

OHIO ACADEMY OF SCIENCE  
Geology Field Trip 1976

UPPER ORDOVICIAN (RICHMONDIAN) FOSSILS AND STRATA  
OF EASTERN INDIANA, BROOKVILLE TO RICHMOND

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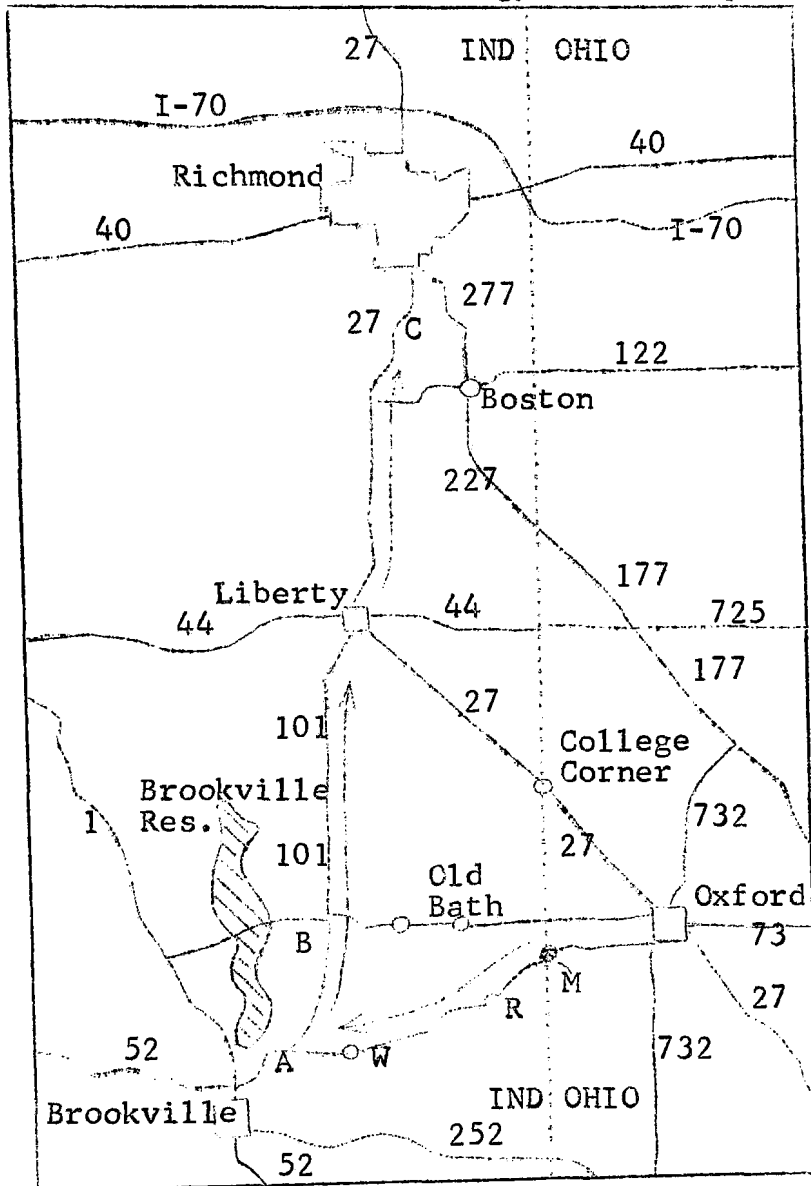
Chart, Richmondian faunal assemblage zones, Fox and Hay.

Chart, Richmondian faunal assemblage zones, Hay and Frey.

Description, Richmondian faunal assemblage zones.

Information contributed by Helen B. Hay, Assistant Professor, Earlham College, and Robert Frey, Miami University. Detailed information available in: Helen B. Hay, 1975, Lithofacies Classification for the Cincinnati Series (Upper Ordovician), southeastern Indiana. M.S. thesis, Miami University.

Itinerary - O.A.S. Geology Field Trip



Sections:

- A- Brookville South
- B- Brookville North
- C- Richmond

Towns:

- M- Mixerville
- R- Raymond
- W- Whitcomb

## ITINERARY

In Oxford, go to the south edge of town. Find Chestnut Street.

Turn west (right) on Chestnut St. Chestnut St. will become Brookville Road which we will follow to Rt. 101 just north of Brookville. Note, do not turn left on Rt. 732 toward Reily.

Proceed west on Brookville Road through the towns of Mixerville, Raymond and Whitcomb to Indiana Rt. 101. (Caution, there are sharp turns on Brookville Rd.) Turn southwest (downhill) on Rt. 101. Park along long roadcut. (For safety and space, some cars should turn around at the bottom of the hill and park in the up-hill direction.) Walk to the lowest exposure along the road.

STOP A. BROOKVILLE SOUTH ROADCUT. This roadcut extends from the Arnheim Formation, through the Waynesville Formation, into the Liberty Formation in float at the top of the hill. The lightest gray shale (about 1 to 2 m thick) near the middle of the outcrop is the trilobite shale. This locality is also called Bon Well Hill.

Return to cars. Drive north (up-hill) on Ind. Rt. 101. Proceed about 5 miles to large descending, then ascending roadcuts. Park along ascending roadcut. (the northern roadcut of the two). If you wish and if time permits, you may stop briefly at the descending roadcut to collect the abundant brachiopods at the top of the section.

STOP B. BROOKVILLE NORTH ROADCUT. This roadcut extends from the top of the Waynesville Formation, through the Liberty Formation and into the Whitewater Formation. Collect fossils at the base of the roadcut in the Waynesville and Liberty Formations. Leave time to walk to the top of the exposure to see the coral zone in the Whitewater Formation.

Return to cars. Drive north on Rt. 101 to Liberty, Ind. Find Rt. 27 in Liberty, drive north on Rt. 27 toward Richmond. (Do not go southeast toward Oxford.) About 2 miles south of Richmond, stop at large roadcut.

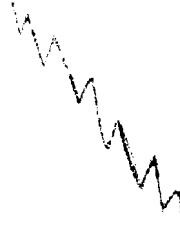
STOP C. RICHMOND ROADCUT. This roadcut exposes to rubble zone of the Whitewater Formation. Large fossils are abundant at this locality. A resistant, oncolite bearing limestone caps this exposure.

If you wish to return to Oxford, turn around, follow Rt. 27 back to Liberty, proceed on Rt. 27 through College Corner to Oxford.

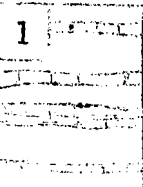
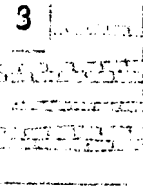
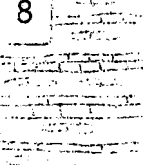
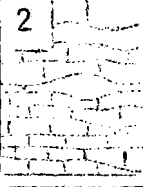
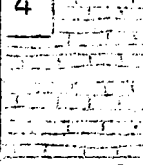
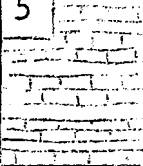
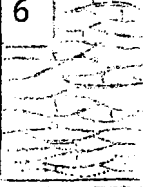
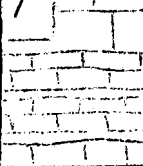
# GEOLOGIC FORMATIONS IN BUTLER AND PREBLE COUNTIES, OHIO

		FORMATION	GUIDE FOSSILS	SECTION	MEMBERS			
C I N C I N N A T I A N	SILURIAN	MEDINAN	BRASSFIELD	from: Caster, Dalve and Pope, 1955, Elementary guide to the fossils and strata of the Ordovician in the vicinity of Cincinnati, Ohio. Cincinnati Museum of Natural History		BRASSFIELD		
	R I C H M O N D	WAYNESVILLE	LIBERTY	ELKHORN	<p><i>Megalograptus zone</i></p> <p><i>3rd Coral zone</i> <i>Favistella, Labechia</i> <i>Stromatocerium, Tetradium</i></p> <ul style="list-style-type: none"> <li>• Lepadocystis moerei</li> <li>• Calapoecia huronensis</li> <li>• Columnaria alveolata</li> <li>• Ischyrodonta decipiens</li> <li>• Homotrypa wortheni prominens</li> <li>• Bucania crassa</li> </ul> <p style="text-align: right; font-size: small;">RED FACIES TO EAST</p>		ELKHORN 60'±	
	C I N C I N N A T I A N	WAYNESVILLE	LIBERTY	WHITEWATER	UPPER WHITEWATER	<p><i>2nd Coral zone</i> <i>Labechia, Tetradium</i></p> <p>Constellaria polystomella Whitella umbonata</p> <ul style="list-style-type: none"> <li>• Ceraurus miseneri</li> </ul> <p><i>Homotrypa beds</i></p> <p><i>Stromatocerium, Tetradium - 1st Coral zone</i> <i>large Cephalopod fauna</i></p> <p>Hebertella alveata Whitella oliquata</p>		UPPER WHITEWATER 40'±
	C I N C I N N A T I A N	WAYNESVILLE	LIBERTY	WHITEWATER	LOWER WHITEWATER	<p><i>Stromatocerium, Tetradium - 1st Coral zone</i> <i>large Cephalopod fauna</i></p> <p>Hebertella alveata Whitella oliquata</p> <ul style="list-style-type: none"> <li>• Ischyrodonta elongata</li> </ul> <p>(6-8') <i>Charactoceras zone</i> "Turkey track" layer <i>Sowerbyella common</i></p> <p><i>3rd Glyptorthis insculpta zone</i> <i>2nd Glyptorthis insculpta zone</i></p>		SALUDA 6's LOWER WHITEWATER 30'±
	C I N C I N N A T I A N	WAYNESVILLE	LIBERTY	BLANCHESTER	BLANCHESTER	<p><i>Isotelus zone</i></p> <ul style="list-style-type: none"> <li>• Strophomena neglecta</li> <li>• Byssosynchia cultrata</li> <li>• Anomalodontia gigantea</li> </ul> <p><i>1st Glyptorthis insculpta zone</i></p>		BLANCHESTER 35'
	C I N C I N N A T I A N	WAYNESVILLE	LIBERTY	CLARKSVILLE	CLARKSVILLE	<p><i>1st Glyptorthis insculpta zone</i></p> <p>Platystrophia clarksvillensis</p> <ul style="list-style-type: none"> <li>• Sowerbyella rugosus clarksvillensis</li> <li>• Modiolopsis concentrica</li> <li>• Cyclonema conica</li> </ul> <p><i>Treptoceras duseri zone</i></p> <p>Abundant Flexicalymene meeki</p> <ul style="list-style-type: none"> <li>• Strophomena nutans</li> <li>• Homotrypa dawsoni</li> </ul>		CLARKSVILLE 26'
	C I N C I N N A T I A N	WAYNESVILLE	LIBERTY	FT. ANCIENT	FT. ANCIENT	<p><i>Treptoceras duseri zone</i></p> <p>Abundant Flexicalymene meeki</p> <ul style="list-style-type: none"> <li>• Strophomena nutans</li> <li>• Homotrypa dawsoni</li> </ul>		FT. ANCIENT 36'
	C I N C I N N A T I A N	WAYNESVILLE	LIBERTY	OREGONIA	OREGONIA	<p><i>Fossil "hash" with Cyclora</i> <i>Ctenodonta, ostracods</i></p> <p><i>1st appearance of typical Richmond faunas</i></p> <ul style="list-style-type: none"> <li>• Platystrophia ponderosa arnheimensis</li> </ul> <p><i>Retrorsirostra carleyi zone</i></p>		OREGONIA 27'
	C I N C I N N A T I A N	WAYNESVILLE	LIBERTY	SUNSET	SUNSET	<p><i>Recurrent Corryville fauna</i> Platystrophia cypha</p> <p><i>Glyptocrinus zone</i></p> <ul style="list-style-type: none"> <li>• Homotrypa bossleri</li> </ul> <p><i>Diplograptus zone</i> Cyclonema inflatum</p>		SUNSET 35'
	C I N C I N N A T I A N	WAYNESVILLE	LIBERTY	MT. AUBURN	MT. AUBURN	<p><i>1st appearance of typical Richmond faunas</i></p> <p>Platystrophia ponderosa</p>		MT. AUBURN 16'

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Nickles, Foerste. S E Indiana 1905	Cummings. S E Indiana 1903	Cummings, Cummings & Galloway. S E Indiana 1903, 1912	Fox. S E Indiana 1962	Brown & Lineback. S E Indiana 1966	Weir et al. S C Kentucky 1965	Peck. N C Kentucky 1966
Saluda	Elkhorn	<u>Platystrophia</u> <u>moritura</u>	Whitewater	Whitewater	Preachers ville	Drakes
Whitewater	Whitewater	<u>Rhyncho-</u> <u>trema</u> <u>dentatum</u>		Saluda		
Whitewater	Saluda	<u>Tetradium</u> <u>minus</u>				
Liberty	Liberty	<u>Strophomena</u> <u>planumbona</u>	Tanners Creek	Dillsboro	Rowland	Bull Fork
Waynesville	Waynesville	<u>Dalmanella</u> <u>meeki</u>				
Arnheim	Arnheim	<u>Homotrypa</u> <u>bassleri</u>			Reba Terrill	
	Laughery				Ashlock	

Stratigraphic divisions of the Upper Ordovician,  
Richmond Group in southeast Indiana and Kentucky

Facies type	Clastic ratio	Other defining characteristics	Example
1 	Group A >70% shale	Defined by clastic ratio alone.	Waynesville, Elkhorn, Miamitown shales.
3 	Group B 55-70% shale	Shales blocky or plastic with few or no calcareous nodules.	Base of Brookville North section, containing <u>Glyptorthis</u> & <u>Leptaena</u> .
8 		Shales containing calcareous nodules and lenses. Limestones fairly well bedded with fossils mainly fragmental.	Arnheim
2 	Group C <55% shale	Poorly bedded. Thicker limestone beds tend to split into thinner, irregular slabs. Limestones composed of mostly granule-sized fossil fragments.	Bellevue
4 		Well-bedded limestone. Distinguished from facies types 1 and 3 mainly by clastic ratio.	Liberty, above <u>Thaerodonta</u> peak zone.
5 		Like facies type 4 except consists of >20% barren, burrowed laminated, medium to dark gray, medium crystalline limestones.	Part of Liberty at Brookville North section.
6 		Rubbly weathering poorly bedded limestones and very calcareous shale. Whole fossils common.	Whitewater
7 		Relatively barren, light gray, micritic, thoroughly burrowed dense limestone. Shales thin and commonly brown.	Above the <u>Tetradium</u> zone Brookville North section.

Cincinnatian lithofacies in eastern Indiana. No stratigraphic sequence implied in this diagram. from Hay, 1975.

Lithofacies	Faunal Assemblage Zones	Feet above base	General Stratigraphic Description		Formation
3	Zone D. <u>Platystrophia-Leptaena</u>	90 85 80 75 70 65 60	Unit 7	Rather regularly spaced limestone and shale beds, ls, about 2½" thick and shales about 6-8" thick.	Waynesville
1	Zone B. <u>Onniella-Zygospira</u>	55 50		Limestones and shales less regularly spaced than above, but ratio about the same.	
3		45 40		More shale than above, one bed about 4' thick (probably Fox's (1962) boundary between his parastratigraphic units B & C).	
1		35 30 25	Prominent limestone band, increases upward in ls.		
4	Zone A. <u>Rafinesquina Zygospira</u>	20	High shale percentage. About half of the thin limestones are very silty and barren of fossils.	Arnheim	
8		15 10 5	Prominent ls. band with brown, sandy shales with abundant phosphatic minute fossils.		
			Unit 5	Lithology variable; some burrowed light gray massive hard limestones, some wavy bedded rather thin, fossiliferous beds. Shales more calcareous than unit above.	

STOP A - BROOKVILLE SOUTH ROADCUT = Bon Well Hill. From Hay, 1975. Numbered faunal zones are those of Hay, 1975. The lithologic units shown are numbered upward from the base of the spillway of the Brookville Reservoir dam.

Lithofacies	Faunal Assemblage Zones	feet above base	General Stratigraphic Description	Formation
6	F.		Rubbly weathering, many fossils	Wh.
7	Tetradium G. ?	85	Massive to medium-bedded, light gray, thoroughly burrowed, relatively unfossiliferous ls. with scattered <u>Tetradium</u> colonies.	Saluda
		80		
		75		
6	F. Platystrophia acutilirata	70	Very limy shale and shaly ls. Partially silicified fossils	Wh.
4	F. Platystrophia acutilirata	65	Thin to medium-bedded ls. with interbeds of very calcareous nodular shale. Bryozoa more abundant than brachiopods.	Transitional Lib.-Whitev.
4 & 6		60		
4		55		
4		50		
5		45		
3	E2. Strophomena planumbona	40	Predominantly shale	Liberty
4		35	Medium-bedded ls. with thin shale interbeds. Prominent limestone band in outcrop.	
3		30	Predominantly shale	
4		25	Lowest prominent ls. band	
3	E1. Sowerbyella rugosus	20	Highly fossiliferous ls. beds tending to occur in clusters separated by thick shales. Brachiopods diverse and abundant.	
		15		
		10		
	D. Letp-acna	5		

STOP B - BROOKVILLE NORTH ROADCUT. From Hay, 1975.  
 Numbered faunal zones are those of Hay, 1975.



STOP C - RICHMOND ROADCUT, no section necessary.

About 6 m of poorly bedded, rubbly to lenticular limestone and calcareous shale of the Whitewater Formation (lithofacies type 6) are exposed here. This unit contains abundant, large fossils, especially large brachiopods (Rafinesquina and Hebertella), large gastropods, bivalves, bryozoa and solitary corals. Many of the fossils show abrasion and fracture and many are incrustated with bryozoa and the tabulate coral Protaraea. The stratification and the condition of the fossils suggest that this unit was deposited in an environment of active currents. It is probable that the coral zone observed at the Brookville North Roadcut does not extend this far north. At places at the top of this roadcut there are hard, resistant, fairly well-bedded coarsely biofragmental limestone strata containing oncolites and unusual species, such as Cupulocrinus and Ceraurinus.

Faunal Assemblage Zones, Fox, 1962, for Richmond Group	Faunal Assemblage Zones, Fox, 1968, Madison, Ind., Maysville and Richmond Stages.	Faunal Assemblage Zones, Hay, 1975, Brookville, Ind. area Maysville and Richmond Stages.
		Zone H <u>Platystrophia moritura</u> (Cumings, 1908)
<u>Homotrypa wortheni</u>		Zone F <u>Platystrophia acutilirata</u>
<u>Tetradium minus</u>		Zone G <u>Tetradium minus</u>
<u>Strophomena planumbona</u>	Zone E	Zone E <sub>2</sub> <u>Strophomena planumbona</u>
<u>Sowerbyella rugosus</u>	<u>Lepidocyclus</u> & <u>Platystrophia</u>	Zone E <sub>1</sub> <u>Sowerbyella rugosus</u> = <u>Thaerodonta clarksvillensis</u>
<u>Leptaena richmondensis</u>	Zone D <u>Platystrophia</u> & <u>Leptaena</u>  Zone C <u>Onniella</u> & <u>Sowerbyella</u>	Zone D <u>Platystrophia</u> & <u>Leptaena</u> (Fox's Zone C not present at Brookville)
<u>Resserella meeki</u>	Zone B <u>Onniella</u> & <u>Zygospira</u>	Zone B <u>Onniella</u> & <u>Zygospira</u>
	Zone A <u>Rafinesquina</u> & <u>Zygospira</u>	Zone A <u>Rafinesquina</u> & <u>Zygospira</u>

Location and stratigraphic position, from Hay, 1975.	Hay's Zones, from last page.	Faunal zones, Franklin Co., Ind. (Some are peak or range zones.) Information collected by Robert Frey. No scale implied.
Above Elkhorn shale along Elkhorn Cr.	Zone H	
Whitewater and transitional 4-6 facies At Brookville North below Zone G.	Zone F	<u>Rhynchotrema dentatum</u> <u>Platystrophia acutilirata</u>
Near top of Brookville North Roadcut.	Zone G	<u>Ostracod-Mollusk</u> <u>Tetradium</u>
Liberty, facies types 4 and 5.	Zone E <sub>2</sub>	<u>Flaesiomys subquadrata</u>
Within facies type 3, lower part of Brookville North Section.	Zone E <sub>1</sub>	<u>Loxoplocus bowdeni</u> <u>Thaerodonta clarksvillensis</u>
Base of Brookville North section, top of Brookville South. Faunal change from zone below takes place within type 3 facies.	Zone D	<u>Glyptorthis insculpta</u> <u>Strophomena nutans- T. neglecta</u>
Waynesville type 1 facies and part of the upper type 3 facies, Brookville South.	Zone B	<u>Onniella meeki</u> <u>Lyrodesma major</u> <u>Catazyga- 2 Retror.</u> <u>Trilobite zone</u> <u>Batostoma-Eridotrypa</u>
Everything below the Waynesville at Brookville South Roadcut and Brookville Dam spillway.	Zone A	<u>Cyclora - Phosphatic zone</u> <u>Pelecypod zone</u> <u>Retrorsirostra carlevi</u> <p>The line above represents the base of the Brookville South Roadcut, not the base of faunal zone A.</p>

## DESCRIPTION OF FAUNAL ZONES

The following faunal zones are found in the Richmond Group of Franklin and Union Counties, Indiana. Most are assemblage zones, some are range or peak zones. Summarized from information collected by Robert Frey.

### RETRORSIROSTRA CARLEYI ZONE:

A thin zone characterized by the occurrence of the convex-concave brachiopod Retrorsirostra carleyi, found within nodular shales of Type 8 lithofacies near the base of the Richmond Group in Franklin Co., Ind. R. carleyi is restricted to an indurated shale unit one to three feet thick, about 12 feet below the Cyclora zone. Other fossils in this assemblage include a highly convex form of Rafinesquina, Zygospira modesta, Hallopora ramosa, endoceroids, bivalves, gastropods and crinoidal debris. R. carleyi reappears in Type 1 and 2 lithofacies of Zone B, Waynesville Formation.

### PELECYPOD ZONE:

This zone consists of about five feet of nodular, indurated shale, about six feet above the R. carleyi zone. The pelecypods Ambonychia alata, Anomalodonta gigantea and Orthodesma recta occur with the gastropods Cyclonema bilix and C. humerosa.

### CYCLORA OR PHOSPHATIC ZONE:

A massive-appearing limestone stratum about 10 inches thick which, upon weathering, parts into thin slabs, and which marks the boundary between the nodular shales of Type 8 lithofacies below (Arnheim Fm.) and Type 1 lithofacies above (Waynesville Fm.). The rock has a sandy texture caused by abundant, phosphatic steinkerns of minute mollusks and phosphatic nodules. The minute phosphatic fossils include the mollusks Cyclora, Microceras inornatus, Nuculites neglectus, Paleoconcha obliquata, Hyalithes versailleensis, Flagiogypta iowaensis, conodonts, brachiopods, bryozoa, and the ostracods Bythocypris cylindrica and Milleratia cincinattiensis. These species are found in reduced numbers throughout the Richmond Group.

The Cyclora zone may be overlain by a thin limestone rich in ramose trepostome bryozoa, including Batostoma varians and Eridotrypa simulatrix. Lithologically this limestone seems related to the Arnheim Formation whereas faunally it is related to the Waynesville Formation.

The Batostoma-Eridotrypa zone is overlain by about 30 feet of Type 1 and Type 3 lithofacies. This 30 foot interval contains few fossils except for several impure limestone strata which contain abundant bivalves.

### TRILOBITE ZONE:

Six to 10 feet of light blue, clay shale with abundant Flexicalymene meeki, fragments of Isotelus and the bivalve Modiolopsis concentrica. This unit is found near the middle of the Waynesville Formation at Brookville.

#### ONNIELLA MEEKI ZONE:

About 15 feet of blue clay shale, Type 1 lithofacies, overlying the Trilobite Zone, and containing the peak zone of the dalmanellid brachiopod Onniella meeki. Locally, but not at Brookville, Onniella is accompanied by Thaerodonta clarksvillensis. Toward the top of this unit, Onniella is joined by Leptaena richmondensis, Platystrophia cypha, Rafinesquina loxorhytis and the rugose coral Grewingkia rusticum.

#### CATAZYGA HEADI ZONE - 2nd RETROSIROSTRA ZONE:

A five foot interval near the top of the Onniella meeki Zone which contains the only occurrence of the rare atrypid brachiopod Catazyga headi and the second occurrence of Retrosirostra carleyi. This zone marks the transition from Type 1 to Type 3 lithofacies. The strophomenacean brachiopod Holte dahlina sulcata is found in this zone, but it is more common in the Type 6 lithofacies of the Whitewater Formation. In Ohio, this zone also contains Glyptorthis insculpta.

#### LYRODESMA MAJOR ZONE:

Also called the Isotelus zone. About one and a half feet of blue clay shale and thin, fossiliferous limestone strata at the top of the Onniella meeki zone, about five feet above the Catazyga headi zone. The five foot interval below this zone contains abundant Rafinesquina. The fauna of this Lyrodesma major zone includes Isotelus brachycephalus, Flexicalymene meeki, Iocrinus sp., the bivalves Lyrodesma major and Deceptrix albertina, the bryozoa Bythopora meeki, Heterotrypa subramosa and Rhombotrypa quadrata, and the last occurrence of Onniella.

#### STROPHOMENA NUTANS - TETRAPHALERELLA NEGLECTA ZONE:

Several beds of coquinoid limestone at the base of Faunal Zone D which are distinguished by the brachiopods Strophomena nutans and Tetraphalerella neglecta, and which also contain Strophomena planumbona, S. vetusta and Rafinesquina. Several feet above this zone is a blue mudstone which contains the small rhynchonellid brachiopod Rhynchotrema dentatum, a species common in the Type 6 lithofacies, Faunal Zone F, of the Whitewater Formation.

#### GLYPTORTHIS INSCULPTA ZONE:

Two zones of similar limestone, within 10 feet of each other, about 15 feet above the S. nutans zone, which contain the first occurrence of the brachiopod Glyptorthis insculpta in Franklin Co. Other fossils in this zone include the brachiopods Strophomena planumbona, Lepidocyclus capax, large Hebertella occidentalis and rare specimens of the colonial corals Cyathophylloides and Foerstephyllum. These limestones may form small waterfalls in creeks of the area.

#### THAERODONTA CLARKSVILLENSIS ZONE:

Five to ten feet above the top of the Glyptorthis insculpta zone, several thin, silty, closely spaced limestone strata, in an interval about 1 foot thick, contain abundant specimens of Thaerodonta clarksvillensis. This plectambonitid brachiopod

occurs sparingly in Type 4 lithofacies above this level.

#### LOXOPLOCUS BOWDENI ZONE:

A thin, blue mudstone about two feet above the Thaerodonta clarksvillensis zone is crowded with many, large specimens of the gastropod Loxoplocus bowdeni and also contains the brachiopod Zygospira modesta, the bivalves Ctenodonta cingulata, Deceptrix albertina and Pterinea corrugata, and the snail Sinuities subcompressa.

#### PLAESIOMYS SUBQUADRATA ZONE:

The coquinoid limestone strata of the Type 4 lithofacies above the Thaerodonta clarksvillensis zone contain an abundant and diverse brachiopod fauna marked by Plaesiomys subquadrata. Additionally, the brachiopods Hebertella occidentalis, Strophomena planumbona, S. vetusta and Lepidocyclus capax are common and the corals Grewingkia rusticum and Cyathophylloides occur. These limestones may bear large ripple marks.

#### TETRADIUM ZONE:

This zone contains large colonies of the tabulate coral Tetradium. Along Rt. 101 north of Brookville there is but one, five foot thick Tetradium zone but at other localities there may be several such zones. It is likely that the Tetradium zone or zones do not occur at a fixed position in the Richmondian section. The Tetradium colonies are surrounded by a micritic matrix which contains few smaller fossils and which commonly has a buff color. The colonies commonly show fracture and abrasion. Along Rt. 101, the Tetradium zone is separated from the Plaesiomys subquadrata zone by almost 30 feet of sparingly fossiliferous rock. This interval may contain some rare cephalopod species.

#### OSTRACOD-MOLLUSK ASSEMBLAGE:

Type 7 lithofacies composed of dense, bioturbated, micritic limestone in places occurs between Tetradium colonies and overlies the Tetradium zone. This lithofacies contains a sparse but distinctive fauna of large ostracods, Isochilina subnodosa and Leperditia ? caecigenia, bivalves, Ambonychia robusta, Ischyrodonta elongata and Rhytimya byrnesi, cephalopods and gastropods. The Type 7 lithofacies (Saluda) and this fauna suggest a very shallow, perhaps lagoonal, environment of deposition.

#### PLATYSTROPHIA ACUTILIRATA ZONE:

This zone is found in Type 6 lithofacies, rubbly limestone and calcareous shale (Whitewater Formation) above, below or surrounding the Tetradium zone (if one is present). At the Brookville North Roadcut, Type 6 lithofacies with its Platystrophia acutilirata assemblage occurs under the vegetation at the top of the section but it is well exposed at the Richmond Roadcut, Stop C. This zone is of variable thickness but it generally thickens northward at the expense of Type 7 lithofacies, Saluda. This zone may contain thin units of Type 4 and Type 7 limestone. The Platystrophia acutilirata assemblage

contains an abundant and diverse group of large fossils, including the brachiopods Platystrophia acutilirata, Hebertella alveata, Holtedahlina sulcata, Lepidocyclus capax, Rhynchotrema dentatum and Rafinesquina sp., the bryozoa Homotrypa wortheni and Monticulipora epidermata, the gastropod Salpingostoma richmondensis, bivalves Ambonychia obesa, Ischyrodonta truncata, and Ortonella hainesi, the incrusting coral Protaraea richmondensis and exotic cephalopods.

**RHYNCHOTREMA DENTATUM ZONE:**

This zone is of variable thickness and occurs in the upper part of the Platystrophia acutilirata zone. At Richmond, Ind., this small brachiopod is associated with algal oncolites, Girvanella richmondensis.