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A tour of the Peach Bottom Slate—Once the best building slate in the world

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ABSTRACT

Within the Piedmont Uplands Section of southeastern Pennsylvania lies a metamorphic terrane containing the Peach Bottom Slate. The Peach Bottom Formation has been the center of attention for both quarrymen and geologists for more than 200 years. This probably early Paleozoic unit, underlying "Slate Ridge," has been mined in Lancaster and York Counties, Pennsylvania, and Harford County, Maryland. The Peach Bottom Slate was judged the best building slate in the world at the 1850 World Exposition in London. Although mining terminated in the 1940s, the effect of the slate on the community and its heritage is well preserved today. The main purpose of the field trip is to examine some of main landmarks of the slate's cultural effects, including a visit to a Welsh cemetery and a view of the district's largest quarry. We also will seek an understanding of how the slate industry's history has been preserved.

Some problems of the regional geology also will be addressed. At our first two stops in Chester and Lancaster Counties, we will examine serpentinite within the Baltimore Mafic Complex. Our next stop in Lancaster County is a key exposure showing the relationship between the Peach Bottom Formation and its neighboring rock units. Despite much research on the structural implications of these rocks, the interpretation is still "up in the air." Your opinions will be very much welcomed.

Keywords: Peach Bottom Slate, serpentinite, Welsh; quarry, foliation.

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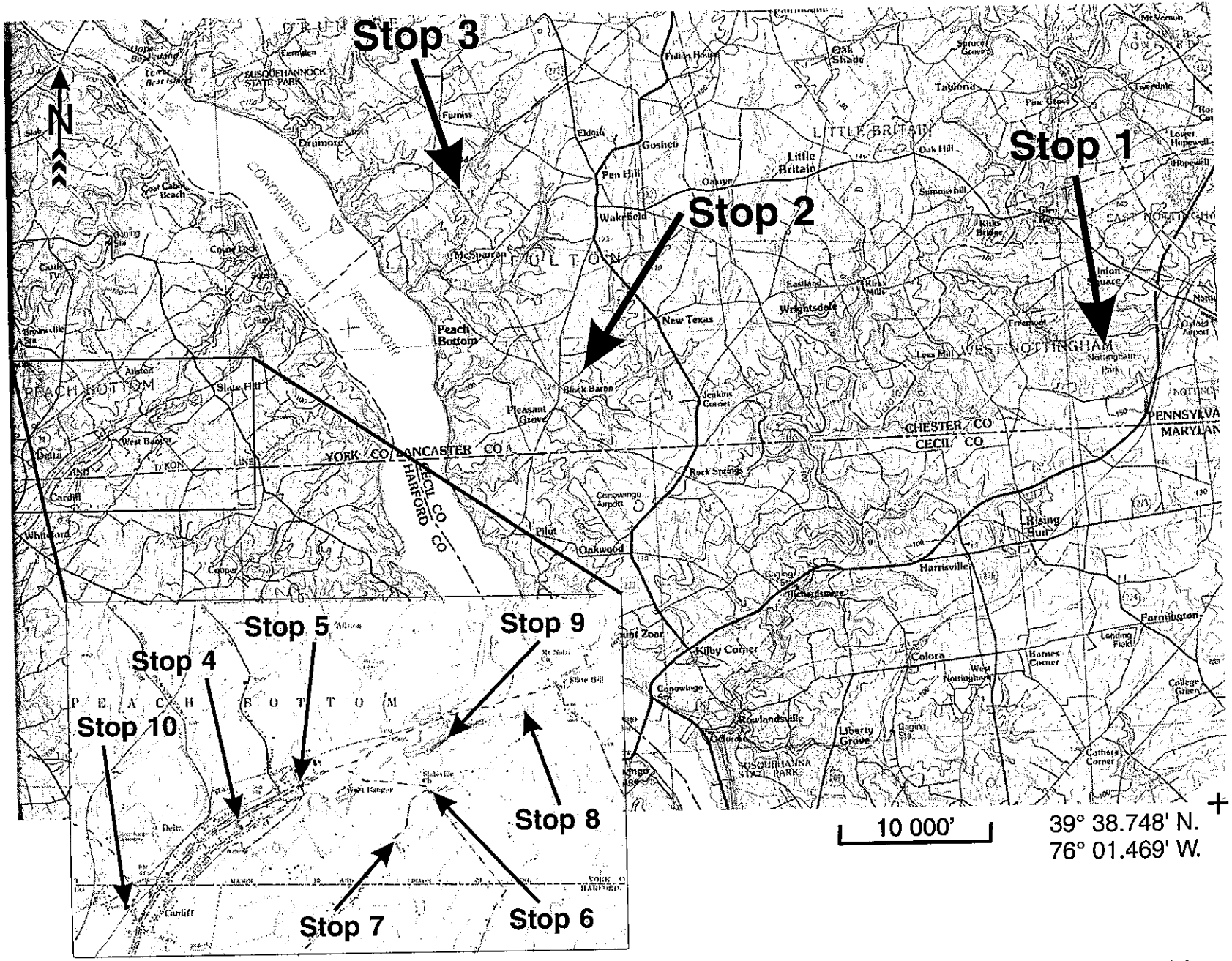

Figure 1. Location of stops in Chester, Lancaster, and York counties, Pennsylvania. All stops are located within the Piedmont Uplands physiographic section. Stop 1 is located within the Baltimore Mafic Complex and remaining stops are located within a complex metamorphic terrane including the Peach Bottom Formation, Cardiff Formation and Peters Creek Formation. Map source is the U.S. Geological Survey York Pennsylvania-Maryland 30′ × 60′ topographic map.

INTRODUCTION

Among the rolling terrain of southern York and Lancaster counties, Pennsylvania are small quiet towns of Delta and Peach Bottom, respectively. Situated within the Piedmont Uplands Section, a ridge locally known as "Slate Ridge" contains a living heritage of a historic past mineral resource. Underlying this ridge is the Peach Bottom Formation, a rock unit containing slate of probable Ordovician age. This is not a normal slate, but a rock that was voted as the best building slate in the world at the London World Expo in 1850 (Stose and Jonas, 1939). The slate was utilized as roofing, cemetery markers, sidewalks, fence posts, blackboards, ornamental pieces and window sills. The Vanderbilt family even requested the Peach Bottom Slate for their roof on the Biltmore Mansion in Asheville, North Carolina (Biltmore Mansion archives, 2005, personal commun.).

Slate was used as roofing dating from 1625 to 1640 and from 1640 to 1670 in Williamsburg, Virginia, in Boston as early as 1654, and in Philadelphia in 1699. Imported slate from North Wales was used in the United States during Colonial days. By 1876, slate was no longer imported; instead, the United States became a net exporter of the slate to other countries. The U.S. slate industry reached its peak in the period 1897–1914. In 1899, there were more than 200 slate quarries operating in thirteen states (Dale et al., 1914), with Pennsylvania historically being the largest producer. Two major mining districts arose in Pennsylvania, namely from the Martinsburg Formation in Northampton and Lehigh counties and from the Peach Bottom Formation in York and Lancaster counties (as well as within Harford County, Maryland).

The Peach Bottom Slate District is certainly one of worldwide fame. Although the discovery of the slate resources in Delta are credited to Welshman John J. Roberts in the 1730s, the first commercial slate quarry in the United States was opened in York County in 1785 by William Docher (Stose and Jonas, 1939). In York County, all of the slate operations were situated on the original McCandless property and were later owned by the Williamson estate (Gibson, 1886). The first slate quarry in Lancaster County opened in 1795 along the Susquehanna River (Stose and Jonas, 1939).

In 1843, the Welsh brought with them the knowledge to extract the slate from deep excavations. Named for their owners, the quarries included William E. Williams and Co., E.D. Davies and Co., James Perry and Co., William C. Roberts, Thomas W. Jones and Co., John W. Jones and Co., Faulk Jones, Hugh E. Hughes and Co., and Kilgore and Co. The quarries profited until the 1920s when cheaper similar materials replaced slate (Jones, 1999).

Slate Ridge, with a general topographic relief of ~110 ft, strikes for ~13 mi from Lancaster County southwestward into Harford County, Maryland. The ridge reaches a maximum width of 0.75 mi. The Peach Bottom Formation lies within a complex metamorphic series of Lower Paleozoic metamorphic rocks. The Peach Bottom Formation has long been debated by geologists concerning its structure and regional implications. You will have a chance along the way to see the evidence and join the discussion. (See Fig. 1.)

A small group of Delta-area residents have dedicated their efforts to preserving the heritage of the slate industry (Wilson et al., 2003; Jones, 2005). The formation of the Old Line Museum, including the world famous Slate Clock, the Rehoboth Welsh Church, the Slateville Presbyterian Church cemetery, and Coulsontown will allow you to relive the heyday of the Peach Bottom Slate.

Miles (interval and cumulative)		
Int.	*Cum.*	
0.0		U.S. Rte. 1 south at Rte. 272/Nottingham exit, Chester County. Exit here to top of ramp.
0.1	0.1	Turn left onto Pa. Rte. 272 south.
0.15	0.25	At stop light, turn right onto Herr Drive.
0.30	0.55	Stop sign. Turn right onto Old Baltimore Pike. Notice Herr's Potato Chip's to the left.
0.25	0.8	Stop sign (right turn keep moving). Turn right onto Kimmel Road.
0.1	0.9	Cross over U.S. Rte. 1
0.75	1.65	Turn left into Nottingham County Park
0.1	1.75	Turn left past Visitors Center and proceed to the restrooms on the right. The nature trail begins here.

Stop 1. Nottingham County Park Serpentinite Barrens (Fig. 2)

Latitude: 39° 43.785′ N. Longitude: 76° 01.290′ W
Discussant: Mary Ann Schlegel

Nottingham County Park, situated in the southwestern corner of Chester County, Pennsylvania, is considered "...the most outstanding of the Piedmont's serpentine barrens...for its size, characteristic flora, and all-around natural history significance..." (Godfrey, 1980, p. 360). As one of several barrens in the State Line Serpentinite District straddling the Pennsylvania-Maryland border east of the Susquehanna River, Nottingham County Park not only exhibits the typical barrens flora and fauna but also illustrates the land use (or rather lack thereof) typical on serpentinized soils.

Serpentine is a metamorphic phyllosilicate derived from the hydration of ultramafic igneous rocks, including dunite, peridotite, and pyroxenite (Ehlers and Blatt, 1982). Three polymorphs are common in the serpentine mineral group. Antigorite and lizardite are massive and fine-grained and may appear greasy, waxy, or scaly. Chrysotile is fibrous and silky. When the aspect ratio of chrysotile fibers exceeds 100:1, it is considered asbestos. Note that the reptilian names allude to the frequent scaly habit and green color of this mineral group! All three polymorphs occur in shades of very light to dark green and are often variegated or mottled (Klein and Hurlbut, 1985). Lizardite is not only the most common serpentine polymorph, but it is the most abundant mineral in Nottingham County Park (Smith and Barnes, 1998).

Rock composed primarily of serpentine minerals, called serpentinite, is typically exposed as part of an ophiolite sequence and interpreted as representing ocean crust obducted during closure.

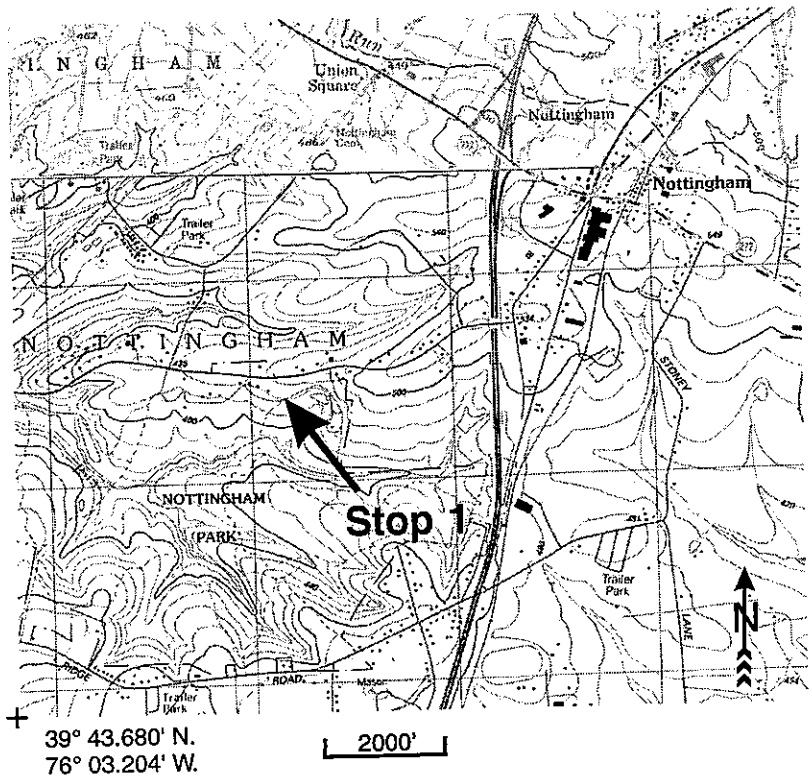

Figure 2. Location of Nottingham County Park, Chester County. This stop begins at the head of Chrome Trail near the restroom at the east end of the parking area. Map source is the U.S. Geological Survey Rising Sun, Maryland-Pennsylvania and Kirkwood 7.5′ quadrangles

Alternatively, serpentinites may originate as stratiform intrusions of mafic magmas. The serpentinites of Nottingham County Park are part of the Baltimore Mafic Complex, which includes serpentinites and gabbroic rocks in a 90 mi (150 km) swath from Philadelphia southwest through the Baltimore area. Though still controversial, petrologic, mineralogic, and isotopic data suggest that the Baltimore Mafic Complex originated as mafic magma intruded and assimilated crustal material beneath an arc complex (Wylie and Candela, 1999). A Nd-Sm date of 490 ± 20 Ma places the protolith crystallization at the beginning of the Taconic Orogeny (Shaw and Wasserburg, 1984).

Serpentine barrens are readily distinguished by the unique plant and animal communities they support. Serpentinites are typically depleted in calcium, potassium, and phosphorus and enriched in magnesium, chromium, nickel, and cobalt. The net effect is that soils developed on serpentinite bedrock are depleted in nutrients and enriched in elements that are generally deleterious to plant growth (Smith and Barnes, 1998). Thus, serpentine barrens are typically sparsely vegetated and home to unusual plants that are able to proliferate in the poor, thin soils. Pitch pine (*Pinus rigida*) and greenbriar (*Smilax rotundifolia*) are obvious; some rare herbaceous plants are less so (Vanderwerff, 1996).

While visiting Nottingham County Park, you are encouraged to follow the Chrome Trail south to the Nature Trail. The Nature Trail loop is ~0.3 mi long but offers not only a walk through the sparse and uniquely vegetated barren, but also a look at serpentinite in the wall of a small, fenced (chromite) quarry at Stop #2. Between Stops #5 and #6, lizardite is exposed in a small pit to the left of the trail. The trail traverses south of a savannah between Stops #6 and #7.

Int.	*Cum.*	
1.75	3.5	Retrace directions back to the intersection of Pa. Rte. 272 and U.S. Rte. 1. Continue west on Pa. Rte. 272.
7.6	11.1	Enter village of Little Britain.
0.2	11.3	Intersection with Little Britain Road south. Continue straight.
1.7	13.0	Turn left onto Little Britain Church Road.
0.7	13.7	Intersection with Soap Stone Hill Road. Entering a small serpentinite area.
1.4	15.1	Stop sign. Turn right onto Black Barren Road.
0.1	15.2	Stop sign. Intersection with Pa. Rte. 222. Continue straight across Pa. Rte. 222.
0.9	16.1	Note old serpentinite quarry on right at intersection with Happy Hollow Road.
0.2	16.3	STOP 2

STOP 2—Serpentinite Exposure and Barrens (Fig. 3)
Latitude: 39° 44.521′ N. Longitude: 76° 10.841′ W.
Discussant: Mary Ann Schlegel

For a portion of its length, Black Barren Road follows the contact between serpentinites to the north and schists of the Peters Creek Formation to the south. The contrast visible in the terrain, habitats, and land use on either side of the road illustrates clearly

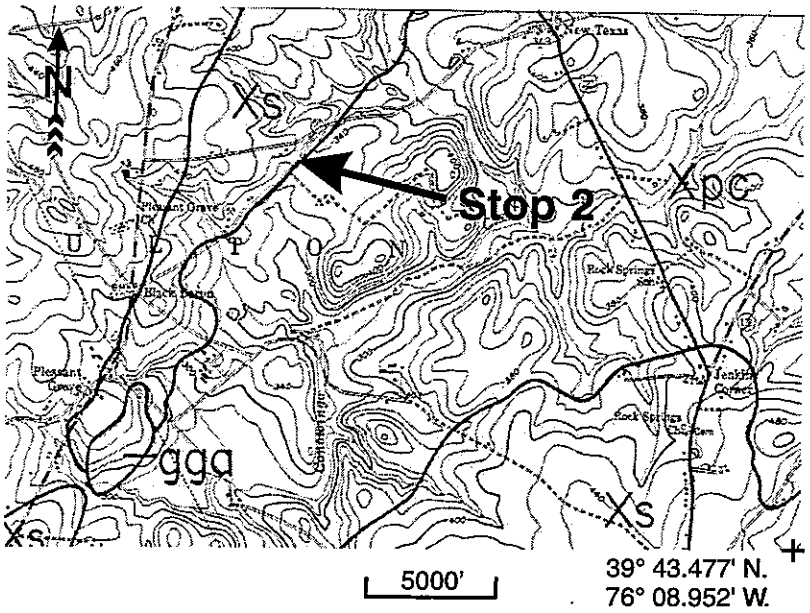

Figure 3. Location of Stop 2, Black Barrens Serpentinite Roadcut in Lancaster County. This is one of the better exposures in the area for the lizardite and an excellent example of vegetation change between the serpentinite and schist. Xs represent serpentinite; Xpc is the Peters Creek Formation; gga is the gabbroic gneiss and gabbro. Map source is the U.S. Geological Survey Conowingo Dam, Maryland-Pennsylvania 7.5′ quadrangle. Geology is from Berg and Dodge (1981).

the origin of the term "barren" for areas underlain by serpentinized bedrock. As noted in Nottingham County Park, serpentine barrens typically support stunted and depauperate floras. Early settlers, mainly farmers, coined the term to describe the notable lack of deciduous forest typical throughout the region and the contrasting stark terrain (Smith and Barnes, 1998). Serpentine barrens are not suitable for agriculture and were typically left as waste areas, as seen along Black Barren Road.

You are encouraged to take a short walk up the hill onto the serpentine barren. Note the lizardite at or close to the surface and the poorly developed soil cover. In many spots, the ground is saturated or at least very moist; many of the "grasses" are actually sedges better adapted to these inhospitable conditions.

Int.	*Cum.*	
0.8	17.1	Stop sign at Pilottown Road. Continue straight on Riverview Road.
0.2	17.3	Bear right onto Cherry Hill Road.
0.8	18.1	Intersection with Rigby Road. Continue straight.
0.8	18.9	Intersection with Arcadia Trace Road. Continue straight.
0.55	19.45	Intersection with Peach Bottom Road. Continue straight.
0.85	20.3	STOP 3

STOP 3. Cherry Hill Road Section (Fig. 4)
Latitude: 39° 46.722′ N. Longitude: 76° 13.048′ W
Discussant: Dr. Charles Scharnberger

In the Cherry Hill Road section, immediately south of Tanningyard Hollow Road, in Drumore Township, Lancaster County,

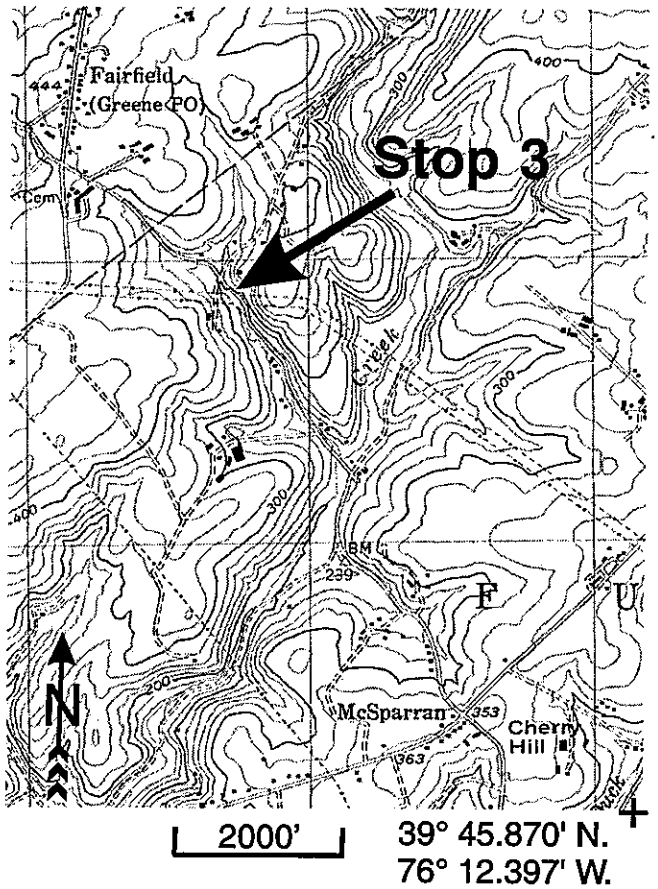

Figure 4. Location of the Cherry Hill Road exposure. Exposures containing the Peach Bottom Formation, Cardiff Formation, and the Peters Creek Formation are rare in this region. In addition, structural interpretation of the rock units can be examined here. Map source is the U.S. Geological Survey Wakefield 7.5′ quadrangle.

Pennsylvania, a 1300 ft (400 m) section of the Peters Creek, Cardiff, Peach Bottom Formations is discontinuously exposed. We will traverse this section from southeast to northwest, starting in the Peters Creek Schist, crossing the Cardiff Conglomerate, and ending in the Peach Bottom Slate. Unfortunately, we will see only ~130 ft (40 m) of the slate at the southeastern edge of its outcrop belt. The entire slate belt may be traversed along the tracks of the Norfolk and Southern Railroad on the east shore of the Susquehanna River ~2 mi (3 km) to the west, but railroad officials are vigilant against trespassers.

There is no agreement among those who have studied these rocks regarding their orientation. Starting with Knopf and Jonas (1929), most workers until the 1970s interpreted the structure as a syncline, with the Peach Bottom Slate occupying its core (Figs. 5 and 6). Under this interpretation, our traverse is up section. Higgins (1972) reinterpreted the Peach Bottom structure as an anticline which, if true, means that we are traversing down section. Valentino (1994, 1999) agrees with Higgins that the section faces to the southeast, but rejects a fold interpretation entirely, proposing instead that the structure is a ductile shear zone, a splay off of the Pleasant Grove–Huntington Valley shear zone that accumulated significant dextral strike-slip during the Alleghanian Orogeny. In this interpretation, the Peach Bottom Formation is regarded as an ultramylonite, rather than an ordinary prograde slate (Valentino, 1994; Chiarenzelli and Valentino, 2006).

0–26 ft	Peters Creek Formation: chlorite-muscovite-quartz schist. Cleavage (regional S_3 of Valentino, 1994) strikes N35°E and dips 80°SE
26–558 ft	Covered zone with schist and diabase float
425–495 ft	Approximate location of diabase dike, as revealed by magnetic survey
558–847 ft	Peters Creek Formation; cleavage dips ~40°SE. Intersection lineation $S_{1?} \times S_3$ visible on some surfaces.
847–1115 ft	Covered zone; Peters Creek float
1115–1121 ft	Talc zone; interpreted by Smith (1993) as derived from an ultramafic parent and possibly marking a fault on which the Cardiff and Peters Creek Formations were thrust onto the Peach Bottom Formation.
1121–1158 ft	Cardiff Conglomerate; foliation, defined by strongly flattened quartz pebbles, strikes N25° E and dips 80° SE. Rock has been quarried here, presumably for building stone. Question: Are the flattened pebbles oblate or prolate? If prolate, what direction of lineation do they define?
1158–1287 ft	Peach Bottom Slate. S_3 cleavage is folded into steeply plunging, upright folds. Attitude of cleavage is quite variable. Two intersection lineations are present.

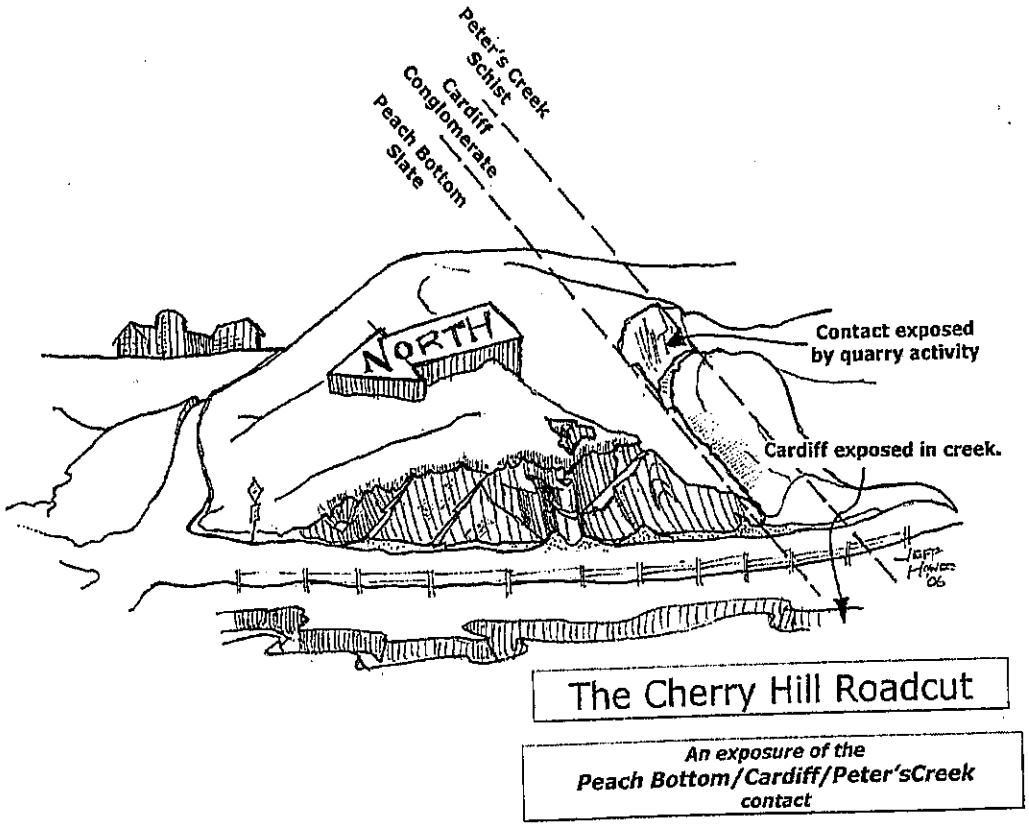

Figure 5. Drawing of the Cherry Hill Road exposure (by Jeff Howe).

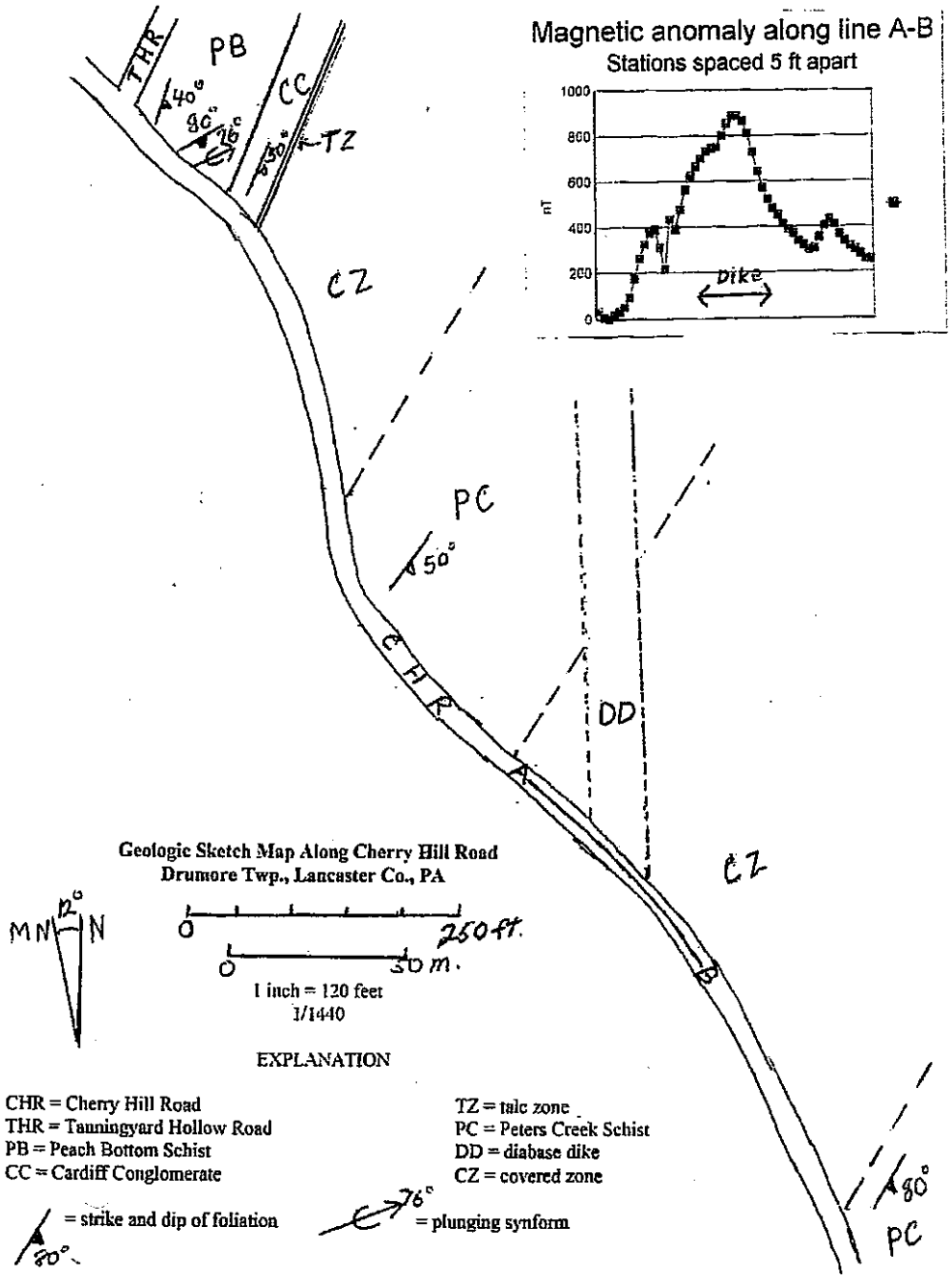

Figure 6. Geologic Sketch along Cherry Hill Road (by Charles Scharnberger).

Int.	*Cum.*	
0.3	20.6	Vans will pick up participants at the intersection of Tanningyard Road and Cherry Hill Road.
0.4	21.0	Intersection with Slate Hill Road. Turn right onto Slate Hill Road.
0.8	21.9	Intersection with Furniss Road. Continue straight.
1.15	23.05	Stop sign at intersection with River Road. Turn right onto River Road. Notice slate gravestones in cemetery to the right.
0.2	23.25	Intersection with Spring Valley Road. Turn left onto Spring Valley Road.
0.35	23.6	Stop sign with Pa. Rte. 222. Turn left.
3.65	27.25	Enter Buck. At blinking light, turn left onto Pa. Rte. 372 west.
6.05	33.3	Notice outcrops of the Octorara Formation schist believed to be Lower Paleozoic in age.
0.4	33.7	Norman Wood Bridge crossing the Susquehanna River. To the west of Holtwood Dam north of the bridge, a small outcrop of the Holtwood Basalt exhibiting pillow structures can be observed.
0.9	34.6	Additional outcrops of the Octorara Formation on the left side.
2.1	36.7	Intersection with Pa. Rte. 74. Turn left onto Pa. Rte. 74 south.
2.9	38.6	Cross Muddy Creek at Castle Finn. Ironmaster Thomas Coleman built a mansion and operated a forge here in the early nineteenth century on the north side of Muddy Creek Forks. One of the best placer gold-bearing streams in York County is found ~0.25 mi west of here. Originating from the Peters Creek formation, flakes up to 0.75 inches have been found.
1.4	40.0	Turn left onto Broad Street Extended.
1.2	41.2	Notice Stonewall Inn on the right.
0.2	41.4	Intersection with Main Street in Delta. Turn right onto Main Street.
0.3	41.7	Turn left onto College Ave.

STOPS 4 and 5. Old Line Museum and Rehobeth Welsh Church (Fig. 7)
Latitude: 39° 43.654′ N. Longitude: 76° 19.491′ W
Discussants: Donald Robinson and Jeri Jones
The Old Line Museum

Welcome to the Old Line Museum, named after it's proximity to the famous boundary line between Maryland and Pennsylvania. The museum was organized in 1975, in order to preserve and promote the unique history of the small communities that straddle this line, the Mason-Dixon Line.

Many displayed items are typical of the past 150 years from small town American life. Items in the collections include: railroad memorabilia from the famous short line, the Maryland and Pennsylvania Railroad, affectionately remembered as the MA and PA, photographs of local industries and organizations,

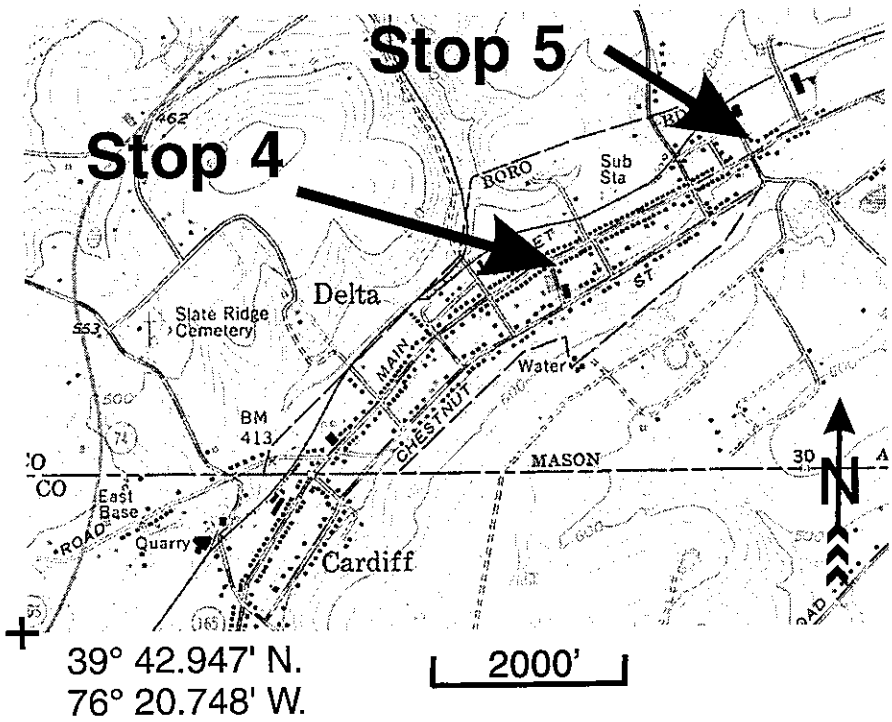

Figure 7. Location map for the Old Line Museum and Rehobeth Welsh Church in Delta. A short walk from the museum to the Rehobeth Welsh Church includes many examples of slate usage. Map source is the U.S. Geological Survey Delta Pennsylvania-Maryland 7.5′ quadrangle.

church histories, heirloom clothing, Civil War items, and American Indian artifacts.

Portions of the collection include items that were brought to Delta by the Welsh immigrants. They were treasured items that survived the passage in the sailing ships that crossed the Atlantic. Some of these items include bibles written in the Welsh language, one of the oldest languages of Europe.

The museum's most unique collection focuses on the famous Peach Bottom Slate industry. It includes numerous photographs and the town's most interesting artifact, the Slate Clock, which is housed in the vault. It is the only such clock in the world and its facade is constructed almost entirely of three colors of slate. The blue-black is our Peach Bottom Slate and the red and green slates are from quarries near the Vermont–New York state borders.

The Slate Clock was made by a local Welsh craftsman and skilled slate quarryman, named Humphrey Pritchard. The clock is 100 years old this year (2006).

Walk to the Rehobeth Welsh Church at 1029 Main Street, corner of Main and Pendyrus Streets. Note the slate roofs and sidewalks along the way. A short detour down the drive for the Delta General Store and Western Auto Center at 805 Main Street will lead to the original jail. The builder of the jail happened to be the first to use it, imprisoned on a drunk and disorderly charge, he soon became the first to escape as well.

Latitude: 39° 43.780′ N. Longitude: 76° 19.210′ W
Discussants: Donald Robinson and Jeri Jones
The Rehoboth Welsh Church

When Welsh quarrymen emigrated to the area in the 1840s, the quarrymen and their families set about starting a church, as they were very devout in their religion. They organized a non-denominational chapel because the first immigrants consisted of members from diverse protestant faiths. The Rehoboth Welsh Church descended from one of these original churches. In the United States, such a church today is a rarity.

As the congregation grew, they frequently disagreed about religious doctrine. This led to the eventual formation of two distinct congregations. The first to form was the Calvinistic Methodists (essentially Presbyterians).Calvinistic Methodism was the most popular religion in Wales at this time. They named their church "Rehoboth." In 1857, the Congregationalist Church was formed. By this time, the town of West Bangor had been settled and contained all three churches.

West Bangor, named after Bangor, North Wales, grew to a town of almost 400 Welsh settlers. Today, only a few of the original homes remain. By the 1890s, the population center of the "slate ridge" had shifted to the fledgling town of Delta. This was precipitated by the railroad reaching Delta in 1876. The first church had ceased to exist, but the congregations of the remaining two churches had grown and larger meeting houses were needed. Rehoboth built a larger chapel in Delta, in 1891, at the present location. The Congregational Church moved to Delta in 1894.

Circa 1910, the slate roofing industry, with cheaper competition, began to contract. World War I adversely affected the industry when many potential employees moved away to work in the defense industry. With a reduction of members, the Congregationalist Church was forced to close in 1916, and many members joined with Rehoboth.

Rehoboth Welsh Church has continued to survive and is active today. It still uses the Welsh language in its services. Only two other Welsh Churches in the United States still use the Welsh language. One is in New York City and one is in Los Angeles (Williams, 1996).

Please note the uses of Peach Bottom Slate in the church building. The foundation consists of slate rubble blocks, a quarry waste product. Slate also is used for window and door sills, as siding in the eaves, for sidewalks, and as shingles for the roof, the use that makes Peach Bottom Slate famous.

Int.	*Cum.*	
0.4	42.1	Rehobeth Welsh Church. Slate splitting demonstration behind the church; board bus for Stop 4 behind the church. Continue east of Main Street.
0.2	42.3	Main Street and Slateville Road. Turn right onto Slateville Road. Note Funkhauser Quarry dumps to the left and John D. Williams Quarry dumps to the right.
0.5	42.8	Prospect Road and Slateville Road. Turn right and park in the parking lot for Slateville United Presbyterian Church.

STOP 6. Slateville United Presbyterian Church (Fig. 8)
Latitude: 39° 43.769′ N. Longitude: 76° 18.230′ W
Discussants: Don Robinson and Jeri Jones

(In the graveyard, notice the Sears cast iron markers on several Caskey family plots. Note also the preservation of scribe lines on the slate stones, on the Griffith Jones monument, for example.)

The congregation of Slateville Presbyterian Church organized in 1849. The present structure was built in 1867. The adjacent cemetery has always been shared with Rehoboth Welsh Church. Note the extensive use of the blue-black Peach Bottom Slate for tombstones. Only the finest grade of slate was used for this purpose and many of the stones are considered works of art. Utilizing slate for this purpose illustrates the significance the rock played in their lives. They were proud to memorialize their deceased family members with the material that gave them their livelihood.

The Welsh were very skilled in music, poetry, and prose. Virtually all could read and write. In the past, both here and in Wales, a special competition was conducted that they called "Eisteddfods." Translated into English, this means "competitive gathering." These competitions (still performed in Wales) pitted musician against musician, and poet against poet.

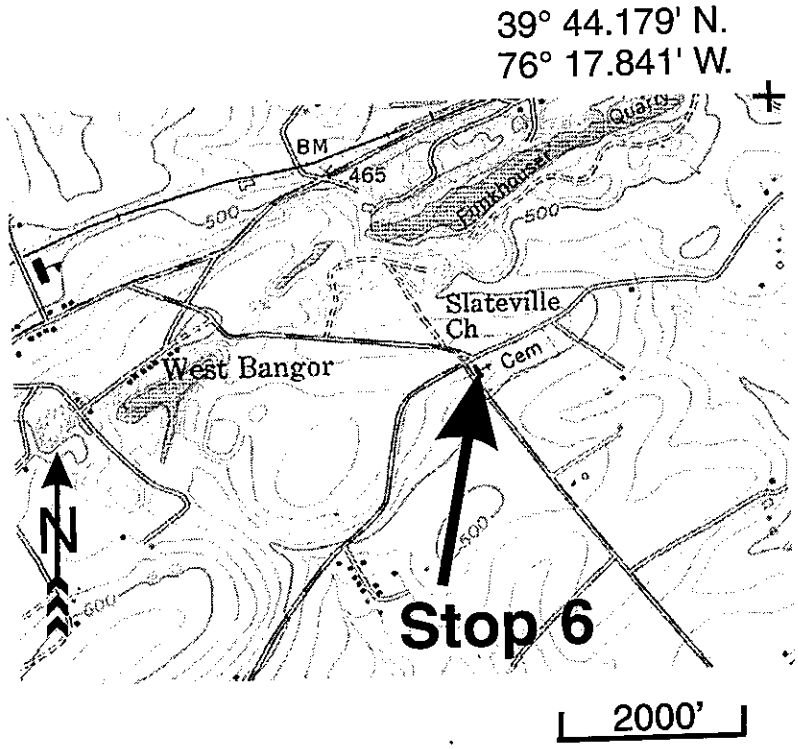

Figure 8. Location of Slateville Presbyterian Church and Cemetery. A walk through the cemetery will illustrate the fine carving and durability of the Peach Bottom Slate. Also notice the names of many Welsh buried here. Map source is the U.S. Geological Survey Delta Pennsylvania-Maryland 7.5′ quadrangle.

Each Welsh community usually had two or more poets in residence, and when a person passed away, a poem was composed to illustrate their life. Many of the poems, written in Welsh, can be found on the tombstones. In addition, the carver often added artistic sculpting to the stone. Virtually all of the artistic slate tombstones were carved by a Welsh immigrant, Mr. Robert Evans. His skill using only a hammer and chisel was outstanding, but when he died, the craftsmanship vanished with him.

From here, head southwest of Ridge Road.

Int.	*Cum.*	
0.4	43.2	Ridge and Green Roads. Note Cardiff Conglomerate exposure on the right just before the intersection. Park in pull-off area on left.

STOP 7. Coulsontown—A Welsh Community (Fig. 9)
Latitude: 39° 43.492′ N. Longitude: 76° 18.478′ W
Discussant: Mary Ann Schlegel

Walk Green Road (aka Main Street, Coulsontown) to view homes of the Welsh miners.

Note brick rows just below the roofs, slate roofs (on outhouse also), fenceposts, and walkways.

The settlement of Coulsontown and the predominance of Delta–Peach Bottom slate in the industry originated with the immigration of Welsh quarrymen in 1843. The quarrying expertise and techniques imported from Wales by these industrious immigrants moved the quarrying operations in Delta to another level. Certainly, the Scots and Irish who opened the first quarries had refined their quarrying techniques to produce maximum recovery in the shortest time, but the Welsh discovered that the physical layout and geology of the Delta slate quarries were very similar to the slate deposits in Wales. They felt right at home and quickly showed the Delta residents better methods of quarrying. Welsh names, such as Humphreys, Williams, Davies, Perry, Roberts, Jones, and Hughes, became prominent in the slate industry.

The Welsh settlers in the Delta area were a close-knit group. Descendents of an ancient Celtic race with a language predating the English language, Welsh children were taught English in schools in their native land so they easily assimilated into schools in the Delta area. Nevertheless, the Welsh did not settle in Delta, but constructed vernacular cottages in nearby settlements. Three settlements are believed to have once existed in the Delta–Peach Bottom area: Ludwig, Stonetown, and Coulsontown. West Bangor is also said to have been started by the Welsh (Gibson, 1886). These communities were working-class settlements with the cottages built to replicate villages found in the mountains in the Snowdonia region of northwest Wales. Stonetown was believed to have been a Scots-Irish settlement from 1790 until 1840. Whereas physical features of most of these towns have long since disappeared, Coulsontown is very much alive and well.

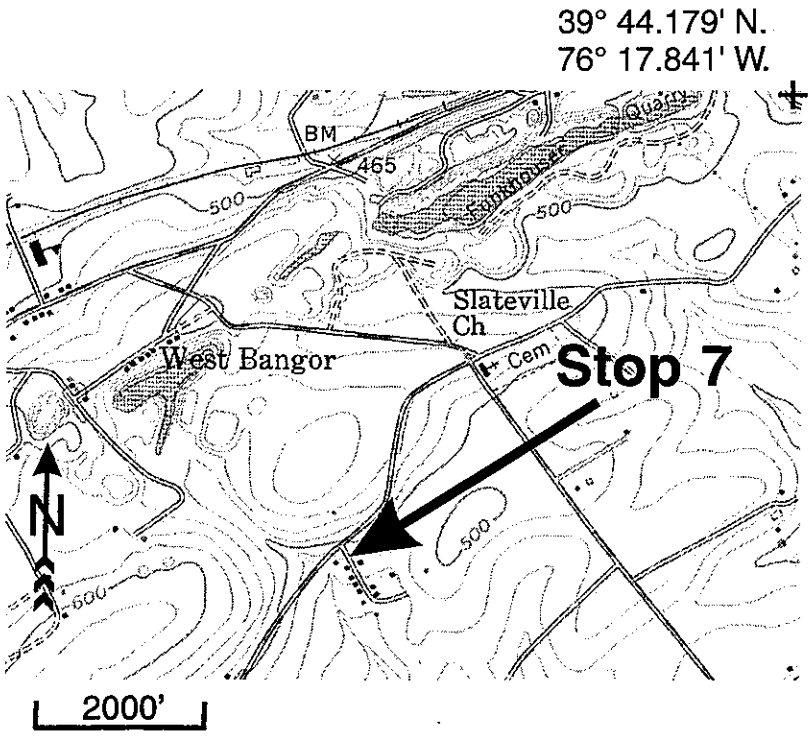

Figure 9. Location of the Welsh settlement known as Coulsontown. Notice the craftsmanship of using the Cardiff Formation conglomerate as their building stone. Map source is the U.S. Geological Survey Delta Pennsylvania-Maryland 7.5′ quadrangle.

Coulsontown presently consists of seven houses along Main Street. Several vacant lots where framed houses once stood are scattered among the homes along the 600 ft paved main thoroughfare. The homes standing today include a pair of modern homes, a two and one half story frame cottage and four stone quarrymen's cottages. The house closest to Ridge Road was probably the first cottage built while the other structures along Main Street followed.

The quarrymen's cottages are simple, squat, two-story rectangular buildings with a moderate depth. Cornerstones are large, well-shaped quoins. Door and lintels are single blocks. The walls are composed of the Cardiff Conglomerate, the formation underlying Coulsontown. A distinctive characteristic of the quarrymen's cottages is the four courses of brick cornice. Brick was considered a luxury item in Wales. It is a possibility that these decorated cornices symbolized the economic advantages found by these workers in America. Roofs are slate; even the outhouse located behind the first house on the right off of Ridge Road is roofed with slate (York County Planning Commission, 1981).

Through the efforts of the York Planning Commission and Historic York, Coulsontown placed on the National Register of Historic Places in 1984. Lynn Rozental, former executive director of Historic York, asserts "Coulsontown is one of the rarest collections of buildings in North America."

Retrace steps to bus. Retrace route back to intersection of Ridge Road and Prospect Road.

Int.	*Cum.*	
0.4	43.6	Prospect and Ridge Roads. Go left ~100 ft to stop sign. Turn right onto Slateville Road.
1.2	44.8	Turn left into driveway at large slate slab at 719 Slateville Road. Park at house.

STOP 8. Faulk Jones Quarry (Fig. 10)
Latitude: 39° 44.167′ N. Longitude: 76° 17.533′ W
Discussant: Jeri Jones

(Also note reconstructed Welsh miner's home composed of Cardiff Conglomerate.)

The role of a slate miner was a semi-skilled occupation. Wages were low for a ten-hour day and work was very hard and dangerous. Loosening large slabs from the vertical walls and removing these giant slabs out of the quarry to the sawyer's shack was risky. Not only was skill involved in being a miner, but a lot of luck, hoping that the machinery, tools or cables would not fail, causing a serious accident.

Loosening the slate from the bedrock was not done by dynamite, as one might think. Dynamite was too strong and would seriously fracture the slate. The miners worked on a wooden platform extracting the large blocks of the slate out of the quarry walls. It was the practice for many years to drill holes into the bedrock and hammer wooden pegs into the holes. This process of wedging slowly fractures the rock into rectangular blocks, which are then prepared for removal off the vertical wall (Jones, 1996).

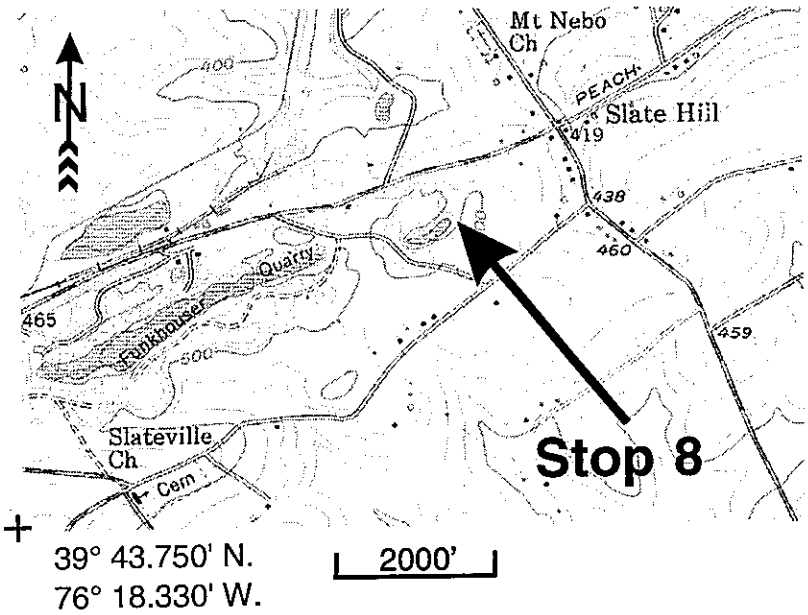

Figure 10. Location of Faulk Jones Quarry and restored Welsh cottage. Access to this property is by permission only from the property owners. Map source is the U.S. Geological Survey Delta Pennsylvania-Maryland 7.5′ quadrangle.

In later years, low-energy black powder was used to extract the blocks. The blocks removed from the quarry were 12 ft (3.65 m) by 8 ft (2.43 m).

Probably the biggest influence introduced by the Welsh for slate mining was that of steep-wall quarrying. Prior to the Welsh influence in1843, the dredge and crane method of quarrying was used. With this technique, deep excavations were not possible. The Welsh introduced the cable and hoist method, which allowed for deep, straight-wall quarrying. A large hoist system was installed over the quarry that was used to lift both the workers and blocks out of the quarry. Cables ran across the quarry. From these cables ran trolleys and with other cable rigging, the workers were able to lift the slab and get the slate to the slab shanties and onto the sawing tables. Steam-powered saws could handle about an 8-inch (20.32 cm) thick slab. Not only was splitting the slate difficult, but for those pieces being used as roof shingles, another talented worker had to punch two nail holes in each shingle. To install the slate shingles onto a structure properly took a carpenter with many years of experience (Norris, 1898).

Another technique of the industry introduced by the Welsh was that of underground mining or what some knew as tunneling in the Delta area. Advantages to tunneling are that the overburden was not disturbed, and it took less work to find commercial slate. Also, the tunnels provided shelter for the workers during inclement weather, and the rock acted as an insulator, keeping the temperature constant year-around.

The commercial-grade slate occurred below a lie that was known across the region as the "big flat joint," a horizontal joint pitching slightly south, some 40–60 ft (12.1–18.2 m) below the surface.

The Faulk Jones Quarry is ~500 ft (152 m) long and 100 ft (30.4 m) wide, with its high halls ~70 ft (21.3 m) high. The water depth is ~100 ft (30.4 m). A tunnel exists in the southeast corner and can be seen when the water table is down. This operation was opened ~1860 and last worked in 1922 as Faulk Jones and Sons Quarry. Foundation of saw shanties is found to the south of the opening.

Exit driveway to Slateville Road and turn left.

Int.	*Cum.*	
0.2	45.0	Stop sign. Turn left onto Flintville Road.
0.4	45.4	Stop sign. Turn left onto Atom Road. Note large slate dumps on left.
0.7	46.1	Park along Atom Road at abandoned plant remains.

STOP 9. Funkhauser's Quarry (Fig. 11)
Latitude: 39° 44.150′ N. Longitude: 76° 18.132′ W
Discussant: Charles Scharnberger

Funkhauser's (or Funkhauser) Quarry is the largest of the abandoned slate pits in the Delta district. The exact date that quarry operations began at this site is not known, but the Pennsylvania Department of Environmental Protection described Funkhouser's in 2001 as a 200-year-old slate quarry (PADEP, 2001). The pit extends ~4500 ft (1370 m) along the strike of the Peach Bottom Slate outcrop belt, approximately N65°E, and is ~250 ft (75 m) wide.

The Peach Bottom Slate has long been regarded as one of the highest quality roofing slates in the world because of its hardness, strength, and resistance to color change (Berkheiser, 1994). These very qualities, ironically, contributed to the demise of mining in this district because of the difficulty in trimming and milling the rock. Furthermore, the presence of a joint set

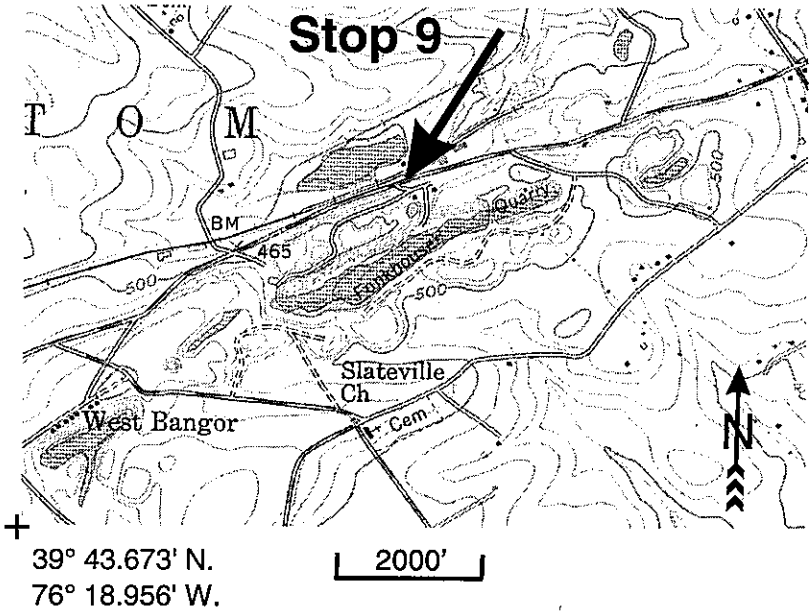

Figure 11. Location of entrance to the Funkhauser Quarry. This is the largest quarry in the district and has been the site of numerous drownings in past years. Permission for access was granted from the property owners for this trip only. The property is patrolled on a regular basis. Map source is the U.S. Geological Survey Delta Pennsylvania-Maryland 7.5′ quadrangle.

striking only 10 to15 degrees from the strike of cleavage causes the rock frequently to break into pieces that are wedge-shaped rather than planar. As much as 88% of the rock mined had to be discarded as waste, compared to 65% in today's economically viable slate mines. Finally, the vertical orientation of the cleavage planes made mining difficult and dangerous (Berkheiser, 1994). The most recent mining operations at Funkhouser's, production of roofing granules by the GAF Corporation, ended in 1970 (Hoff, 1999).

Valentino (1994) describes the mineralogy of the Peach Bottom Slate as up to 90% very fine muscovite and sericite, with accessory quartz, chlorite, chloritoid, and ilmenite. He attributes the unusually dark color of the slate to the ultra fine size of the mica, which he interprets as evidence for the slate's origin as a mylonite, as discussed at the Cherry Hill stop. Five chemical analyses, performed in the late nineteenth century and cited by Berkheiser (1994), have the following mean values:

SiO	57.3%
AlO	21.2%
FeO + Fe	6.8%
KO	3.4% (mean of 4 analyses)
CO}	3.0% (mean of 3 analyses)
NaO	1.9% (mean of 4 analyses)
MgO	1.4%
CaO	1.0%

More recent analyses (Smith, 1994) generally agree with these values, but show more iron and less sodium and calcium.

The structure of the slate is well exposed in the cut providing access to the pit from the north side. Note that in many places, the near-vertical cleavage is curviplanar rather that perfectly planar. A conjugate system of vertical joints is present. One set strikes N05° W, the other N55° E. The strike of the cleavage is N65° E.

Public safety is a matter of concern at Funkhouser's Quarry. Since 1985, at least eight drownings have occurred here (MSHA, 2000). In 2004, the quarry was the site of a locally notorious murder.

Int.	*Cum.*	
0.1	46.2	Notice Funkhauser Company's settling ponds on right side and continue to intersection with Slateville Road.
0.8	47.0	Continue west on Atom Road. Note street name changes to Main Street. Continue past Rehoboth Welsh Church and Old Line Museum to stop sign at Broad Street. Continue straight on Main Street.
0.6	47.6	Feed Mill—Location of the Mason Dixon Line. Enter Cardiff, Maryland.
0.2	47.8	Turn right onto Green Marble Road and continue to Heaps Oil Company.

Stop 10 (drive-by): Cardiff Green Marble Company (Green Marble Recycling) (Fig. 12)
Latitude: 39° 44.150′ N. Longitude: 76° 18.132′ W

The rock quarried here is a serpentinite, similar to the rock seen at Stop 2. What makes this attractive are the calcite veins cutting through the green groundmass. When polished, the rock is very attractive. The rock quarried, cut and polished here has been used for lamp bases, table tops, fireplaces, desk ornaments, and chair railings. The Cardiff Marble can be found in, among others, the Empire State Building in New York City, numerous federal buildings in Washington, D.C., and the Department of Highways Building in Harrisburg,

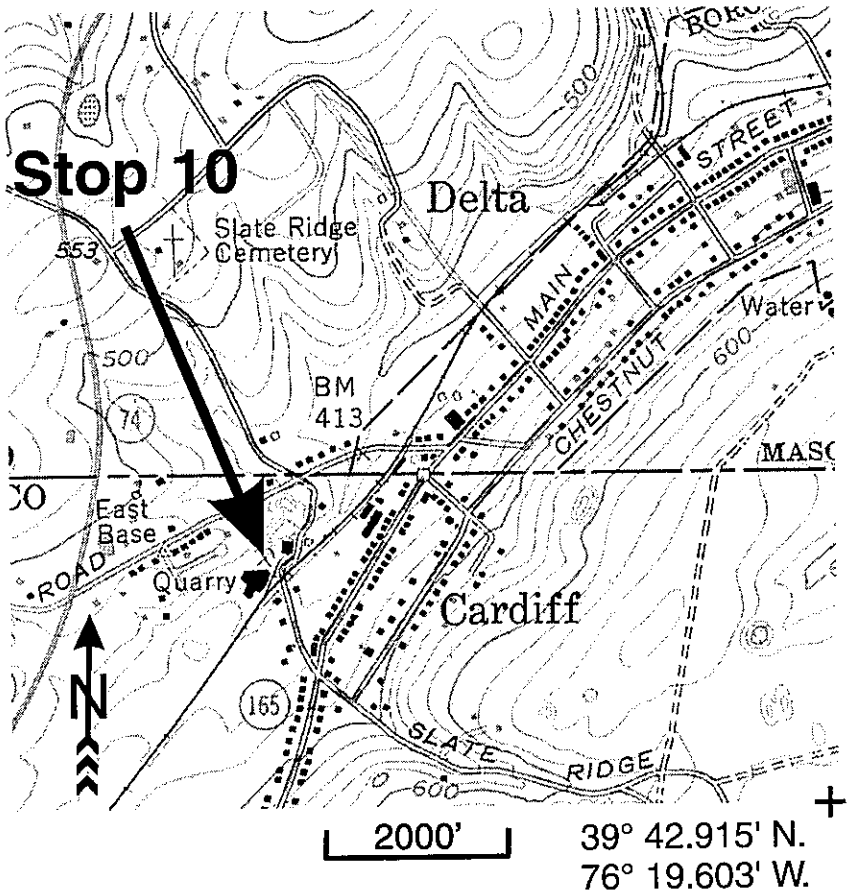

Figure 12. Location of the Cardiff Green Marble Company in Cardiff, Maryland. A water-filled vertical shaft over 300 ft deep is still located within the fenced-in area. The hoist is the most visible landmark in Cardiff. Map source is the U.S. Geological Survey Delta Pennsylvania-Maryland 7.5′ quadrangle.

Pennsylvania. As recently as 2000, the federal government removed some blocks of the serpentinite from surrounding dumps to be cut and polished for use at the White House in Washington, D.C.

Similar to the neighboring Peach Bottom Slate, the Cardiff Marble has been used throughout North America as a building stone. The quarry was opened in 1900, removing stone for road construction. In 1913, blasts in the quarry floor tore lose a giant mass of a grass-green beautifully grained rock. The company sent the rock to Baltimore, Maryland, to be polished. The company immediately changed their focus of the product, setting up saws and polishing stations to produce the decorative stone. The operation worked continuously until the late 1960s, at which time five horizontal tunnels had been driven following the best rock. The company closed due to the high cost of mining and finishing the rock compared to that of the cheaper "artificial marble" coming onto the market.

Today, the shaft is water-filled, obtaining a depth of over 300 ft (91.4 m). A number of drifts extend off of the vertical shaft. The water table is ~15 ft (4.5 m) below ground level. The buildings still stand today. The only remaining working saw sits inside the closest building to the road. The hoist and crane system is the highest point in Cardiff.

Proceed along Green Marble Road past blocks of Cardiff Conglomerate and serpentinite.

Int.	*Cum.*	
0.2	48.0	Turn left onto Dooley Road.
0.2	48.2	Proceed to stop sign with Pylesville Road. Turn left onto Md. Rte. 136.
0.5	48.7	Intersection with Md. Rte. 136. Turn left onto Md. Rte. 136 east.
0.35	49.05	Pass through Slate Ridge one final time. Notice slate quarries on both sides of the road. Continue to follow Md. Rte. 136.
6.35	55.4	Intersection with U.S. Rte. 1. Turn left onto U.S. Rte. 1. Cross the Susquehanna River at Conowingo Dam and retrace steps back to Philadelphia.

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