopods are very common.

Tichenor Limestone: Hard crinoidal limestone; very fossiliferous (corals, crinoids, and brachs.), an upper layer of pyrite.

Upper Wanakah Shale (Demissa bed): soft fissile, grey shale much like the Windom, but with a different fauna.

Vert. Scale: 1"=4'

Figure 1. Stratigraphic section at Bayview, N.Y.

assemblage is supplemented by abundant, large, rugose corals. Heliophyllum halli, Cystiphylloides confollis and Heterophrentis simplex occur closely packed in a soft, shaley matrix. Although the large rugose corals actually occur in only a few localities, Grabau (1899) termed this coral-brachiopod assemblage the "Coral layer" and this name has generally been applied to the entire unit which in this report is called the Spinatrypa bed. The local nature of the coral fauna is well demonstrated in Windom shale exposures along the Lake Erie Shore south of Eighteenmile Creek. The large rugose corals are lacking in the Spinatrypa bed along most of the exposure, but suddenly reappear just north of Pike Creek.

In a group of 800 rugose corals collected from the S. spinosa bed at Penn Dixie Quarry, 107 were found to be attached to recognizable objects. Ingrown shell fragments and vague impressions on many others suggest that many or most of the corals initially attached themselves to hard objects. The majority grew on brachiopod shells. The fact that brachiopods are somewhat more common in the coral beds than elsewhere suggests that shell beds were selected as settling sites by coral planula larvae. Several specimens of corals were grown onto the interiors of brachiopod valves which must, therefore, have lain unburied in concave-up position on the seafloor. This suggests both low deposition rates and relatively little water movement near the seafloor.

The "Coral layer" fauna of large rugose corals occurs only as localized patch reefs. The circumstances favoring the formation of such patches seem to be the following:

1. A low rate of sedimentation, preventing smothering of corals.
2. Moderately shallow water with little or no turbulence on the seafloor, but sufficient circulation to prevent stagnation.
3. The presence of local accumulations of shells providing firm substrates for settling larvae.

Unit 3. Coral-Trilobite Bed

The Spinatrypa bed terminates abruptly and is followed by 1-6 ft. of resistant calcareous, medium-grey to purplish-grey shales which weather whitish. The lower portion of this calcareous band is quite fossiliferous, but contains a distinctive assemblage dominated by the brachiopod Mucrospirifer consobrinus, small rugose corals such as Stereolasma rectum and Amplexiphylloides hamiltonae, and the trilobite Phacops rana. The brachiopods are not as common in this bed as in the underlying beds of the Windom; although Mucrospirifer consobrinus is fairly common, and Atrypa reticularis Rhipidomella vanuxemi and Douvillina ineaquistriata are usually found.

The rugose corals which are extremely common in the basal foot of this unit, unlike the large forms found in the Spinatrypa bed, usually show no evidence of basal attachment. Instead, they are conical or horn-shaped with pointed bases. Presumably they were held upright by sinking into the firm, limey muds. Contorted shapes frequently observed in Amplexiphylloides from this horizon may have resulted form repeated toppling of the corallite.

The association of trilobites with corals in this horizon recalls the Wanakah "Trilobite beds" (Grabau, 1898). Specimens of Phacops, often in excellent condition, are abundant at this level. Occasionally, perfectly preserved trilobites occur in clusters of five or more individuals. These clusters appear to be segregated by species. Of four such aggregations examined, three were found to be exclusively Phacops rana. The fourth shows remains of five Basidechenella rowi on a small slab. This form is extremely rare in the lower Windom as a whole. Thus, such trilobite clusters appear to represent catostrophic death of intraspecific aggregations of trilobites.

Unit 4. Barren shales -"Spirifer" tullius bed

The calcareous shales of the coral-trilobite bed grade upward into fissile, medium-grey shales which in most localities in Erie County are almost completely barren of fossils except for rare Ambocoelia umbonata and choenetid brachiopods. An assemblage of fossils suggestive of the later Middle Devonian including "Spirifer" tullius, Schizobolus truncatus and Lieorhynchus multicostus occurs at Eighteenmile Creek in the upper portion of the "barren" shales. On the lake shore near Pike Creek where the Windom thins to about 9 ft., the author has found this fauna immediately overlying the coral-trilobite beds, suggesting that the intervening barren shales are totally absent here.

The maximum thickness of the barren shales is attained near the center of Erie County where about 30 ft. are exposed on Cazenovia and Buffalo Creeks. This suggests that a shallow basin with restricted circulation (and therefore conditions unfavorable to organisms) existed in this area.

Unit 5. Small Tropidoleptus Beds (Upper Windom Pyritized Assemblage)

An assemblage of pyritized fossils was discovered in an interval 2-3 ft. thick in the upper Window Shale underlying the Ambocoelia praeumbona beds at Penn Dixie Quarry in Bayview, Erie County. It has been possible to trace this assemblage southwest to Pike Creek where the Windom dips beneath the level of Lake Erie and east as far as Buffalo Creek, a total distance of about 30 miles along the outcrop. At present however, the geographic limits and the relationship of this fossil assemblage to other fossil beds occurring farther east are still undetermined. There is a close resemblance between this fossil assemblage and the older Ledyard pyrite fauna described by Fisher (1951) which suggests a recurrence of similar conditions.

Fossils in this horizon occur in soft, poorly-laminated, dark-grey shale which has a strong petroliferous odor when broken. Small twig-like pyrite nodules are very abundant in this horizon, but large nodules like those of the Ledyard are rare. Fossils occur free in the shale rather than as nuclei of pyrite nodules. Overall, the most abundant fossils in this interval are diminutive (probably immature) forms of the brachiopods Ambocoelia umbonata and Tropidoleptus carinatus. In some exposures at Cazenovia Creek near Spring Brook, nearly equal numbers of choenetids and small Tropidoleptus (which superficially resemble the former) are found. Elsewhere, Tropidoleptus is completely dominant, coating some bedding planes in great numbers.

Of other fossils, pyritized nuculoid pelecypods, nautiloids, the ammonoid Tornoceras uniangulare, and the gastropods Mourlonia itys and Bucanopsis leda are very abundant in local accumulations. The trilobite Greenops boothi is a moderately abundant member of the fauna, but Phacops rana is very rare. Rare specimens of the more "normal" benthonic species such as the brachiopods Mediospirifer audaculus and Mucrospirifer mucronatus and the corals Stereolasma rectum and Pleurodictyum sp. have been found. They are generally associated with pyritized wood fragments which suggests that they may have been rafted in or that they survived otherwise unfavorable conditions by attaching to waterlogged pieces of driftwood.

Fisher (1951) inferred a relationship between the unique assemblage of fossils (mainly diminutive brachiopods, mollusks and trilobites) and the occurrence of a band of pyrite, the "Marcasite horizon", in the upper Ledyard. He suggested that under conditions of restricted circulation, hydrogen sulfide resulting from fouling of the poorly-oxygenated seafloor by the organisms caused the precipitation of pyrite. It appears that similar conditions may have recurred in upper Windom seas in western Erie County; but at present, this hypothesis needs further study.

Unit 6. Praeumbona Beds

A series of calcareous shales and argillaceous limestones occurs in the upper Windom. In places the limestone occurs as a single massive band up to 2 ft. thick. Elsewhere, separate thinner beds or concretionary layers occur throughout an interval of about 5 ft. in the uppermost Windom. This calcareous interval contains a limited fauna dominated by the brachiopod Ambocoelia praeumbona, which is restricted to this portion of the Windom and to the overlying North Evans Limestone. The brachiopods, Lieorhynchus multicostus and Schizobolus truncatus, are associated with Ambocoelia praeumbona in the upper concretionary portion of this unit at Eighteenmile Creek. A few species of brachiopods, auloporid corals, crinoid fragments, and large Phacops rana make up the remainder of the Praeumbona bed fauna. This suggests a partial return to the more normal "Moscow" depositional conditions of the lower Windom. There is evidence that the uppermost beds of the Windom have been considerably eroded and that fossils of the Praeumbona Fauna have been reworked into the overlying North Evans Limestone of the Genesee Formation.

TABLE 1.

SUMMARY CHART
OF THE DISTRIBUTION
OF MEGAFOSSILS IN THE
WINDOM MEMBBR OF THE
MOSCOW FORMATION IN
WESTERN NEW YORK

	BASAL PHOSPHATIC ZONE	AMBOCOELIA BED	SPINATRYPA BED	CORAL TRILOBITE BED	SPIRIFER TULLIUS BED	SMALL TROPIDOLEPTUS INTERVAL	PRAEUMBONA BED	CONODONT BED (CONTACT)
	L	2	3	4	5	6	7	8
Plants:								
unidentified wood fragments	c			r	r	c		
Sponges:								
hexaxon spicules			c					
Coelenterates:								
Amplexiphylloides hamiltonae (Hall)				C*				
Aulocystis dichotoma (Grabau)			c_e					
A. jacksoni (Grabau)	c	c	c	c	c			
Cystiphylloides americanum (E.&H.)			L					
C. conifollis (Hall)			L					
Hadrophyllum woodi (Grabau)		c	c					
Heliophyllum halli (E.&H.)	R		L*					
Heterophrentis simplex (Hall)			L					
Pleurodictyum americanum (Romer)			L	c		R		
Stereolasma rectum (Hall)		c	r	C*		R		R
Stewartophyllum intermittens			c	c				
Streptalasma ungula (Hall)				c*				
Trachypora romingeri (Ross)	c_d		r					
Bryozoans:								
Fenestella emaciata (Hall)	r	r						
Leptotrypella ssp.			c					
Reptaria stolonifera (Rolle)						R_e		
Sulcoretipora incisurata (Hall)		c						
various encrusting trpostomes			c_e					
Echinodermata:								
Arthrocantha sp.				r				
Deltacrinus clarus (Hall)			r	r				
Hyperoblastus goldringae (Reimann)			r			R		
Synbathocrinus sp.			r					
plates		c	c	r		r	r	c
scutella-type holdfasts			c_e					

	1	2	3	4	5	6	7	8
Brachiopods:								
Ambocoelia praeumbona (Hall)							C*	r_d
A. spinosa (Clarke)						r		
A. umbonata		C*	c	c	c	L	L	
Athyris spiriferoides (Eaton)		c		r			r	
Atrypa reticularis (Linneaeus)			C	c			r	r_d
Camarotoechia c.f. horsfordi (Hall)	r_d							
Choenetes lepidus (Hall)							r	
C. vicinus (Castelnau)		c						
Craniops hamiltoniae (Hall)		c	c	c			?	
Cyrtina hamiltonensis (Hall)		r				r		
Douvillina inequistriata (Conrad)		r		c				
Elita fimbriata (Conrad)			r					
Emanuella subumbona (Hall)						c		
Leiorhynchus multicostum (Hall)							L	r_d
Longispina mucronatus (Hall)		c	c	c	c	L	c	
Mediospirifer audaculus (Conrad)		L	c			R	L	r_d
M. audaculus var. eatoni (Hall)			L					
Megastrophia concava (Hall)			c					
Microspirifer consobrinus (D'Orbrigny)		c	r	c				
M. mucronatus (Conrad)						r	r	r_d
Nucleospira concinna (Hall)		r						
Orbiculoidea doria (Hall)					L			
O. media (Hall)					L			
Petrocrania hamiltonae (Hall)			r_e					
Productella spinulcosta (Hall)					L			
Protoleptostrophia perplana (Conrad)		c	r	r				
Rhipidomella idonea (Hall)			r					
R. vanuxemi (Hall)		c	c	c				
R. penelope (Hall)			C					
Schizobolus truncatus (Hall)					L*		L*	
Schuchertella arctostriatus (Hall)		c	?	c			r	
Spinatrypa spinosa (Hall)			C*					
Spinocyrtia granulosa (Conrad)	c_d		r					
"Spirifer tullius (Hall)						L*		
Tropidoleptoleptus carinatus (Conrad)						C*		
MOLLUSKS:								
Circoconarida:								
Hyolithes sp.	R					r		
Styliolina fissurella (Hall)				c		c	c	c
Gastropoda:								
Bucanopsis leda (Hall)					r	c		
unident. bellerophontids	c			r				
Cyrtolites sp.						r		
Loxonema hamiltonae (Hall)			r_i	r_i		R		
Mourlonia itys (Hall)						c		
Naticonema lineata (Conrad)	r		c	c		r	r	
Platyceras ssp.			r	r				

	1	2	3	4	5	6	7	8
Pelecypods:								
Cardiola sp.						R		
Cypricardinia indenta (Hall)		c						
Grammysia arcuata (Conrad)						r		
Modiella pygmaea (Conrad)						r		
Nucula corbuliformis (Hall)					r	c*		
N. oblongatus sp.						r		
Nuculites triqueter (Conrad						c		
Palaeoneilo fecunda (Hall)		r						
P. tenuistriata		c	r_i	c				
Pseudaviculopecten princeps (Conrad)			L					
Pterinopecten conspectus (Hall)						c		
Cephalopods:								
Bactrites arkonenesis						L		
Michelenoceras ssp.				c		L		
Spyroceras nuntium (Hall)				c				
Tornoceras uniangulare (Conrad)				R		c*		
—								
Trilobites:								
Basidechenella rowi (Green)				R				
Dipleura dekayi (Green)				R				
Greenops boothi (Green)		r	r	c		c		
Phacops rana (Green)	c_d	c	c	C*		r	c	
Graptolites:								
Dictyonema hamiltonae				R				

Symbols: The following symbols are used in this chart to designate the abundance of various species.

- C - very abundant, making up a high percentage of a particular fauna
- c - common usually present (50 - 500 specimens have been observed at all outcrops)
- r - rare (5 - 10) specimens have been observed at all outcrops)
- R - extremely rare, (only 1-5 specimens have been collected)
- L - found commonly only in a few localized areas elsewhere rare or lacking

Various other notations used as subscripts in conjunction with abundance are:

- e - occurs as an encrusting epizoite or other fossils
- i - occurs as an impression on basal attachment of corals
- d - derived from some other unit; a secondary reworked fossil
- * - an index fossil of a particular bed; i.e. restricted nearly or entirely to one bed.

REFERENCES CITED:

Fisher, D. W., 1951, Marcasite fauna in the Ludlowville Formation of western New York, Jour. Paleontology 25: 365-371.

Grabau, A. W., 1898-99, Geology and paleontology of Eighteenmile Creek and the lakeshore sections of Erie County, New York. Buffalo Soc. Nat. Sci. Bull. 6: Pt. 1 Geology, Pt. 2 Paleontology.

_____, 1899, The faunas of the Hamilton Group of Eighteenmile Creek and vicinity in western New York: N.Y. State Mus. Ann. Rept. 50 vol. 2; 227-339.

Rickard, L. V., 1964, Correlation of the Devonian rocks in New York State, N.Y. State Mus. and Sci. Serv. Map and chart series No. 15.

TRIP G - A SELECTED MIDDLE DEVONIAN (HAMILTON) FOSSIL LOCALITY REFERENCE SECTION

Carlton E. Brett

Total Miles	Miles from last point	Route Description
		We will take the N.Y. Thruway to Exit 56 where the road log begins.
		Take Exit 56 from the N.Y. Thruway to Mile Strip Road. Bear right around ramp to toll booth, then straight ahead to intersection.
0.0	0.0	BEGIN ROAD LOG AT TOLL BOOTH.
.8	.8	Intersection Mile Strip Road turn right (west)
1.0	.2	Intersection of U.S. 62 South Park Rd. Turn left (south)
2.2	1.2	Intersection with Big Tree Road. Turn right (west) onto Big Tree Road.
2.6	.4	Intersection of first road on the left, near West Ave., which cuts across the intersection of Bayview and Big Tree Roads. Park along this road. Walk back (north) across Big Tree Road and through gate onto gravel road of Penn Dixie Cement Co. Proceed north into bare shale outcrop area and turn right into the east side of the quarry.
		STOP 1. Penn Dixie Quarry, Buffalo Southeast quadrangle: The reference section that has been selected for this quadrangle is a large shale quarry (formerly owned by Penn Dixie Cement Co. of Woodlawn) north of Big Tree Rd. just west of the Erie-Lackawana tracks in the Town of Hamburg. The main access road to this quarry is located near the corner of Big Tree Rd. and Bayview Rd. This road divides the quarry--actually a large shale pit--into east and west sides. The west side is older and has not been used for several years consequently it is highly weathered and is beginning to

Total Miles	Miles from last point	Route description

grow in with grass in a few spots. It is still owned by Penn Dixie Co. although this company is out of business in Buffalo. The east side is somewhat larger, is floored almost entirely by grey Windom Shale (Moscow Formation), and was actively used up to 1970 as a source of landfill. Presently it is owned by Sipprell Bros. Real Estate, Hamburg.

1A. East Side of Quarry - Upper Windom

The south side of the quarry forms a slight bank (8-10 ft. high). In places the uppermost Windom beds and the overlying Genundewa-West River are exposed. There is no Genesee black shale nor any Penn Yan exposed here. Rather, the Genundewa Limestone is in direct contact with the "Conodont bed".

The Conodont bed is a coarse-weathering, dark-grey (weathering yellowish-buff) limestone. Fish plates, teeth, and mandibles are very common in this limestone as are conodonts. This bed which is equivalent to the North Evans of Wells (1964)* yields abundant condonts and bone fragments when digested with diluted acetic acid. Worn, broken valves of brachiopods (Ambocoelia praeumbona, Atrypa reticularis, and Mucrospirifer mucronatus) also occur in this bed, apparently derived from the underlying limestone.

The uppermost Windom is a calcareous, concretionary layer about one foot thick, weathering light-yellowish, but light-grey when fresh, and containing fossils (Ambocoelia praeumbona, Phacops, Mucrospirifer) which are quite abundant in spots. Directly above this (in some places) is a thin (1-2 in.) layer of argillaceous limestone. It occurs on the underside of the Conodont limestone and is partly or entirely incorporated into the North Evans. Angular slabs as well as rounded pebbles, can be seen "floating" in the crinoidal bone-bed matrix of the latter. It appears brecciated and the fragments have cracks in them which are "squeezed" full of crinoidal matrix. Some greenish stains on the concretionary bed resemble glauconite.

*In Rickard (1964)

Total Miles	Miles from last point	Route Description

The upper Windom is shaley below the uppermost concretionary layer for about 3 ft. and is "barren" of fossils. The "Praeumbona bed", a calcareous, slightly concretionary interval about 1½ ft. thick caps the small knob in the southwest corner of the east side of the quarry. Abundant Ambocoelia praeumbona (in patches) as well as Atrypa, Athyris, Devonochocnetes, auloporid corals and large trilobites (Phacops) occur in this unit. Below this is a shale interval some 5 ft. thick extending down to the next thin calcareous bands. This interval contains pyritized fossils and a fauna similar to that of the Ledyard shale (Fisher 1951). Pyrite nodules also occur here, but they are almost always small twig-like bodies unlike the large nodules found at Alden. The most abundant fossils here are Nuculites, tiny Tropidoleptus and Ambocoelia, the ammonoid Tornoceras uniangulare, nautiloid fragments and the gastropod Mourtonia. Rarer items include coiled Greenops and wood fragments. At present, this undescribed occurrence of pyritized fossils is under study.

The remainder of the middle Windom which covers most of the quarry floor is barren of fossils down to the lower 3-4 ft. Three thin calcareous shale bands about 2 in. thick are exposed just below the pyrite zone and represents distinct traceable horizons (no fossils).

1B. Tichenor limestone and coral-trilobite beds

In the northeast corner of the quarry, mounds of bulldozed shale have been left. These mark the position of the fossiliferous lower Windom. Here the contact between the Windom and the Tichenor limestone is exposed in a few spots due to the occurrence of small swells* which dome the Tichenor up 5-6 ft. (in maximum relief) above its

*The cause of this structural feature is unexplained; such features are rare in Western New York

Total Miles	Miles from last point	Route Description

normal position. The upper surface of the limestone has a very rusty appearance due to large amounts of pyrite. Fossils in the Tichenor, of which Spinocyrtia and crinoid predominate, are somewhat abraded. There are not as many Favosites or other corals as elsewhere. The upper surface of the Tichenor limestone appears to have been subjected to erosion prior to Windom deposition. There are pockets in the surface of the Tichenor which are filled with soft, grey shale (Windom). The lowest beds of the Windom here are very soft, friable, grey shales containing Ambocoelia (though not in great abundance as at Eighteenmile Creek). These occupy the lower foot of the Windom.

The coral layer fauna of the Spinatrypa bed is well-developed at this locality, though not as rich in Heliophyllum or Cytiphylloides as that of Eighteenmile Creek. In 1970 when bulldozers were still working in this area, it was possible to collect literally bushels of excellently preserved Cystiphylloides, Heterophrentis, Atrypa, Spinatrypa, and Mediospirifer from this bed. Rhipidomella, Douvillina, Megastrophia and rarely Elytha are also found in this layer. The total thickness of this layer is probably only about 3-5 in.

Some 2 ft. up from the Tichenor limestone the shale becomes calcareous. These harder layers stand out in several spots surrounding the Tichenor "domes". This is the coral-trilobite horizon characterized by a low diversity fauna made up chiefly of trilobites and rugose corals. Phacops predominates here and occurs most frequently as somewhat distorted, coiled individuals when complete. Flat specimens can also be obtained though more rarely and occassionally they are found in clusters. I collected here a single slab with 11 complete individuals of Phacops rana. Greenops and Dechenella are also rarely found. Brachiopods are much reduced in this horizon, but Atrypa, Rhipodemella, Athyris and Mucrospirifer consobrinus are present. Trace fossils

Total Miles	Miles from last point	Route Description

are particularly prevalent at this horizon, the surfaces of otherwise barren slabs show long sinuous "trails" of limonite suggesting worm or gastropod tracks. Typically, the lower beds are packed with rugose corals, but like the trilobites, their distribution tends to be patchy. Traces of nautiloids (Spyroceras,"Orthoceras") are fairly common and I have collected a very faint trace of a large goniatite here. The area around the outcropping edges of the "Trilobite-beds" are considerably worked by collectors who have made extensive "pits" and debris piles. These calcareous layers are about one foot thick and grade into barren middle Windom seen in section 1A.

Return to the bus and retrace the route to Fredonia.