



GEOLOGY

and

CIVIL WAR

Highlights of
YORK COUNTY,
Pennsylvania

York County Parks
Guidebook #5

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PHYSIOGRAPHY AND GEOLOGY

The topography of York County is greatly influenced by the underlying bedrock and structure. As one drives on either Interstate 83 or U. S. Route 30, one can see a change in elevations and the lay of the land. Two physiographic provinces are found in York County, the Blue Ridge and Appalachian Piedmont provinces. Each province contains its own elevation above sea level, soil types, drainage pattern and in some cases, vegetation.

The Blue Ridge province is better known to local residents as South Mountain, (not to be confused with South mountain, located between Reading and Allentown in the eastern part of the state). The Blue Ridge continues southward into Maryland, Virginia, North Carolina and Tennessee, where the scenery is spectacular. The Blue Ridge province (or mountains, if you desire), terminate at White Rocks, about two miles north of Dillsburg, marking the terminus of this popular mountain range. Its elevation ranges from 600 feet to 1,400 feet above sea level. In fact, the highest point in York County, Stone Head, at 1,380 feet above sea level, is located 3.5 miles southwest of Dillsburg. Rocks within the Blue Ridge province represent igneous, sedimentary and metamorphic rocks ranging in age from 820 to 540 million years old (mya), and have been strongly folded and faulted.

Piedmont Province - Gettysburg Newark Lowland Section: Named for a geologic period 245 - 208 mya, this section occupies the northern third of the county. Route 74 crosses this section between Shiloh and Dillsburg. Interstate 83 crosses it between Emigsville and Reeser's Summit. The average is 400 to 600 feet, however some peaks like Ski Roundtop, Blair Mountain and Neill's Hill rise above 1200 feet above sea level. The rocks within this section are sedimentary in origin and are composed of sandstone, conglomerate, shale, mudstone and limestone. Also, diabase occurs on the higher elevations. Few faults or folds are known as the rocks are generally tilted toward the north or northwest at a gentle angle. The first documented earthquake west of the Susquehanna River in southern Pennsylvania occurred in this section in June, 1997 (Scharnberger, Jones and Kreiger, in press).

Piedmont Province - Lowland Section: Also known locally as the York - Hanover Valley, this region is the heartland of York County. U. S. Route 30 travels through this region from Wrightsville westward through York and Thomasville. The general elevation is 250 - 500 feet above sea level. Rocks within the York Valley are mostly sedimentary, such as sandstone, limestone, dolomite, shale and conglomerate. Two highlands found within this section are known as the Pigeon Hills, located between Thomasville and Hanover and the Hellam Hills located between Pleasureville and the Susquehanna River. Elevations range from 350 feet to over 1,000 feet above sea level in the Hellam Hills and over 1,200 feet in the Pigeon Hills. Rocks within these highlands are mainly composed of metamorphic rocks, quartzite and phyllite. The oldest rocks in York County are metabasalts, which have been dated at 820 mya. Faults are numerous within this section.

CRYPTOZOIC (PRECAMBRIAN) EON

PHANEROZOIC EON

Origin of Earth
4600 mya*

3450 mya

2300 mya

1150 mya

Present
1.5 mya

Quaternary Period

Tertiary Period

65 mya

Cretaceous Period

135 mya

Jurassic Period

180 mya

Triassic Period

225 mya

Permian Period

280 mya

Pennsylvanian Period

310 mya

Mississippian Period

350 mya

Devonian Period

400 mya

Silurian Period

430 mya

Ordovician Period

500 mya

Cambrian Period

GEOLOGIC TIME. The four and a half billion year history of the Earth is divided unequally into the eons of the Cryptozoic ("hidden life") and Phanerozoic ("evident life"). The Phanerozoic Eon is subdivided into twelve periods which are grouped into the eras of the Paleozoic ("ancient life"), Mesozoic ("middle life"), and Cenozoic ("recent life"). Color codes represent periods of geologic time preserved in the rock formations of York and Lancaster counties.

4025 mya

375 mya

370 mya

CENOZOIC ERA
MESOZOIC ERA
PALEOZOIC ERA

*mya = millions of years ago

Piedmont Province - Upland Section: This section occupies the southern third of York County. The area is characterized by northeast - southwest trending ridges and rounded hills separated by narrow valleys. Elevations range from 600 - 900 feet above sea level. This section is dominated by metamorphic rocks such as schists, phyllites, metabasalts, marble and slate. The rocks are believed to be 450 - 375 mya. Several faults have been mapped, following the strike of the formations.

INTRODUCTION AND ITINERARY

Welcome to the fall edition of the York County Parks semi-annual geology field trip. As tradition has been, our fall trips take a general look at the County's geology, while spring trips take a closer look at a specific location or mineral resource. In the spring of 1999, we hosted a trip to see the rich slate heritage in Delta. Today's trip not only introduces you to the general geology of the County, but also examines several areas where the Civil War activities affected residents of York County. We hope you enjoy this trip and learn several interesting facts about York County.

Schedule:

9:05 AM	Depart from John Rudy County Park
9:15-9:45 AM	Stop 1 - Rocky Ridge County Park
10:05-10:35 AM	Stop 2 - Wrightsville Borough
10:45-11:05 AM	Stop 3 - Accomac, Hellam Township
11:25-11:40 AM	Stop 4 - Locust Lane, Manchester Township
12:00-12:30 PM	Lunch , Wolf's Church
12:40-1:40 PM	Stop 5 - Baker Refractories Quarry, W. Manchester Township
2:00-2:30 PM	Stop 6 - Hanover Junction, North Codorus Township
3:05-3:35 PM	Stop 7 - Zion's View Fossil Site, Manchester Township

ACKNOWLEDGEMENTS

The writer wishes to thank the following persons for their efforts in making this trip a success. Jerry Reimold for his cooperation with his trilobite find; David Hopkins of Baker Refractories for taking his valuable time to be our host; Wolf's Church for allowing us a comfortable lunch stop; and to the Shimell's for hosting us at their fossil site. We, of course, always appreciate the talented and friendly drivers from Community Transit. Finally, my wife, Lou Ann, who designed the cover of this guide.

SOME NOTES ON THE CIVIL WAR IN YORK COUNTY

It is surprising the little bit of information that is available discussing the various "conflicts" and travels of the troops during the Civil War. There is plenty of information available listing the York County residents who, in some shape or form, participated in the Civil War (Gibson, 1886). Even when talking to several authorities on this great encounter, they also mentioned that they have very little information in their libraries about York County.

With rumors arising in mid-June, 1863 about the possibility that the Confederates may be marching toward Pennsylvania, particularly Harrisburg and Philadelphia, residents of York County, as well as other folks in Dauphin, Cumberland, Franklin and Adams counties began to prepare for the worst. A massive evacuation started, with many families pulling up their "stakes and moving across the Wrightsville bridge and further east. At times, the roads were full with these folks. With them they took their families, animals and valuables. Those who decided to stay "put", either buried their valuables in the yards or in the basements.

On Saturday morning, June 27th, 1863, it was known for a certainty that the Confederates were on their way toward York and beyond. Prominent and influential citizens of York met in the hardware store belonging to Messrs. P.A. Small for consultation and to devise means for the protection of the people. The committee was called the "Safety Committee." David Small, chief burgess at the time, along with Messrs. Samuel Small, Sr., W. Latimer Small, George Hay, Thomas E. Cochran and Thomas White and others were involved in this meeting. The meeting was called to order at 7:30 AM and lasted throughout the day. It was decided that the American flag be raised in Centre Square. The committee was informed that Mr. Arthur Farquar, a citizen of York did meet with Confederate Brigade General Gordon, who was camped for the night in Farmers, about seven miles west of York. General Gordon instructed Mr. Farquar that if no resistance was made by the residents, all property and unarmed citizens would be respected (Gibson, 1886; Van Baman, 1913).

At 10:00 AM on Sunday, June 28th, the Confederate troops lead by General Gordon entered the western edge of York. Riding down West Market Street in a cloud of dust, the Confederates marched through York at the time that people were on their way to church. Church bells were ringing in the background as they normally did on Sunday mornings. What a sight that was as York residents lined Market Street to watch the caravan.

At Hanover, the first battle of the war in Pennsylvania, was fought on Tuesday, June 30, 1863, an artillery and cavalry fight which lasted most of the day. The cannon fire was clearly heard in York. The Army of the Potomac under General Kilpatrick, one of the brigades of which was commanded by General Custer, reached Hanover on this day in pursuit of General Stuart. Not realizing Stuart's location, Kilpatrick's rear guard was attacked by Stuart as they halted in the square of Hanover. As forces mounted, the Confederates held the hills to the north, while the 18th Pennsylvania brigade held Hanover and barricaded the streets. During the daylight, cannon and artillery fire continued, but at darkest the enemy retired. Thirteen Union men were killed and

fourteen wounded, four rebels killed and nine wounded. Due to this conflict, Stuart was delayed from meeting up with General Lee until after Gettysburg, and his absence was greatly deplored by the Confederate leader (Gibson, 1886).

“Jeb” Stuart’s adventures through Maryland and Pennsylvania seemed like a comedy of errors. Stuart stopped at Rockville, Maryland. An action that not only hurt the people of Rockville, but also Stuart himself, was the cutting of the telegraph lines. There was no way of finding out if an army had won, lost, or was destroyed totally. Stuart was supposed to supply General Lee with information, but he could not gather enough for his own purposes, let alone giving sufficient information to Lee.

As Stuart made his way northward, he ripped up the Baltimore and Ohio Railroad at Hood’s Mill and burned the bridge at Sykesville, both localities in Maryland. He eventually read in the papers that General Early had reached Wrightsville and therefore was heading through Westminster. He reached Westminster on June 29th, the same day that General Lee’s couriers were attempting to gather the Confederates at Cashtown.

Stuart was still ignorant of the whole situation the following day when he was warned by his scouts that enemy cavalry were in Littlestown. Stuart went on to Hanover, hoping to meet General Early, but instead got surprised by the Federal cavalry.

One last interesting note to share with you. When the Confederates came through York County, several soldiers called at the John Joseph farm, east of East Berlin. They took several horses from the Joseph’s and started to rejoin their comrades. While going down Canal Road toward Dover, they crossed a small stream, and the one horse put his head down as if to drink. When the soldier released the reins, the horse bucked him off. The horse ran home. The soldier followed and recaptured the horse and returned to his companion. When he got to the same stream the same occurrence happened. The two soldiers got into an argument and resulted in the one soldier striking the other over the head with the gun. This injured soldier traveled along the Canal Road to Bigmount where he died from his injuries and was buried along the road, under a cherry tree, almost across the road from the Bigmount schoolhouse stood (Sinner, 1941).

STOP 1 - ROCKY RIDGE COUNTY PARK (NORTH OVERLOOK AND CONGLOMERATE)

One of the best views of northern York County and point east and north is found here. With the more resistant conglomerate underlying the Hellam Hills at this point and the less resistant, softer rocks making up the valleys, this scenic overlook provides us a lovely setting. The most evident landmark is that of Three Mile Island with the cooling towers. In front of Three Mile Island, the tall smoke stack is that belonging to Pennsylvania Power and Light Company's Brunner Island near York Haven. Looking to the west, the most distant peak is that of "Ski Roundtop", located in the Gettysburg-Newark Lowlands Section. To the right of Three Mile Island, the three "peaks" are similar to those of Ski Roundtop, which are composed of diabase. These peaks are located just north and east of Middletown. Looking to the left of Three Mile Island's cooling towers, a river gap can be seen, which is at Goldsboro. These gaps is what makes the Susquehanna River nationally famous. Continuing east, behind the white stack of the Lancaster County Recovery Center, one can spot the brown-pillared building of the Mason Home in Elizabethtown. Looking to the east, the highest elevation of the Hellam Hills is located WGAL TV 8's transmitter and Doppler Radar unit.

One may ask, just how far can you see from this point? On a clear day, the high range in the background is that of Blue Mountain, the first ridge of the Appalachian Mountains above Harrisburg. Continuing this ridge to the east to where it almost disappears, there is a gap in the ridge. This is the location where Pa. Route 61 goes through the ridge heading toward Pottsville, north of Hamburg, Berks County. As a bird flies, this is a distance of 52 miles.

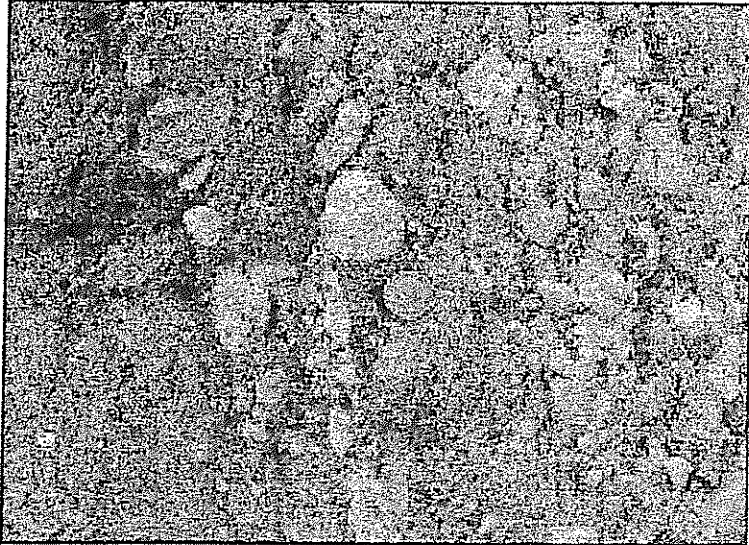
Looking straight out in front of you behind the trailer park below us, you may be able to establish a meandering tree line which marks the position of the Codorus Creek as it flows from North Sherman Street Extended northeastward to the Susquehanna River.

The rock exposed here at the park is known as the Hellam Conglomerate. The conglomerate is the oldest sedimentary unit found in the county and one of the oldest formations in Pennsylvania. The Hellam Conglomerate is a member of the Chickies Formation, named after Chickies Rock in Lancaster County.

Through fossil evidence (a worm boring known as *Scolithus*, which only lived a short time), the conglomerate is considered 620 mya. One theory on its origin suggests that this may have been a delta environment. The velocity of water had to be strong to carry the sized particles seen in the rock, but at other times, had a lesser velocity, only carrying sand-sized particles. Where a body of water flows into a larger body of water, the velocity drops quickly, and the stream drops its load to the bottom.

The majority of the pebbles are composed of quartz. Because of their resistance, one will notice that the pebbles actually "stick up" higher out of the rock. The groundmass is composed

of small crystals of quartz, mica, and chlorite. Upon closer inspection, some of the pebbles are not quartz, but are darker, and more angular in shape. These fragments are rhyolites and basalts (two volcanic rocks making up the older part of the Hellam Hills and will be examined at Stop 3). Evidence of these fragments tells a geologist that weathering and erosion was taking place on the surface, washing those particular rock fragments into a body of water.



Looking at the exposure at a whole, bedding (or sometimes referred to as layering) can be seen in the rock. Some layers contain no pebbles, while other layers contain many pebbles. The layers, when deposited were laid down close to horizontal, but today are tilted. This is due to the various mountain-building events that have affected our Earth in the last 500 million years and recent weathering and erosion processes.

Finally, as mentioned earlier, a fossil, *Scolithus* tubes, have been found in the Chickies Formation rocks. These are known as index fossils, since they may only have existed for 20 million years. Any rock with these tubes in would then be by that age, or in this case, 620 mya. We know that these organisms lived in a very shallow marine water. AS the waves disturbed the bottom, the *Scolithus* fed on small organisms. Because worms are soft-bodied animals, their remains do not fossilize, only leaving their borrows behind for geologists to ponder over.

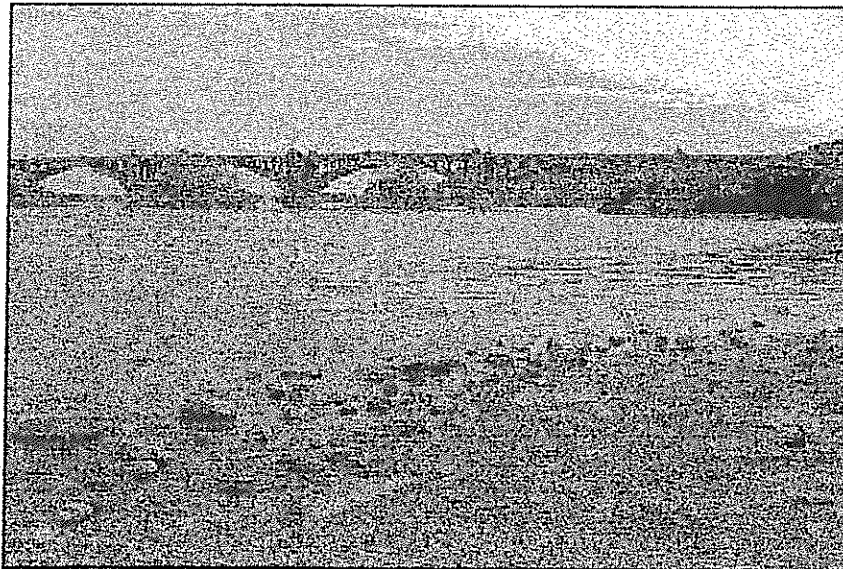
STOP 2 - BURNING OF THE WRIGHTSVILLE BRIDGE

Over its span of history, the Susquehanna River between Columbia and Wrightsville has seen six bridges constructed to make travel across the river easier and allowing early settlers to migrate westward. Two of the bridges now stand which include the Columbia -Wrightsville Memorial Bridge (PA Route 462) and the Wrights Ferry Bridge (U.S. Route 30). The Columbia-Wrightsville Memorial Bridge was opened to traffic in 1930 at a cost of \$2,484,000. The Wrights Ferry Bridge (5,643 feet in length and 86.75 feet wide, spanning 45 piers) was completed on October 20, 1972 at a cost of \$2.4 million dollars.

The four other bridges were situated over the river between two existing structures. The first bridge was constructed about 100 yards south of the Wrights Ferry Bridge. This bridge was 5,690 feet long and 30 feet wide and opened for travel in 1814. Cost of the structure was \$231,171 and it was considered the world's longest covered bridge during this time. A large ice jam destroyed the bridge in 1832. The 32 stone piers can only be seen today when the water is low.

The other three bridges were constructed on the stone piers immediately north of the Columbia -Wrightsville Memorial Bridge. The first bridge built on this site was a covered bridge. The length was 5,620 feet and it was 40 feet wide. It opened for travel in 1834 at a cost of \$128,726 and was owned by the Columbia Bank and Bridge Company. The bridge stood on 27 piers and was used for both foot traffic and railroad. No engines could cross, so the rail cars were pulled across by horse and mule. This bridge is the topic of our conversation, as the North burned

this bridge in 1863 to keep the Federal troops from crossing it.

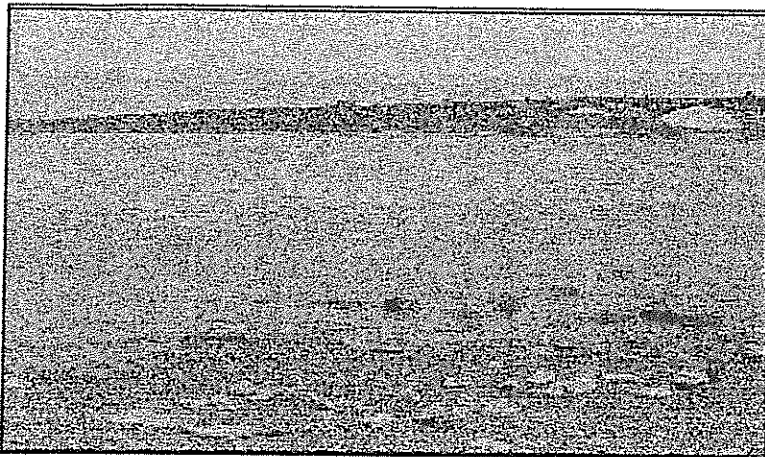


The second bridge built on this site was also a covered bridge, built at a cost of \$400,000. The bridge was 5,390 feet long and 40 feet wide. Two iron spans were placed in the center of the bridge in case of fire. The structure was opened in 1869 and destroyed by a cyclone in 1896. The final bridge constructed on this site was built in 21 working days. It

opened to travel in 1897 and was torn down in 1963. Built at a cost of \$445,000, it was 5,300 feet long. Designed to handle trains on the bottom and automobiles on the top deck, the bridge

was never completed (C. R. Heim).

As the Confederate Army continued their march north through Virginia and Maryland, stories spread throughout southeastern Pennsylvania that the army's goal was to capture both Harrisburg and Philadelphia. In June, the Northern Army began to prepare for a possible invasion, as according to the scouts, the Confederate Army was to cross the Susquehanna River at Wrightsville. On June 15, 1863, General Couch authorized Captain Charles C. Haldeman of Marietta to raise troops, take command of them and arrange for the defense of the Wrightsville Bridge, dams and fords on the Susquehanna River in the section between Wrightsville and Marietta.



At Wrightsville, Captain W. A. Atlee was placed in charge of the militia assigned there. Because a dam was constructed to control the proper water level in the Susquehanna and Tidewater Canal, it was possible, if the water was low, the Confederates could ford the river at that point. Captain W. G. Case, of the Maultsly-Case Rolling Mill of Columbia, started to build emplacements for large guns

on June 12. Case's work consisted of two well-built gun emplacements, each with two cannons. One emplacement was built to cover the dam, just north of the mouth of Strickler's Run. The second emplacement was located at the foot of Grubb's Ridge, just north of Wrightsville and was designed to cover the bridge. The emplacements were built of earthwork and heavy timbers, crescent shaped and about 80 feet wide. The two forts were finished on Saturday, June 20 and both named Fort Case (Nye and Redman, 1963).

It was also during this time in mid June, that residents of northern Maryland, York, Adams, Cumberland and Franklin Counties, began to get nervous about the possible invasion of the Confederates. As the Confederates drew closer, one of the largest migrations ever to hit southeastern Pennsylvania began. Citizens picked up their valuables, belongings, family and animals and moved eastward to escape the invasion. According to witnesses, for nearly ten days prior to the Confederates arrival, there was a steady stream of travelers. At times, the people moving eastward were so large in number that the roads became congested (Van Baman, 1913). The residents that decided to remain either buried or burned their valuables in hopes that the Confederates would not find them. All spare horses were captured and transported to areas east of Columbia.

Companies of home guards were quickly organized and armed under the supervision of Captain Atlee. They were composed of older men and young boys and others who were not already on the battle front. A company of boys from Millersville Normal School, under the

leadership of principal, James P. Wickersham, marched to Columbia and remained several days helping to guard the bridge.

During the afternoon of Sunday, June 28, 1863, the long-awaited event took place at Wrightsville. A brigade of Confederate troops under General Early of General Gordon's division, reached Wrightsville. The division consisted of 2,800 men from Georgia. The two Fort Case's did not interrupt their invasion, as these two emplacements were over run by the enemy. General Frick, who was put in charge of the approximately 100-troop Union defense at Wrightsville was quickly sent retreating eastward across the bridge. The west end of the bridge was barricaded with train cars filled with iron ore.

In the meantime, a party of carpenters were attempting to "pull-off" a miracle to blow up spans of the bridge to block the Confederate advancement. The explosion occurred, but only using black powder because there was not a supply of dynamite accessible, the floor of the bridge remained intact.

Seeing that Wrightsville was now under the possession of General Gordon, the command was given by General Couch to burn the bridge. John Q. Denny, who was in the oil business along Strickler's Run in Wrightsville, assisted by having Jacob Rich deliver two barrels of oil to the bridge. The oil was put on by these two men, applied the matches and soon the structure was a mass of flame.

Since the fire started near the middle of the structure, the northward wind quickly spread the flames toward both sides of the river. The Columbia Fire Department responded to their side of the bridge and laid out hose, but the fire was too intense for the firemen to stay on the bridge. Remembering this bridge was a covered structure, the smoke and flames from the fire cam toward the ends like smoke in a chimney. On the Wrightsville side, the Confederate army also made an attempt to put out the fire, but the borough residents hid all of the hoses and buckets. However, when the fire came closer to Wrightsville, buckets and hoses and the fire wagon quickly appeared. The bridge burned all night and part of the next day, slowly dropping the burning timbers into the river and flowing downstream. One can imagine the people who lined the shores to watch the fire. It was also feared that the flames may spread into both Columbia and Wrightsville to further consume buildings. In Wrightsville, only six buildings were lost.

It is interesting to note that the bridge's owner, Columbia Bank and Bridge Company, has never been reimbursed by the federal government, since the government authorities gave the command to burn the bridge. It is reported that each local succeeding representative in Washington, D.C. has introduced bills to do so (C. R. Heim).

During his short stay in Wrightsville, General Gordon used a house located on the south side of Hellem Street as his headquarters. Mary Jane Magee Rewalt, who was living in the home of her father, James f. Magee, chief burgess of Wrightsville, invited General Gordon and his staff to her house for breakfast the day after the fire to show her appreciation to the Confederates for assisting to save Wrightsville from the fire. During the course of the meal, Mary Jane told the General that she hoped the North would be saved from the war. Mary Jane's husband, Dr. Luther

L. Rewalt was a surgeon assigned to the 25th Pennsylvania regiment.

General Gordon also stayed in a large colonial-style house on East Market Street in York, near the Springettsbury Fire Department while moving through York.

STOP 3 - ACCOMAC ROADCUT (METABASALT)

This road cut is the best exposure of the oldest rock in York County and one of the oldest in Pennsylvania. The rock is known as a metabasalt, but its origin was from volcanic activity over 820 million years ago. However, recent thought is that the metabasalt may only be about 700 mya (Drake, 1999). This rock is the oldest rock in the Hellam Hills, making up the foundation of the highlands. Because the oldest rock is now exposed at the surface here, geologists would call this a "window", since we can "look" down through the overlying rock to see the core. The Pigeon Hills, located to the west of York, also contains the metabasalt as its foundation. The "meta" used in this name comes from later tectonic activity, where these rocks were shifted and heated, slightly changing the composition of the rock. The process is known as metamorphism (Stop 6). This formation has also been correlated with the volcanic rocks (basalt and rhyolite) found in the Blue Ridge Province near Caledonia State Park in Franklin County, Laurel Lake in Cumberland County and near Mt. Hope in Adams County and are mapped as the Catoctin Formation, named for their fine exposures in Catoctin Mountain, Maryland.

Upon inspection of the rock, the greenish color is characteristic of this rock. The mineral



composition is epidote, hornblende, chlorite, quartz, feldspar and magnetite (Stose and Jonas, 1939). The rock's color is mainly from the epidote and chlorite, which gives it its nickname "greenstone." Large, rounded areas of quartz, epidote, chlorite and magnetite as known as amygduls, which are lava gas pockets that have been filled in with mineralization. Also, minor amounts of malachite (Copper sulfide) have also been seen. Near Mt. Hope,

Adams County, large copper deposits have been mined from the basalts (Stose, 1910). In some cases, cavities in the basalt are caused by the weathering of the amygdules. In some cases, evidence of flow structures can be seen and the amygdules have been flattened parallel to the flow direction through late tectonic events. The rock has veins of epidote and asbestos, which formed following the crystallization of the lava. It has been reported that in several cases, significant asbestos has been found in this area to make it "almost economical valuable."

Exactly where the volcanic vents that produced this rock were located isn't known. Due to extensive weathering and erosion and mountain-building processes, much of the needed information has been destroyed. Associated with the metabasalts are also metarhyolite (a volcanic rock rich in quartz and potassium feldspar) and volcanic slate. Windows of these rocks continue

westward to as far as the east end of Rocky Ridge County Park.

So how did volcanic activity originate in York County? If you were to live in the area say some 700 mya, the world then was much different. It is theorized that all of the landmasses were joined as one (similar to Alfred Wegener's Pangaea some 300 mya). After 820-700 mya, this



supercontinent began to split apart. As the splitting continued, magma came up from the Earth's interior to fill in the fractures. The rocks of the Catoctin Formation seem to represent this event which led to the opening of the Iapetus Ocean (proto-Atlantic Ocean; Cooper and Jones, 1977). Rankin (1976) states that the bimodal volcanic suite (basalt and rhyolite) support a rift environment. One possibility of the origin of the Catoctin Formation can be interpreted to indicate either a two-stage event or a very long episode of continental rifting. The basalt was later metamorphosed through at least one and perhaps two episodes of "mountain building" processes,

including the collision of the continents to form Pangaea (325-300 mya) and a collision with a volcanic island arc with eastern North America (425-400 mya).

STOP 4 - LOCUST LANE ROADCUT (KINZERS FORMATION)

We have now moved from the Hellam Hills out into what is locally known as the York Valley, which is predominantly underlain with carbonate rocks (limestone and dolomite). However, this exposure was chosen because the outcrop here is one of the best appearances of the Kinzers Formation shale unit. The Kinzers Formation is named from its good exposures in Kinzers, Lancaster County. The formation has been divided into three units. Stose and Jonas (1939) recognize a lower member (shale); middle member (limestone) and upper member (limestone). More recently, Ganis and Hopkins (199) have proposed a new stratigraphic sequence for the Kinzers Formation:

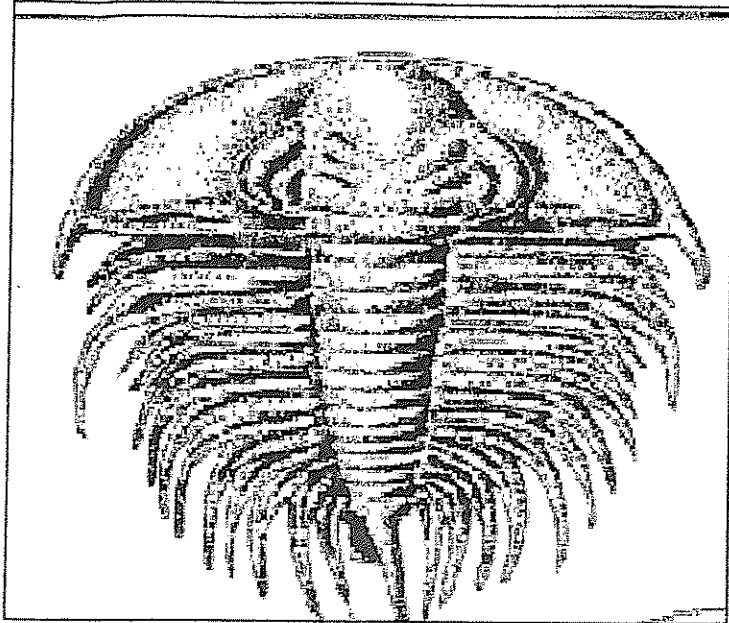
Emigsville Member	predominantly shale	100 - 200 feet thick
York Member	limestone and dolomite	1000-1200 feet thick
Greenmount Member	very impure limestone	50 - 180 feet thick

The Kinzers Formation is the most fossiliferous unit in southeastern Pennsylvania. The formation in Lancaster County has yielded the most fossils, but several sites in York County have produced fossils. The most famous fossil identified are those of trilobites. With the aid of the trilobites, the Kinzers Formation is now assigned to the Lower Cambrian period (570-530 mya). In the past, trilobite specimens have been collected by C. D. Walcott and C. Schuchert in the late 1800's from a site two miles north of York (Reeser and Howell, 1938). Other recent sites in York County include the Shiloh site on Pa. Route 74 near Loucks Road and the Holidrome an along Bull Road adjacent to the Yorktowne Golf Club.

In 1997, an amateur fossil collector found a complete trilobite here. This just goes to prove that new finds are always possible with a little luck and knowledge. This exposure represents the Emigsville Member of the unit, the oldest layers of the Kinzers Formation.

Trilobites are the first unequivocal arthropods to appear in the fossil record. Their shells represent the beginning of the Cambrian Period and the start of the Paleozoic Era, a time that organisms flourished in the seas. They became extinct at the end of the Paleozoic. During this 345 million years, more than 1,500 genera, with about 4,000 species evolved. For a group this large and long-lasting, trilobites show unusual consistency of form, especially compared to crustaceans, which evolved into a tremendous variety of forms. This lack of "evolution" might be explained by the failure of trilobites to develop specialization in the form and function of their legs. The trilobites could never exploit more than a limited number of ecological niches. Trilobites are so named because of their three body parts" head, thorax and tail. Although the undersides of trilobites are rarely preserved due to the lack of being calcified, evidence shows that there was a pair of antennae on the head, and a series of legs. Each leg was bifunctional; a long, segmented part for walking and another branch bearing a fine fringe of blade like filaments for

respiration. Most later trilobites had the ability to roll up for protection, but the early trilobites identified from the Kinzers Formation, did not have that ability.



Olenellus trilobite (from Ryan, 1986)

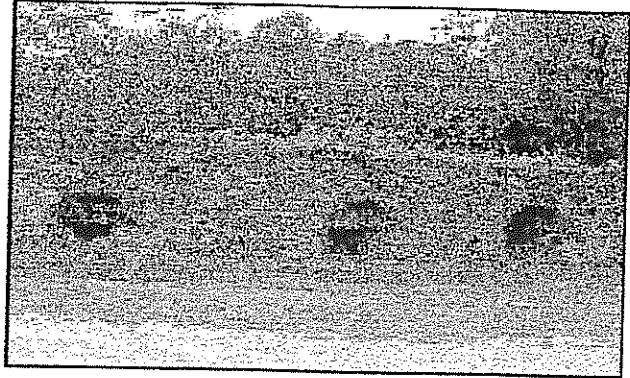
The trilobites found here, *Olenellus*, is one of the primitive trilobites. Although *Olenellus* is probably the most common trilobites from the Kinzers, other species identified include *Paedeumias* and *Wanneria* (Hoskins, 1969; Jonas and Stose, 1930). As mentioned earlier, these species of trilobites represent the Lower CAMBRIAN some 570 mya. The trilobites lived in the shallow portion of the Iapetus Ocean. At this stop, we are looking at sediment which was deposited in the ocean at least 130 million years after the origin of the Iapetus Ocean as seen at Stop 3.

One final principle of geology to illustrate here. One will notice that the shale is tilted toward the road (south). Geologists refer to this as the dip. Remembering that when sediment is deposited, the layers are near to or horizontal. Since these layers have been tilted to about 35 degrees, this means that some force(s) have acted on this rock to push them up. If you imagine a line marking the direction of dip, another line perpendicular to the dip is known as the strike, which is a compass point following the strata. For example, if the dip is to the south, the direction of strike would be either to the east or west.

Using the law of superposition, the oldest layer would be the lowest layer exposed, which would be the shale closest to the road. The youngest layer would be that located nearest to the top of the bank. Remember, each layer represents a certain period of time where sediment was deposited on the floor of the Iapetus Ocean. Just how many years are represented here is hard to calculate, but it would be measured not in thousands of years, but millions!!

STOP 5 - THE BAKER REFRACTORIES QUARRY

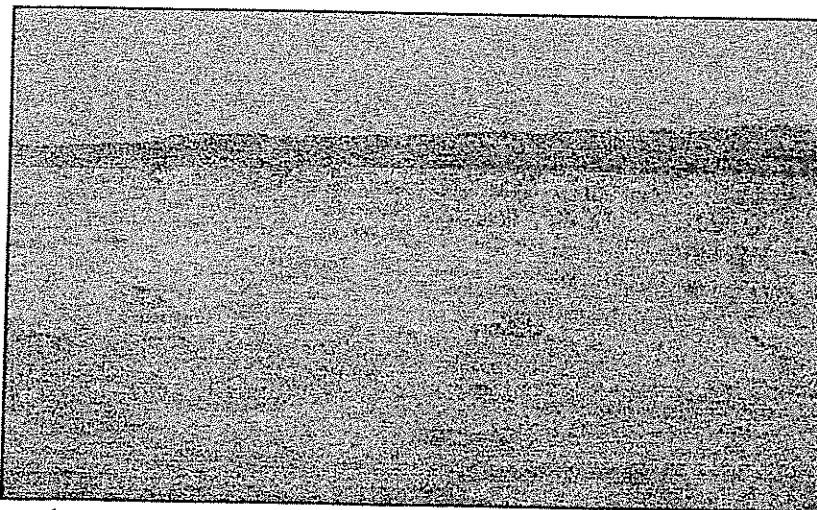
Baker's Refractories first venture began in 1889. Founder John E. Baker started a company (Wrightsville Lime Company) to burn lime that was sold locally for plaster, whitewash and as a soil conditioner. The J. E. Baker Company was the first American company to produce and offer standard roasted dolomite as a refractory repair and maintenance material for the bottoms of open-hearth steel-making furnaces.



Kiln remains in Wrightsville

In March, 1946, Baker purchased this property known as the Franklin Menges farm. It was identified for having a rich supply of dolomite. In mid-1950's, the farm was officially named the York Plant of the J.E. Baker Company. The first furnace, a 10-foot by 300-foot rotary kiln was purchased and installed in 1952. A second rotary kiln was added in 1959.

By 1960, Baker remained a single product company that sold various grades and sizes of dead-burned dolomite. In 1964, the Dolomite Brick Corporation of America, a Baker subsidiary, acquired the technology to produce shaped refractories. This opened the market for dolomite kiln



liners. Product lines have expanded so that Baker now supplies refractory bricks to electric furnaces, ladle furnaces, ladles, stainless steel furnaces and cement and lime producing rotary kilns. The company can also produce a line of high-purity accessory products including rams, mortars, vibratables and shapes for maintaining and repairing furnace linings. In addition to all of these products, Baker still

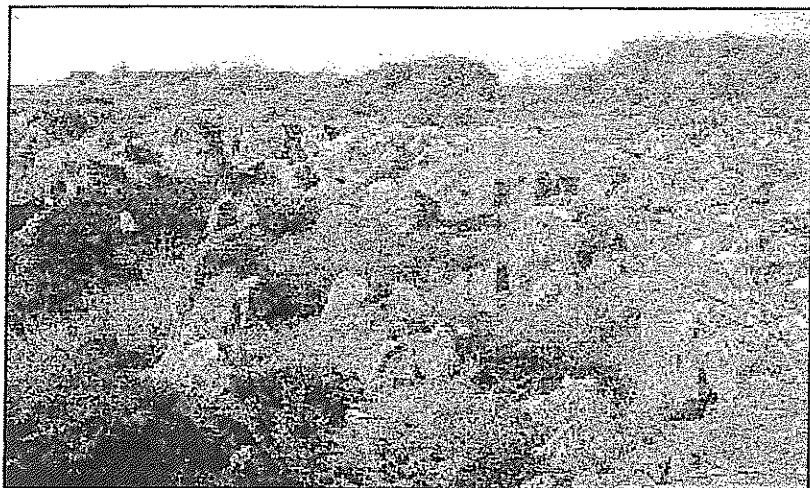
produces dead-burned dolomite. The three plants at the West Manchester Township site along with the main office located in downtown York, employ well over 600 people.

The main quarry presently occupies in excess of 85 acres. The depth of the quarry is in the process of being extended to approximately 250 feet. The quarry is now about 0.6 miles long and 0.25 miles wide. About 1 million tons of rock is removed each year. Over 32 million tons

and 0.25 miles wide. About 1 million tons of rock is removed each year. Over 32 million tons have been removed since the start of production. Vulcan Materials Company, the largest aggregate company in the United States, has recently set up a plant on this site. Vulcan will take rock that does not meet Baker's chemical specifications, and use it for the production of construction materials.

The rock quarried here belongs to the Ledger Dolomite formation of Middle Cambrian age. The formation is at least 1000 feet thick and contains chiefly pure dolomite (Stose and Stose, 1944; Ganis and Hopkins, 1990). The Ledger in this area can be subdivided into three units: the Lower Dolomite Member composed of light gray very pure, coarsely crystalline, oolitic dolomite; the Willis Run Member here a discontinuous unit composed mainly of dark gray algal limestone, and the Upper Dolomite Member composed of gray, fine to medium crystalline, slightly impure dolomite (Ganis and Hopkins, 1990). Within the quarry, bedding (layering) is usually obscured due to the thickly bedded nature of the formation and extensive faulting. Mining operations in the northwest corner of the quarry have recently exposed the unconformable contact with the overlying Triassic age rocks along the southern edge of the Gettysburg basin. Several paleokarst (Triassic age caves) features are also exposed in the west face of the quarry.

The high purity and oolitic nature of the Lower Dolomite Member suggest a carbonate platform and/or platform margin environment. This evidence, along with additional information



from the underlying and overlying formations in the Conestoga Valley, suggest that this was the eastern edge of the North American continent during the Cambrian and Early Ordovician time (Ganis and Hopkins, 1990).

A second pit was opened in 1990 on the east side of Baker Road, and south of East Berlin Road. This pit has produced approximately 400,000 tons of

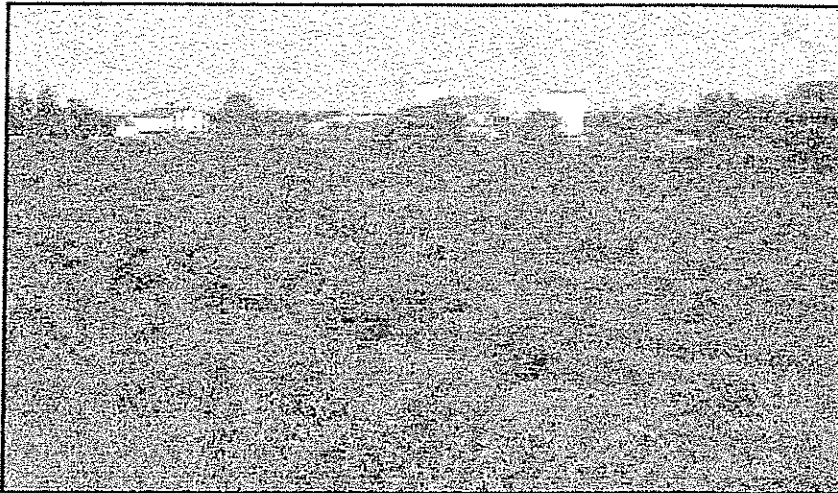
clay, primarily for landfill applications. This area will also eventually be quarried. Several interesting geologic features have been exposed in this pit. This pit contains an algal reef complex that has generated much academic interest. This pit has also generated the first fossils ever found in the Ledger Dolomite formation. Another interesting feature found here are the large pinnacles weathered in the limestone and dolomite.

The Baker Refractories Company goes to great lengths in order to be a good neighbor in the community. Extensive use of berming and tree plantings is utilized to help reduce the visual impact of the operation. Blasting operations at the quarry are always monitored with a

seismograph, and every effort is made to help keep vibration levels and air blast levels to a minimum. Baker in conjunction with Strathmeyer Forest Inc., has planted over 300,000 Christmas trees on various areas of the property. This has helped to create a greenbelt around the operation, and offers excellent wildlife habitat.

After all quarrying is completed, the property will be reclaimed. In the case of the Baker Refractories quarry, the following will occur:

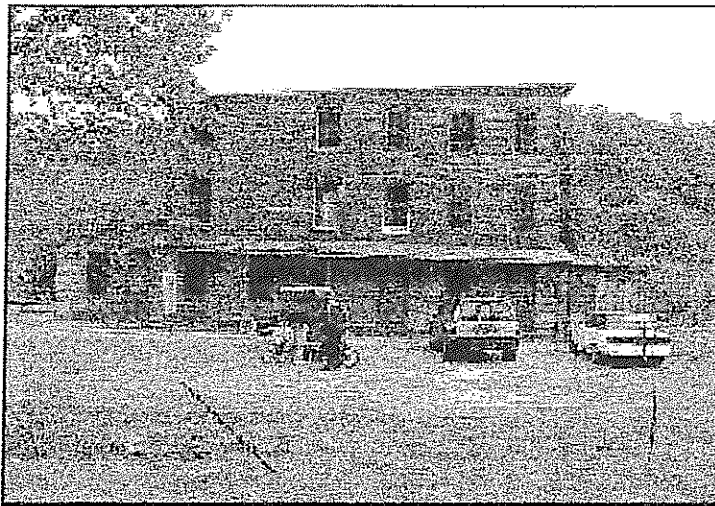
1. All buildings will be removed.
2. All berms will be leveled
3. Any pits will be allowed to fill with water.
4. All exposed quarry faces will be sloped to a minimum of 30 degrees (this slope must extend 50 feet below the projected water level).
5. All disturbed areas will be covered with topsoil and seeded.



STOP 6 - HANOVER JUNCTION (CONFEDERATE INVASION AND METAMORPHIC ROCKS)

We have now moved to the Piedmont Uplands Section, which is predominantly underlain with metamorphic rocks. This stop brings up along the old Northern Central Railroad and to the “infamous” Hanover Junction station. Several notable worth mentioning occurred here during the Civil War., but first, just how did Hanover get here?

As with most of the small towns in southern York County, the railroad had a big influence. It was the outward networking, primarily by the railroads, that was the County’s greatest influence on the way our “community” is laid out today. Towns like Seven Valleys, Hanover Junction, Glen Rock, New Freedom and York Haven would still be “was behind times” if it were not for the railroad. It was the topography of our County that also determined where the railroads would run and control the growth of our communities.



The building at Hanover Junction was constructed by the Hanover Branch Railroad in 1849. The Hanover Branch Railroad, which chartered in 1847, ran from here northwestward through Jefferson and into Hanover. It was the development of this line that products could more easily travel to Baltimore rather than Philadelphia. The building was used as a hotel until 1877 (Gibson, 1886). Just south of here was a coal chute and water tank. A 30-horsepower engine was used to force water from the Codorus Creek to the cars.

The first train ran through Hanover Junction in September, 1852 with the beginning of the Northern Central Railroad. In the 1800’s, the Northern Central Railroad was the only line that transverse Pennsylvania north to south. At that time, the tickets cost \$0.25, which included a meal. By the 1860’s, it was used to ship iron ore and ice cream to Baltimore. It also was the telegraph center for two railroads, the Northern Central and Hanover Branch. The first telegraph was sent from Hanover Junction on April 10, 1852. The message was a congratulatory one from Hanover Junction to Hanover which was replied to by the President of the Hanover Company.

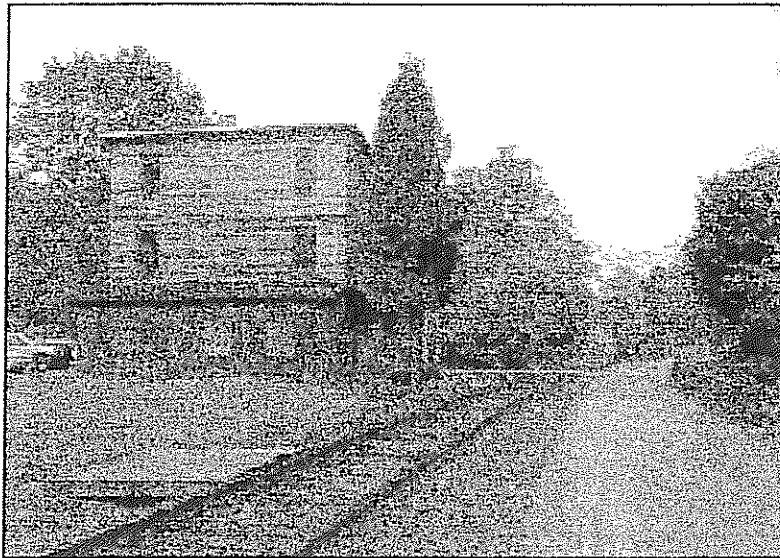
Hanover Junction was an important station during the Civil War. On June 27, 1863, just a few days before the Battle of Gettysburg, a little skirmish occurred here. Confederate Colonel White and his troops came to Hanover Junction to destroy the telegraph station. This attack came immediately after being involved in the Battle of Hanover the same day. Union soldiers were

guarding the station, but when they saw the Confederate brigade, they fired their cannons and fled. The telegraph operators escaped by hopping onto a passing train. The wires were cut by White's men and a covered bridge was burned just south of here. The Union soldiers had the telegraph working the next day, just in time to send information from President Lincoln to General Meade in Gettysburg.

Another attack on Hanover Junction by Jeb Stuart was foiled by a funeral and a farmer. As his troops came up the road, mourners at a funeral at Zeigler's Church saw them and sounded the alarm. Since they had been seen, Jeb decided to wait until the next day. For the night, they "took over" a local farm believed to have been located on Schaffer's Church Road just to the west of here. But, at the farm that night, Jeb's soldiers got drunk, and their horses were stolen by the farmer.

After the Batt of Gettysburg, over 11,000 wounded men passed through Hanover Junction on train, headed for military hospitals in either York or Baltimore.

On is way to make the Gettysburg Address, President Lincoln's train stopped here. It is rumored that Lincoln wrote his address here, but that cannot be verified. Several photographs still exist today showing Lincoln standing here. President Lincoln's funeral train, which included one engine and eight cars, also rode the Northern Central Railroad on the way back to Illinois, stopping here to receive water for the engine. Although York County votes did not support President Lincoln during the election, a large crowd gathered along the tracks to give their last respects to Abraham Lincoln.



The now abandoned Northern Central Railroad is used by the Liberty Limited train excursion originating out of New Freedom. The track and the adjoining trail belongs to the Heritage Rail Trail County Park, extending from the City of York, southward for 22 miles to the Mason Dixon Line. Here the trail meets the Gunpowder Falls Rail Trail, which goes another 22 miles into Maryland. The train stations at New Freedom and Hanover

Junction are being restored through a grant from the York County Planning Commission.

GEOLOGY:

As mentioned earlier, we have now traveled from the Lowland Section to the Upland Section of the Piedmont - but just barely. The train station is located in the Marburg Formation, which is named for the small village of Marburg five mile southeast of Hanover. The rock is a schist, which is metamorphic. Originally, probably being a sedimentary rock, the rock went through several different episodes of heat and/or pressure, which changed the mineralogy of the original rock into a new distinct rock type. Minerals found in the Marburg include: muscovite, chlorite, albite and quartz. Small mica flakes is what gives the rock a silky appearance and the chlorite gives the rock a light greenish color. Thickness of the formation is difficult to determine due to the intense folding that has occurred, but estimates do not exceed 500 feet (Stose and Jonas, 1939).

Located immediately to the north of Hanover Junction is the Conestoga Formation, a limestone unit belonging to the Lowlands Section. The formation is named for its exposures along the Conestoga Creek near Lancaster. Although no fossils have been found in the area, the Conestoga is considered Cambrian to Lower Ordovician in age (Kauffman, 1999). The City of York sits entirely on the Conestoga Formation. Also, within this formation, limestone megaconglomerate and megabreccia have been found, containing blocks up to 30 feet across (Taylor and Durika, 1990). Thickness of the Conestoga appears to be at least 1,000 feet (Ganis and Hopkins, 1990).

The line separating the Conestoga Formation with the Marburg formation is one of importance. This is the location of the Marti Line (or called Marti Overthrust). The Marti Line has been one of the most debated topics in southeastern Pennsylvania geology. According to Jonas and Stose (1930), the type site in the railroad cut at Marticville, Lancaster County, plainly shows a thrust fault. However, other interpretations of the railroad cut and exposures elsewhere throughout the district feel that the fault does not exist. It is however, at least, a line that separates the relatively unchanged predominantly sedimentary rocks to the north with moderate metamorphic rocks to the south. The debate goes on!!!!

It is worthy to note that the Marti Line in Lancaster County has been the epicenters of several earthquakes in the last 200 years. (Scharnberger, 1989). One of the largest earthquakes in southeastern Pennsylvania occurred on April 22, 1984, when a 4.3 magnitude seismic event hit the area. It was first believed the epicenter was located on the Marti Line, but further investigation put the epicenter along a north-south trending fault close to where it intersected with the Marti Line.

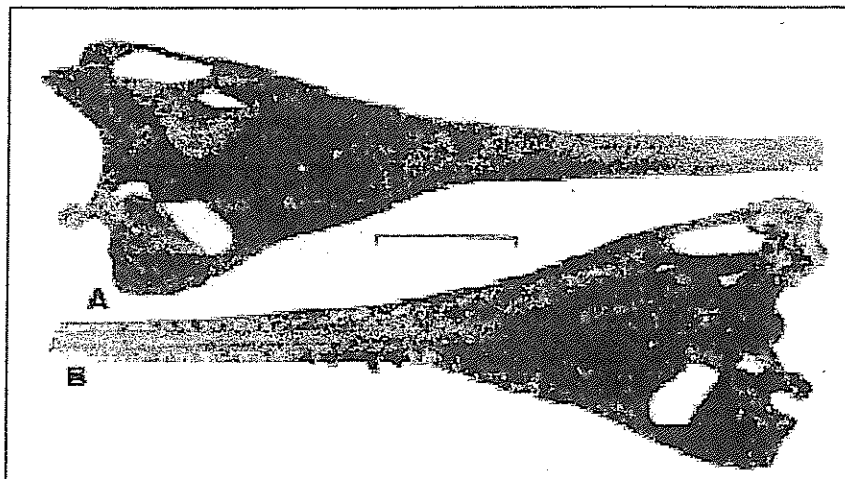
From here, the Marti Line travels to the northeast through Jacobus, Dallastown and exits the county near Long Level. The Marti Line continues through Lancaster, Chester and Montgomery counties, where it intersects another fault system. Striking southwestward, the Marti Line travels through Lake Marburg in Codorus State Park, south of Hanover and continues into northern Maryland.

STOP 7 - ZIONS VIEW TRIASSIC VERTEBRATE SITE

The last stop is probably the most significant Triassic fossil site in Pennsylvania. Exposed here are rocks belonging to the New Oxford Formation, a formation dated at 208 mya and named for New Oxford, Adams County. Stose and Jonas (1939) suggest a thickness of just over 100 feet. The rock unit is composed of mostly red shales, siltstones and sandstones, with minor occurrences of limestone toward the top of the formation. A conglomerate marks the base of the formation where it comes in contact with the older Paleozoic rocks to the east and south (as observed at Stop 5).

Dr. Robert Spangler Stahle discovered this site in 1909 after hearing of stories that “dinosaur” bones were found along the Little Conewago Creek near Manchester. Dr. Stahle continued his efforts until 1912. A second round of research occurred here in the early 1970’s under the supervision of The State Museum of Pennsylvania. Part of the collection accumulated by Dr. Stahle is now at the Academy of Natural Sciences in Philadelphia, and at Princeton University Collection of Yale Peabody Museum in New Haven, Connecticut. The collection made in the early 1970’s by former Earth Science Curator, Don Hoff, of the State Museum, is at the museum.

Fossils identified here include clam shrimp and unionid valves, which have not been studied. Isolated scales of bony primitive fishes, as well as coprolites are common. What has really made this site significant is the finding of a group of crocodile-like reptiles known as phytosaurs and metoposaurs, an ancient amphibian. Some phytosaurs were as much as 30 feet long. All were predators who lived along the Triassic rivers and lakes. A metoposaur looked something like a salamander, but sometimes grew up to six feet long and believed to have been fish eaters.

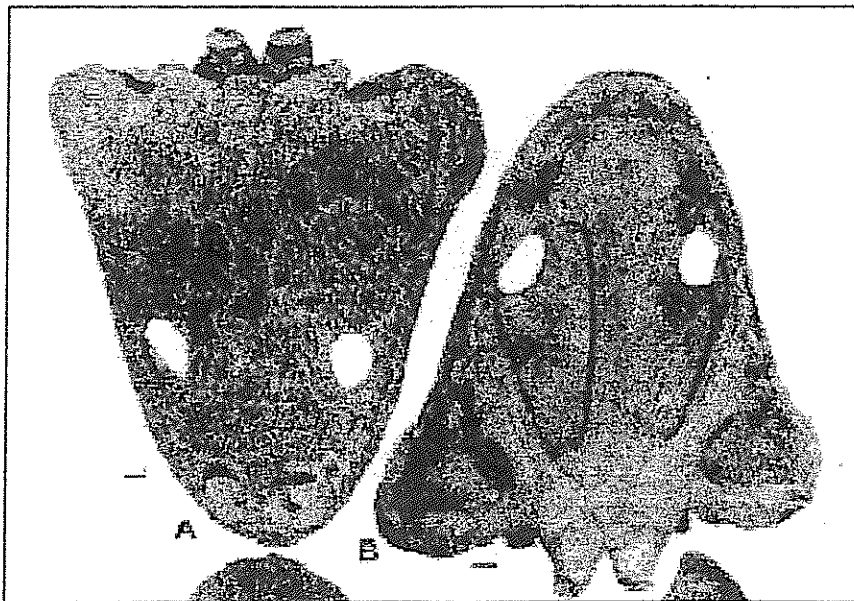


RUTIODON SKULL (From LUCAS AND SULLIVAN, 1996)

At Zion's View, most of the vertebrate fossils belong to the phytosaur, ranging assortment of isolated teeth and bone material, other than the skull and jaws. One of the most significant finds here actually was in 1995, when two researchers (Doyle and Sues) identified a phytosaur skull as *Rutiodon carolinensis*. A metoposaur amphibian skull was earlier identified as *Buttneria perfecta*.

Of course, fossils are very important to geologists of interpreting what the environment was like during a given time. At Zion's View, the fossils suggest a freshwater lake as represented by the bivalves, clam shrimp and fishes. The thinly laminated shales of the New Oxford Formation correspond to thin layers of mud normally formed in lakes. Interbedded layers of shaly sandstone and conglomerate also suggest a periodic flow of water, perhaps similar to what might occur on beaches or at river mouths along a shore. The phytosaur and metoposaur were animals that lived in lakes and rivers and part on land. (Lucas and Sullivan, 1996).

Triassic fossils are not common by any means, but important when found. Over the past 100 years, dinosaur footprints have been found near Yocumtown, Goldsboro in York and County and near York Springs and Gettysburg, in Adams County (Jones, 1999). Localities producing other finds in York County include teeth from a primitive, bird-hipped dinosaur at the LeCron's Copper Mine near Emigsville (Cope, 1878) and Wanner (1921) described fish and phytosaur fossils along the Little Conewago Creek near Manchester. Along with animal fossils in the Triassic area of York County, there have been several localities described containing petrified wood and fern fossils within the New Oxford Formation. Occurrence have been found near York Haven, Dover, Manchester, and York haven areas. The plant remains support a tropical climate.



BUETTNERIA SKULL (From LUCAS AND SULLIVAN, 1996)

FURTHER READING

- Banner, Glenn, 1994. *Flames across the Susquehanna*. Brookshire Printing, Inc., Lancaster, PA.
- Chrastina, Paul C., and Jones, Jeri L., 1989. *Whispering Hills: The geology of York and Lancaster counties*. Matrix Publishing, Dillsburg, PA
- Cooper, Peter P., and Jones, Jeri L., 1977. *Speculation on the origin of the Carolina Slate in central North Carolina*. Catawba College Museum of Anthropology, Spec. Pub. 1.
- Cope, E. D., 1878. *On some saurians found in the Triassic of Pennsylvania*, by C.M. Wheatley. *Proceedings of the American Philosophical Society*, v. 17, p. 177.
- Doyle, K. D., and Sues, H. D., 1995. *Phytosaur (Reptila, Archosauria) from the Upper Triassic New Oxford Formation*. *Journal of Vertebrate Paleontology*, vol. 1, p. 545-53.
- Drake, Avery Ala, Jr., 1999. *Precambrian and lower Paleozoic metamorphic and igneous rocks - South Mountain and Reading Prong* in *The Geology of Pennsylvania*. Charles H. Schultz, editor. Pennsylvania Geologic Survey, 4th ser., Special Pub. 1. Harrisburg, PA.
- Ganis, G. Robert, and Hopkins, David, 1990. *The West York Block: Stratigraphic and structural setting* in *Carbonates, schists, and geomorphology in the vicinity of the lower reaches of the Susquehanna River*. 55th Annual Field Conference of Pennsylvania Geologists Guidebook. Pennsylvania Geologic Survey, 4th ser., Harrisburg, PA.
- Gibson, John, 1886. *History of York County, Pennsylvania*. F. A. Battey Publishing, Chicago.
- Heim, C. R. _____. *The bridges between Columbia and Wrightsville, Pennsylvania*. Columbia, PA
- Hoskins, Donald M., 1969. *Fossil collecting in Pennsylvania*. Pennsylvania Geologic Survey, 4th ser., General Geology Rept. 40, 2nd ed.
- Jonas, Anna I., and Stose, George W., 1930. *Geology and mineral resources of the Lancaster Quadrangle*, Pennsylvania Geological Survey, 4th ser., Atlas 168.
- Jones, Jeri L., 1981. *Geologic Guide to York County, Pennsylvania*. York Rock and Mineral Club, Special Publication 2.
- _____, 1995. *Time Walk - The geology of York County* video. Kondor Teleproductions, York, PA

- _____, 1996. Time Walk - The Delta Story video. Kondor Teleproductions, York, PA
- _____, in press. Triassic Park - Dinosaurs of York and Adams counties, Pennsylvania. video. Kondor Teleproductions, York, PA
- Kauffman, Marvin E., 1999. Eocambrian, Cambrian and transition to Ordovician *in* The Geology of Pennsylvania. Charles H. Schultz, editor. Pennsylvania Geologic Survey, 4th ser., Special Pub. 1. Harrisburg, PA.
- Lucas, Spencer G., and Sullivan, Robert M., 1996. Fossils provide a Pennsylvania standard for part of the Late Triassic time. Pennsylvania Geology, vol. 27, no. 4.
- Reeser, C. E., and Howell, B. F., 1938. Lower Cambrian *Olenellus* zone of the Appalachians. Geologic Society of America Bull., vol. 49. p. 205-248.
- Ryan, John E., 1986. New Cambrian fossil locality in Lancaster County. Pennsylvania Geology, vol. 17, no. 5.
- Schafer, Thomas L., 1999. York County at 250: Patterns of our Past. York County 250th Anniversary Commission, York, PA
- Scharnberger, Charles K., 1989. Earthquake Hazard in Pennsylvania. Pennsylvania Geologic Survey, 4th ser., Educational series 10.
- Stose, George W., 1910. Copper deposits of South Mountain in southern Pennsylvania. U. S. Geological Survey Bulletin 430.
- _____, and Stose, Anna I., 1939. Geology and mineral resources of York County, Pennsylvania. Pennsylvania Geologic Survey, 4th ser., County Rept. 67.
- Taylor, John F., and Durika, Nancy J., 1990. Lithofacies, trilobite faunas, and correlation of the Kinzers, Ledger and Conestoga formations in the Conestoga Valley *in* Carbonates, schists, and geomorphology in the vicinity of the lower reaches of the Susquehanna River. 55th Annual Field Conference of Pennsylvania Geologists Guidebook. Pennsylvania Geologic Survey, Harrisburg, PA.
- Wanner, H.E., 1921. Some faunal remains from the Trias of York County, Pennsylvania. Proceedings of the Academy of Natural Sciences, Philadelphia, vol. 73, p. 25-37.
- Weishampel, David B., and Young, Luther, 1996. Dinosaurs of the East Coast. The John Hopkins University Press, Baltimore.