HARRISBURG AREA GEOLOGICAL SOCIETY
22ND ANNUAL FIELD TRIP, MAY 4 2013

SOME GEOLOGICAL ASPECTS OF THE NORTH SIDE OF THE CUMBERLAND VALLEY IN CUMBERLAND COUNTY, PA

Aerial view of the Opossum Creek drainage basin.

SOME GEOLOGICAL ASPECTS OF THE NORTH SIDE OF THE CUMBERLAND VALLEY IN CUMBERLAND COUNTY, PA

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INTRODUCTION

Cumberland County, PA is part of the Great Valley Section of the Ridge and Valley Province (Sevon, 2000). The area known as the Cumberland Valley has contrasting geology between the north and south sides of the valley. The south side is underlain by carbonate rocks, limestones and dolomites, that have irregular topography, scattered outcrops, and an indefinite drainage pattern.

In contrast, the north side of the valley is underlain by the Martinsburg dark gray shale. "The Martinsburg Formation is separated into three members west of Carlisle ..... In the upper and lower members, dark-gray shale is dominant, but thin interbeds of siltstone and fine-grained greywacke are common, especially in the upper member. The shale weathers either into smooth, planar, dark-orange-brown planes if cleavage and bedding are nearly parallel, or into rough pencil-like fragments if cleavage intersects bedding at a high angle.

A greywacke member several hundred feet thick separates the two shale sequences. The greywacke is progressively thinner to the east, as coarser grained beds are supplanted by siltstone and shale that cannot be distinguished from similar rocks in the upper and lower parts of the Martinsburg. The greywacke weathers dark brown, is moderately well sorted, and is fine to medium grained, but it contains some coarse-grained beds. The beds usually range up to several feet thick, but massive beds also occur. Shale interbeds increase towards the top and base of the greywacke sequence." (Becher and Root, 1981, p. 71).

Despite the several references relating to the Cumberland Valley (Becher and Root, 1981, 1982; Root, 1971, 1977, 1978; and Carswell, et. al., 1968) the amount of detailed information on the Martinsburg west of the Susquehanna River is minimal. East of the Susquehanna River more recent information is present in Wise and Fleeger (2010a and b).

The Martinsburg in the Cumberland Valley is part of the north side of an anticlinorium whose axis runs through South Mountain. The Martinsburg in Cumberland County may be structurally more complex than indicated in the above cited reports. The amount of good exposure is limited and to my knowledge no one has done the detailed work that Ganis and Blackmer (Wise and Fleeger, 2010a, p. 67-75; Wise and Fleeger, 2010b, p. 81-94) have done east of the Susquehanna River.

Some of this is not terribly important to this trip because the emphasis is mostly focused on the geomorphology, not the character or structure of the rocks as a whole. When we examine the drainage patterns that occur on the north side of the valley in Cumberland Co. (Fig. 1), what we find is that 25, well-defined streams originate on the lower slope of Blue Mountain to the north. These streams flow southward creating small drainage basins and eventually junction with Conodoquinet Creek that flows eastward to enter the Susquehanna River.

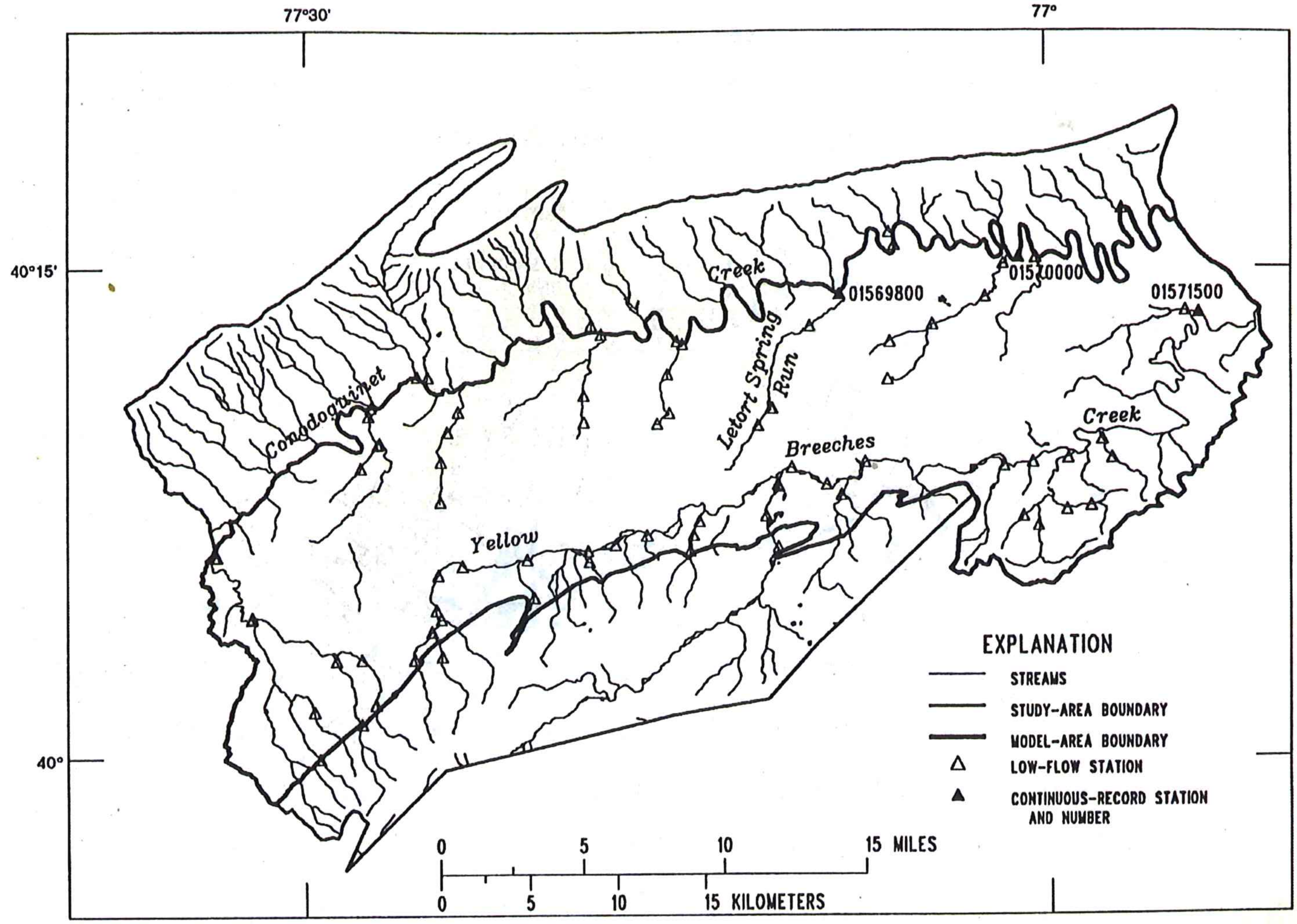

Figure 1. Map showing the drainage patterns of the many small streams in Cumberland Co.

Note in Figure 1 that the small drainage basins have similar orientations and that those orientations change west of Doubling Gap, the large valley that extends NE from approximately 40°15’, 70°30’. Measurements of these orientations done by drawing straight lines parallel as possible to the individual streams, gave the following results. East of Doubling Gap, the streams are oriented N29°W-S29°E and west of Doubling Gap, N39°W-S39°E. Blue Mtn. crest east of Doubling Gap is oriented N83°E and west of Doubling Gap, N52°E. Thus, east of Doubling Gap the streams are oriented less than 90° to the crest of Blue Mtn. whereas west of Doubling Gap they are oriented at nearly 90° to the crest. Why the change? I have no answer. It may have some relationship to joints, but probably not. The only good statement about joints in the Martinsburg occurs in Root (1971, p. 80) who gives the orientation of the joints in NE Franklin Co. as N60°W-S60°E. This orientation does not have any apparent relationship to the stream orientations.

The streams have orientations that are related to some geological aspect, but one that is not clear to me. Sorry. Of more interest is the landscape within the drainage basins themselves. In many of the drainage basins some of the lowest eroded parts of the basin occur in the upper part of the drainage and some of the highest parts occur near the stream junction with Conodoquinet Creek. This is particularly true of the Opossum Creek drainage basin that will be the subject of discussion at Stops 4 and 5. Figure 2 gives some indication of the nature of this topographic phenomena. The figure focuses on Opossum Creek drainage basin, but adjacent drainage basins show the same topographic aspect. The question is why is the erosion more severe near the base of Blue Mountain than farther out in the drainage basin.

A possible answer is that the erosional conditions are more severe near the base of the mountain because of a greater abundance of water that occurs there. This water comes off the large area of the mountain slope during rain and large amounts of water are produced by melting of snow that accumulates on the mountain slope. The combination of these two water sources may be the reason for the excessive erosion. I know of no studies that would confirm that theory, but there probably are some that I am not aware of.

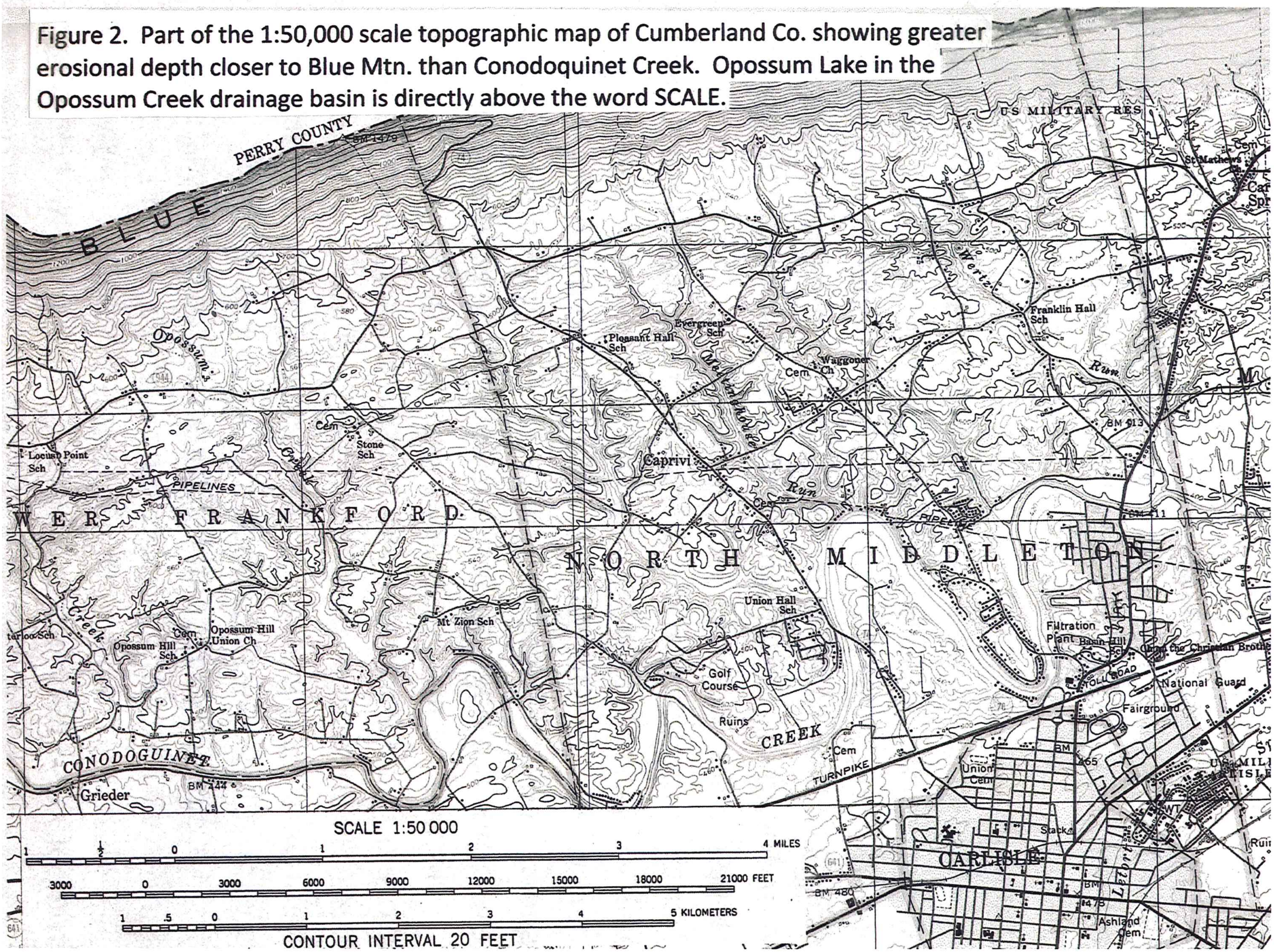

Figure 2. Part of the 1:50,000 scale topographic map of Cumberland Co. showing greater erosional depth closer to Blue Mtn. than Conodoquinet Creek. Opossum Lake in the Opossum Creek drainage basin is directly above the word SCALE.

The Opossum Creek drainage basin has features that are both unique and typical of many of the associated drainage basins. The topography is of low relief and gently rolling. The area is mainly farming countryside (see cover picture). Each drainage basin is separated from adjacent drainage basins by narrow, rounded topographic divides.

Scattered around on the basin uplands are sandstone and quartzite boulders derived from the Tuscarora and Juniata Fms. that create the crest and upper south-facing slopes of Blue Mountain. Contact with the Martinsburg Fm. is on the lower mountain slopes where a major change in slope occurs, the slope is considerably less steep on the Martinsburg than on the higher, more erosion resistant rock units. Figure 3 shows the known distribution of the boulders within the Opossum Creek drainage basin. Figure 4 shows some of these boulders. Similar boulders occur in the other drainage basins, but not in such abundance.

If we assume, as I believe we must, that these boulders were originally transported across a sloping topographic surface, deposited on that surface, and now are residual remnants resting on an eroded and lowered rock surface, we must hypothesize about that former surface.

I assume that a gently sloping surface once existed for the whole of the Martinsburg surface in Cumberland Co. and elsewhere, east of the Susquehanna River, and south of the county onwards into Virginia. The nature and slope of

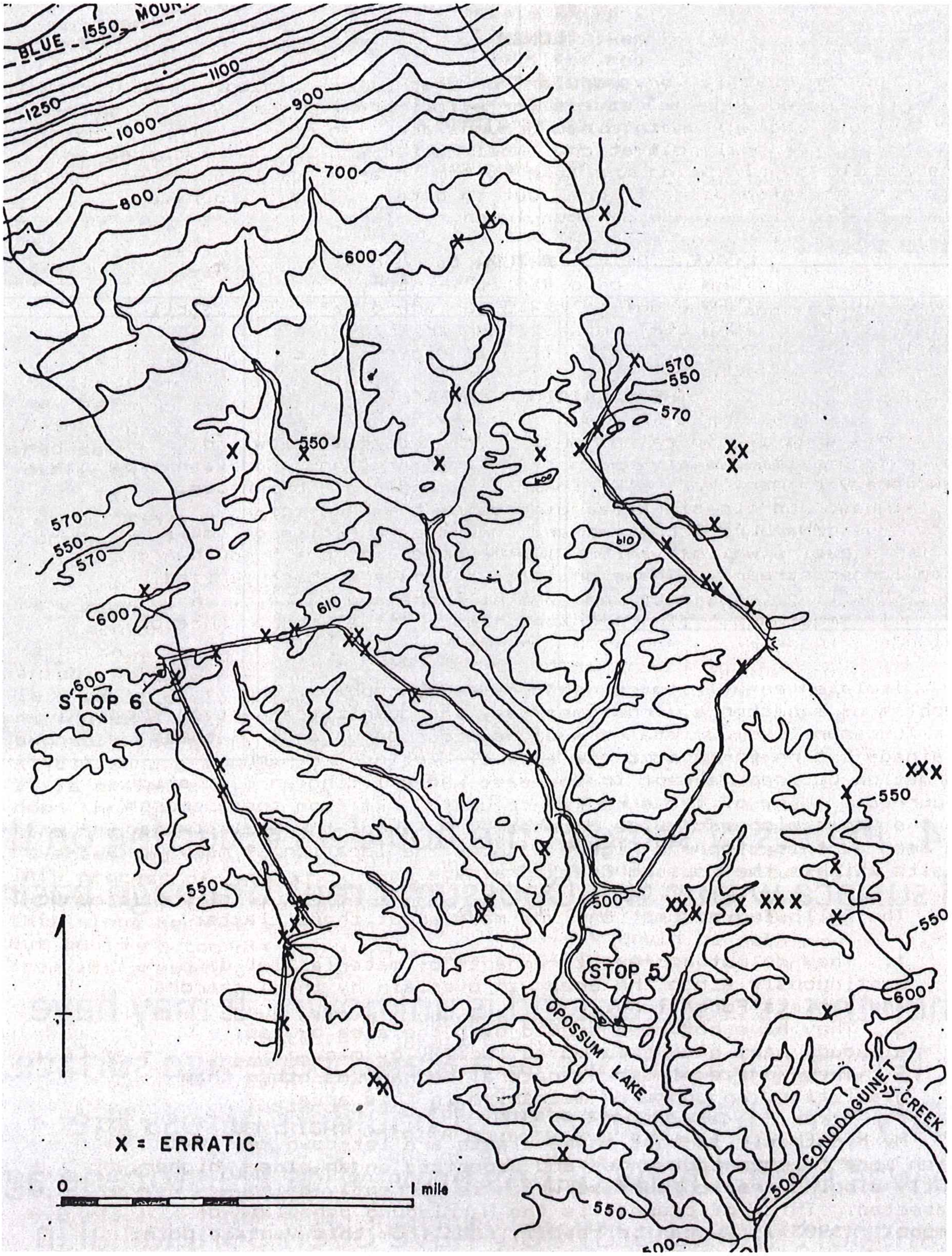

Figure 3. Boulder distribution within the Opossum Creek drainage basin. Only upland boulders are shown.

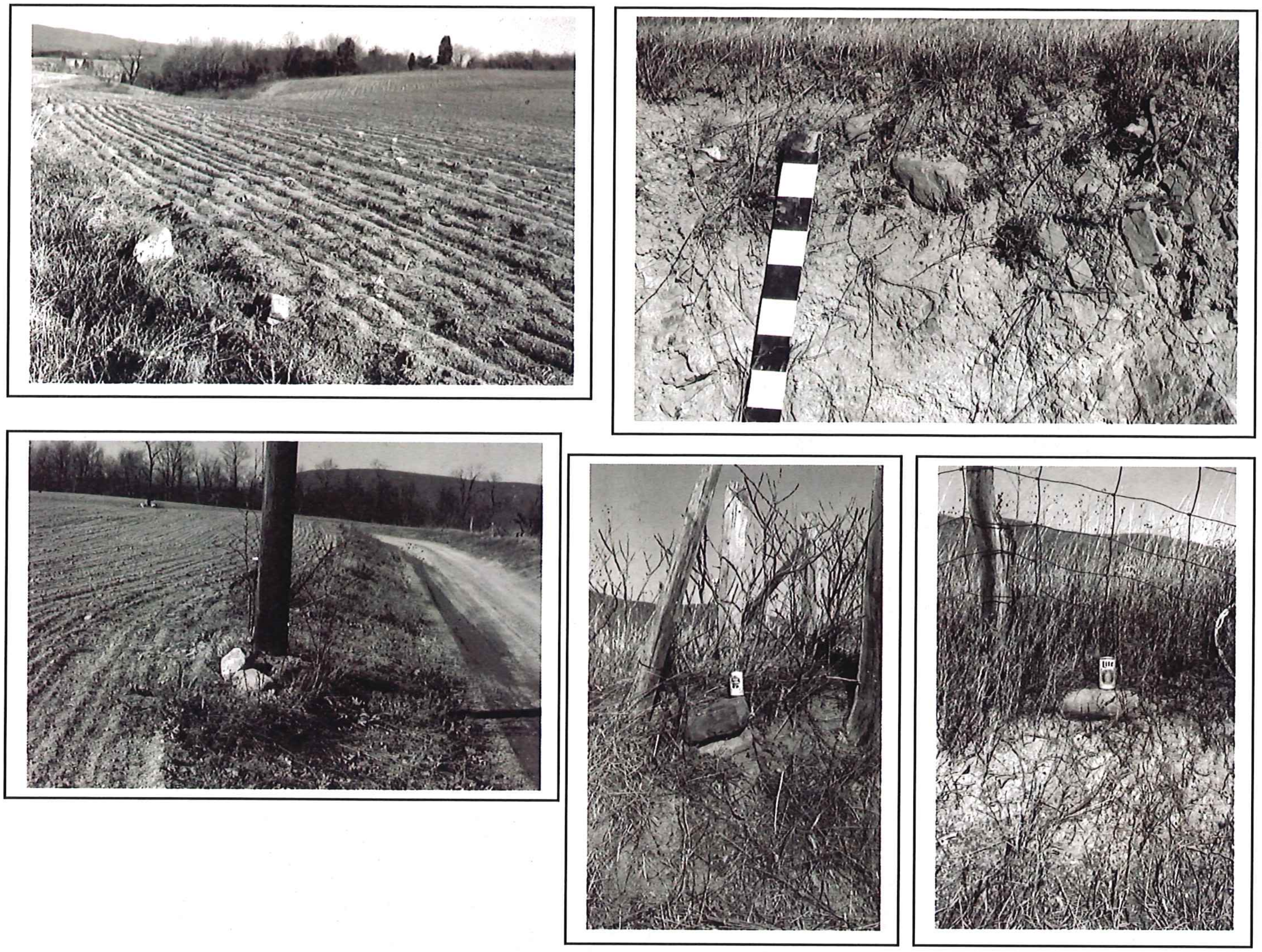

Figure 4. Photos of some of the boulders occurring on the upland surface within the Opossum Creek drainage basin.

When this surface existed is unknown. It may have been a Tertiary-age surface or a Pleistocene-age surface. If of Tertiary age, then transport of boulders across the surface was probably by debris flow. If of Pleistocene age, then transport would probably have been periglacial in origin. Either method is a possibility. One other factor would have been the elevation of the Conodoquinet Creek.

It would certainly have been 50 feet or more above its current elevation.

Eventually Opossum Creek began to incise and create the drainage basin we see today. Many boulders probably were carried away during that erosion process and what we see today are those that normal erosion could not move because of their position on upland surfaces. Boulders probably exist beneath finer-grained alluvium/colluvium in the drainage ways, but I have not investigated that.

Finally, we come to the question as to what the original surface may have been. Campbell (1903) designated the surface developed on the Martinsburg as the Harrisburg peneplain. In his concept the peneplain extended on the upland from the Delaware River across PA and on into Virginia. Some have extended that surface even farther. The concept of peneplains went out of favor many years ago and its reality related to the Opossum Creek drainage basin is an unknown. I personally favor the concept and its relationship to the Martinsburg upland surface. I may be biased because I live on the presumed Harrisburg peneplain and appreciate the fact that it is above flood levels and is a pleasant landscape.

I have never seen any reference to the Martinsburg upland being a former pediment, but that does not mean that it was not. The general concept of the drainage basins abutting a steep slope on the north and drainage flowing south to the Conodoquinet Creek is not atypical of described pediment surfaces elsewhere (e.g., Twidale, 1981). In addition, Mills (1983) has discussed pediment formation in North Carolina. Most pediments occur in dry climates, but Alt (1974) argued persuasively for an arid climate in the southeastern United States during the Miocene. He also argued for deposition on pediplain surfaces. Whether his concepts would have carried northward onto the Martinsburg in the area discussed here is open to question, but I like the concept.

Lastly we come to the concept that the sloping upland surface was developed by simple erosion, that the boulders were transported across the surface by running water in streams that migrated laterally and eventually eroded the present surface leaving some boulders on the uplands (gully gravure, Mills, 1981). The possibility of this mechanism may be just as probable as the other hypotheses, but I don't favor it.

Which possibility is correct? I don't have a real answer. I favor the peneplain hypothesis and only lean towards the pediment. I can't prove either hypothesis. Obviously the presence of Tuscarora boulders lying on surfaces of the drainage basin, particularly the upland parts, creates a real problem that needs better answers. More information is available in Sevon (1985; 1989; 1991). With regard to the age of the surface, earlier (Sevon, 1985, p. 47) I calculated that a hypothetical sloping surface could be eroded to the present in little more than a million years or less. I suspect that calculation has nothing to do with the truth and that the surface is much older, possibly as old a late Miocene. The work of Pazzaglia and Gardner (1993) is worth considerable attention with regard to its meaning in the current area of field trip. Obviously, more research is necessary.

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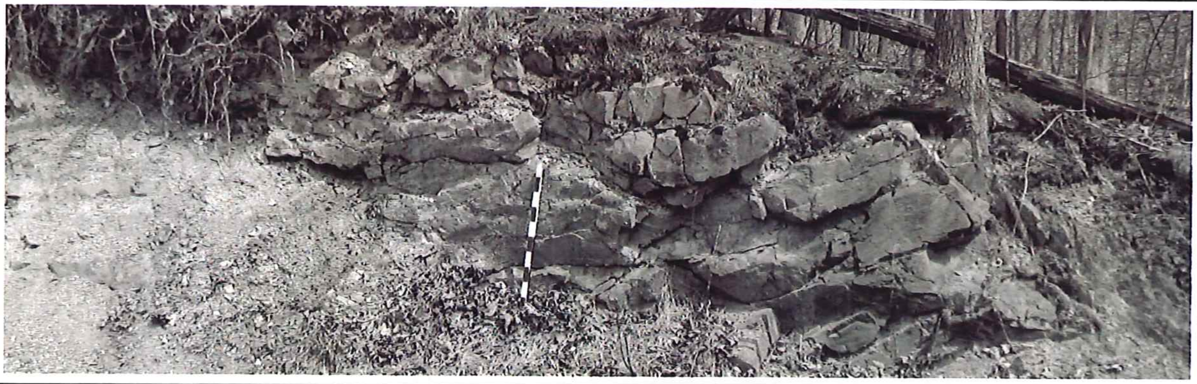
ROAD LOG DESCRIPTION

Mileage		
Inc	**Cum**	Assemble at the Carlisle Commons Mall on the west side of PA 34 at the junction of PA 34 and I81. When turning into the mall from PA 34, enter the first access on the left into the Tractor Supply Co. parking lot. Assemble in the northeast corner of the lot away from Tractor Supply. Be ready for departure at 8 am.
0.0	0.0	**LEAVE PARKING AREA. TURN RIGHT** onto Noble Road.
0.1	0.1	**STOP LIGHT. TURN LEFT** onto PA 34 N.
0.7	0.8	Proceed though 4 stop lights to **STOP LIGHT** at junction of PA 34, US 11, and PA 641. **TURN LEFT** onto PA 641 W. Pass through several stop lights. Note Dickinson College starting on right after 2nd stop light.
1.1	1.8	**STOP LIGHT** (5th light). **TURN RIGHT** following PA 641. Pass under a railroad overpass. Immediately **TURN LEFT** following PA 641.
4.2	6.0	Pass through Plainfield.
2.2	8.2	Grahams Woods Road, continue straight ahead on PA 641 W.
4.5	12.7	**STOP LIGHT.** Center of Newville and intersection with PA 233. **CONTINUE** ahead on PA 641.
2.8	15.5	**TURN RIGHT** at intersection onto Bullshead Road.
0.5	16.0	**STOP 1.** Unload people. Bus goes ahead about 0.05 mile to pull-off area on right just before crossing bridge. More outcrop occurs left side of road across the bridge.

The purpose of this stop is to examine a large outcrop of mixed greywacke and shale that is part of a facies within the Martinsburg Fm. The southern part of the outcrop occurs on the east side of the road south of the bridge over Green Spring Creek. The northern part of the outcrop occurs on the west side of the road north of the bridge. The road has moderately regular traffic so caution is needed while examining the outcrop. An outcrop this size in Cumberland Co. is rare.

I have not studied this outcrop nor do I know of any description of it or the rock unit itself (listed on the 1980 State Geologic Map as Omsg with no description other than interbedded greywacke). Figure 5 shows a number of photographs of both parts of the section. Not all of the outcrop is shown. The first 10 photographs are of the south part of the outcrop shown in order from south to north; the second 10, the north part, are also in order from south to north.



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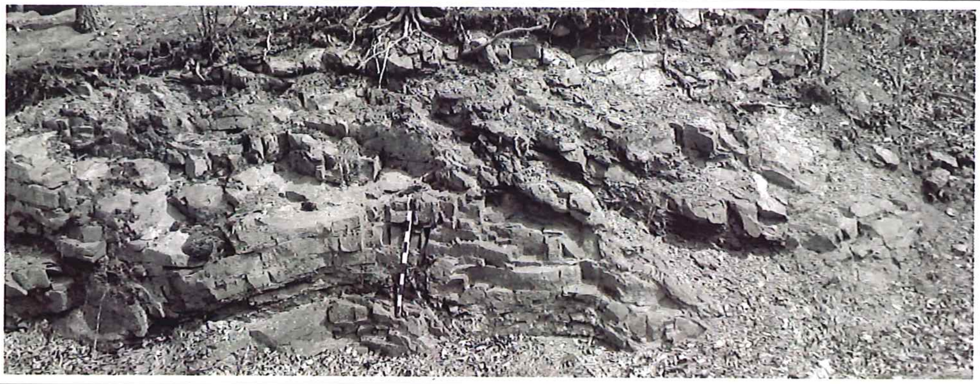

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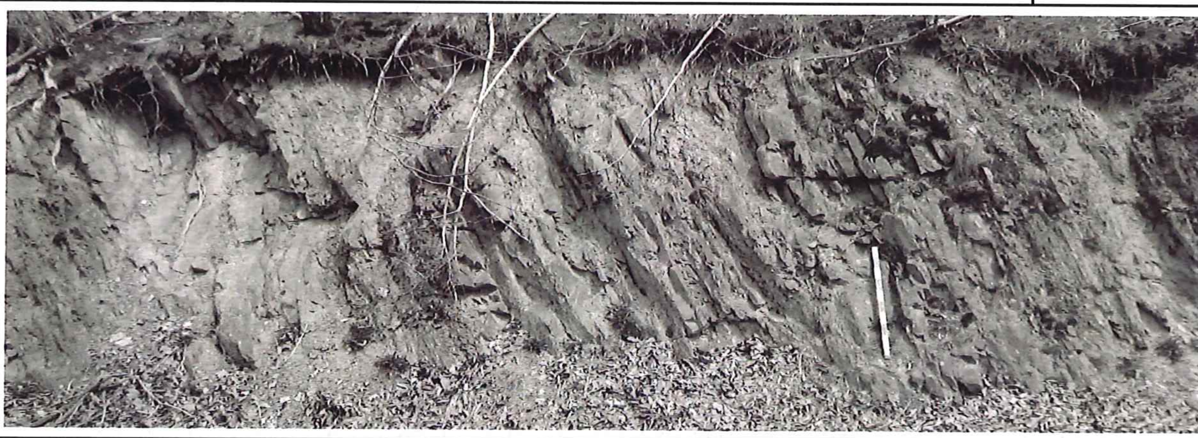

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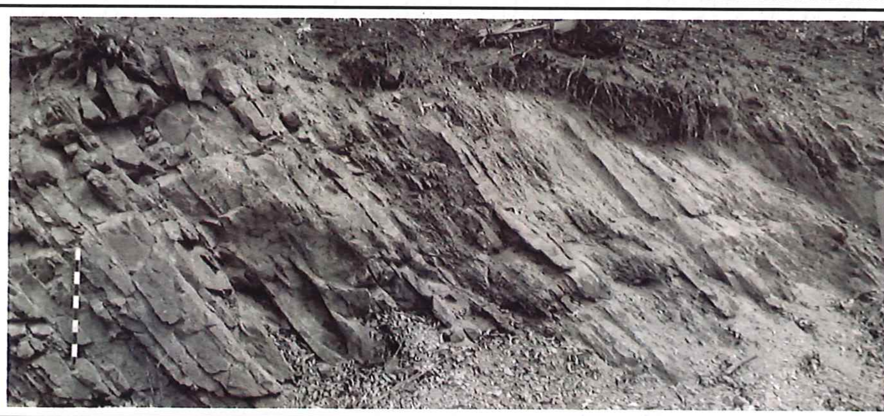

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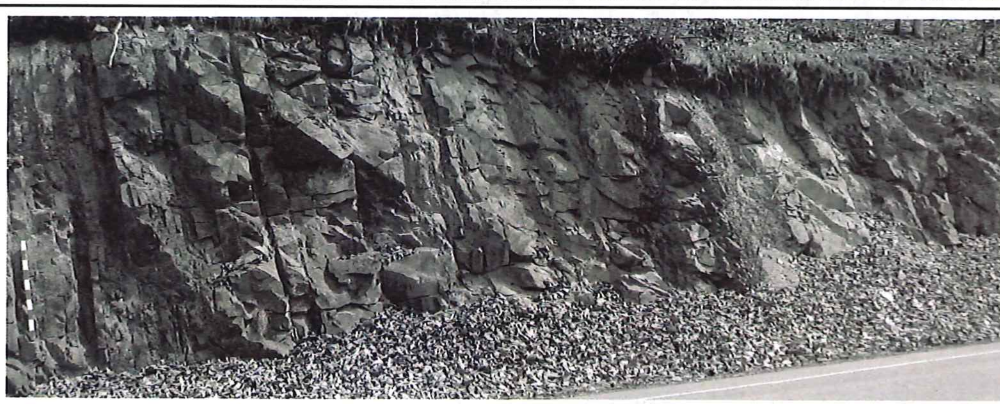
Figure 5.

These photos are numbered from S to N and missing numbers represent missing photos. The same applies to the photos on the next page. The scale is 1 m long and divided into 10 cm intervals.

8

6

3



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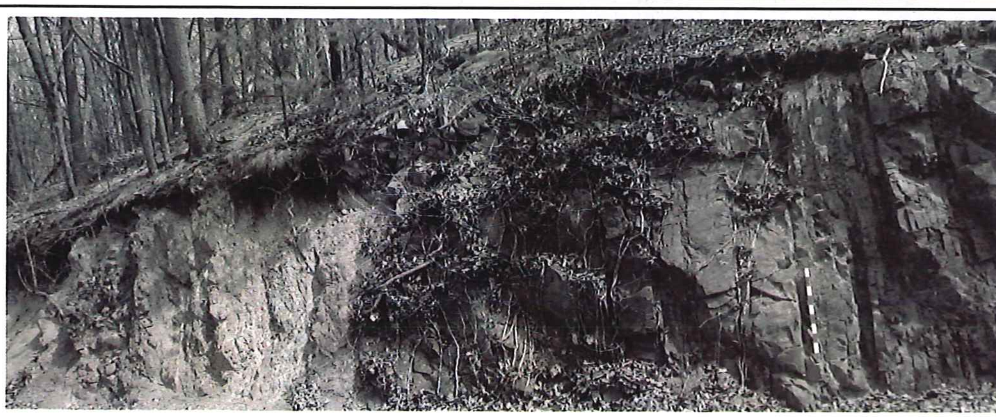

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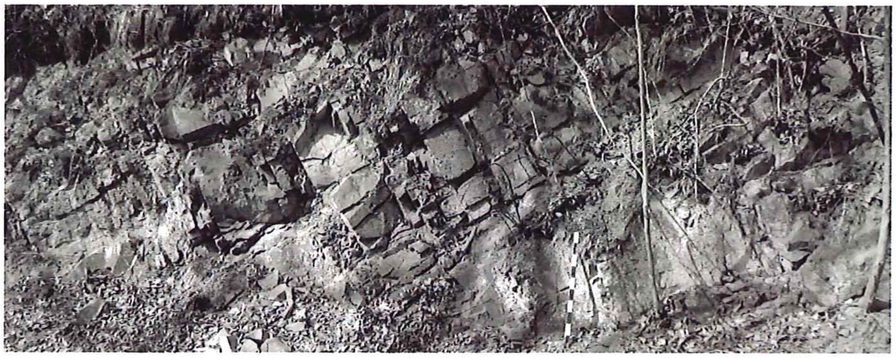
Figure 5 cont. Photo numbers continue from S to N. Photo 1 is the last outcrop along the east side of the road south of the bridge. Note the variation in rocks and the thick units of greywacke.

1



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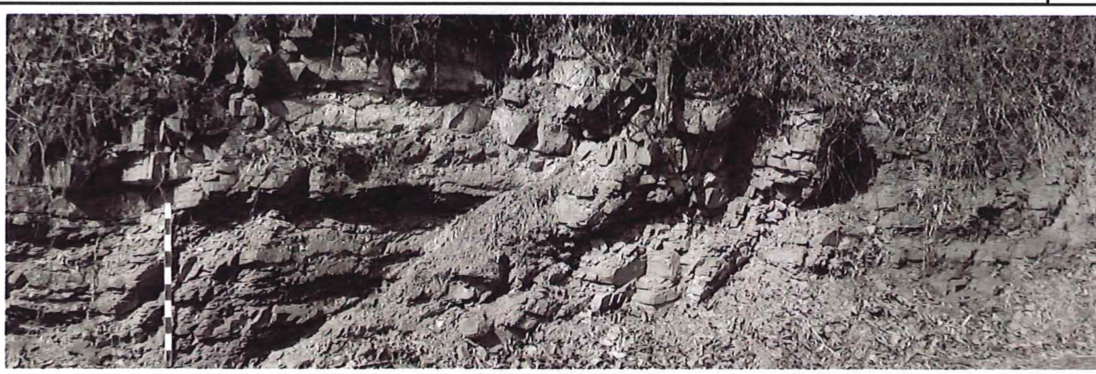

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Figure 5 cont. This part of Fig. 5 has photos of the outcrop on the north side of Green Spring Creek and the photos are in order from S to N. Again, missing numbers indicate gaps in the photo sequence. Scale intervals are 10 cm.


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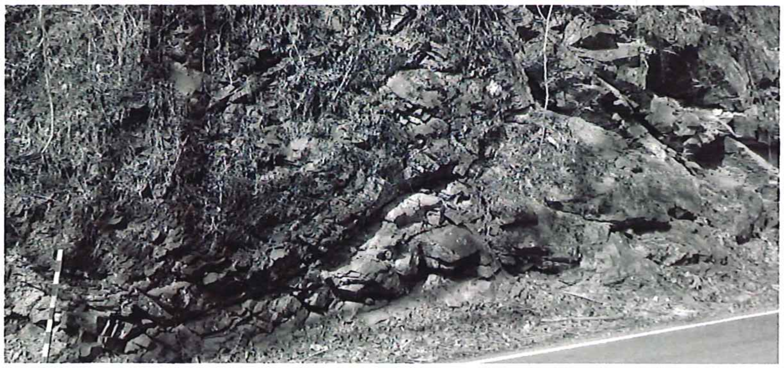
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15

LEAVE STOP 1. GO AHEAD following Bullshead Road.

0.7 16.8 T-intersection. **TURN LEFT** onto Steelstown Road.

0.1 16.9 Cross over Conodoquinet Creek.

0.2 17.0 **TURN RIGHT** onto Whiskey Run Road.

0.5 17.3 **TURN RIGHT** onto Creekview Road. Views ahead of Conodoquiinet Creek floodplain and the creek itself. Note width of floodplain.

1.1 18.4 **STOP SIGN.** Middle Road goes left. **CONTINUE** on Creekview Road.

1.2 19.6 **STOP SIGN. CONTINUE** straight ahead.

0.5 20.1 **STOP SIGN.** Intersection with PA 233. **CONTINUE** straight ahead.

1.1 21.5 Sharp left bend in road. **CONTINUE** on Creekview Road.

0.2 21.7 **TURN RIGHT** onto Blue Rock Road.

0.9 22.6 **STOP SIGN.** Intersection with Bridge Road. **TURN RIGHT** and immediately cross Conodoquinet Creek.

0.2 22.8 **TURN LEFT** at T-intersection onto Creek Road.

0.5 23.3 Cross over PA Turnpike.

0.5 23.9 **STOP SIGN.** Intersection with Bloserville Road. **CONTINUE** straight ahead.

1.5 25.4 **TURN LEFT** onto Grahams Woods Road.

0.3 25.7 **STOP 2.** Conodoquinet Creek terrace level and erosional slope. Pull off onto the right side of the road.

This stop to look at a terrace level of the Conodoquinet Creek (CC) and observe the long slip-off slope created by the CC as it cut downward and migrated eastward. The former existence of the CC at this level is evidenced by the presence of rounded cobbles left behind by CC that occur at this level along the road margin by the woods and also in the cultivated field (Figure 6). Figure 7 shows the form of the landscape and the sloping slip-off slope not only here but on the meander of CC immediately to the west.

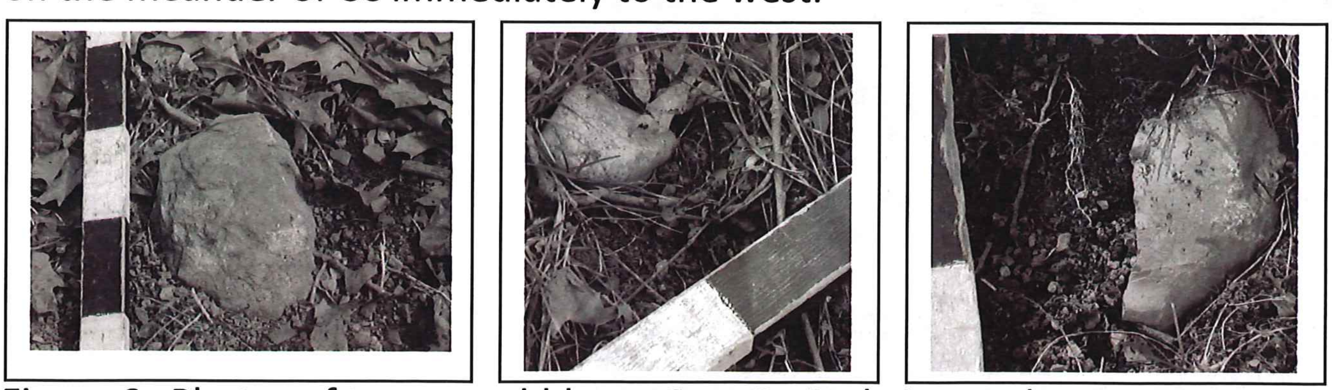

Figure 6. Photos of terrace cobbles at Stop 2. Scale intervals are 10 cm.

This stop gives a good idea of the meander pattern of the CC as well as how much it has cut down from this level. The elevation of this hilltop, 506', is in keeping with other CC adjacent uplands between here and the Susquehanna River where CC junctions. I assume that when the CC was at this level, the landscape between here and Blue Mountain was much different and probably totally sloped towards the CC. Note the extent of the slop-off slope when we continue travel.

The CC has traversed across the landscape maintaining its course on the shale upland. The erosional pattern of not only CC but also Conococheague Creek farther southeast suggests that these streams avoided the carbonate rocks.

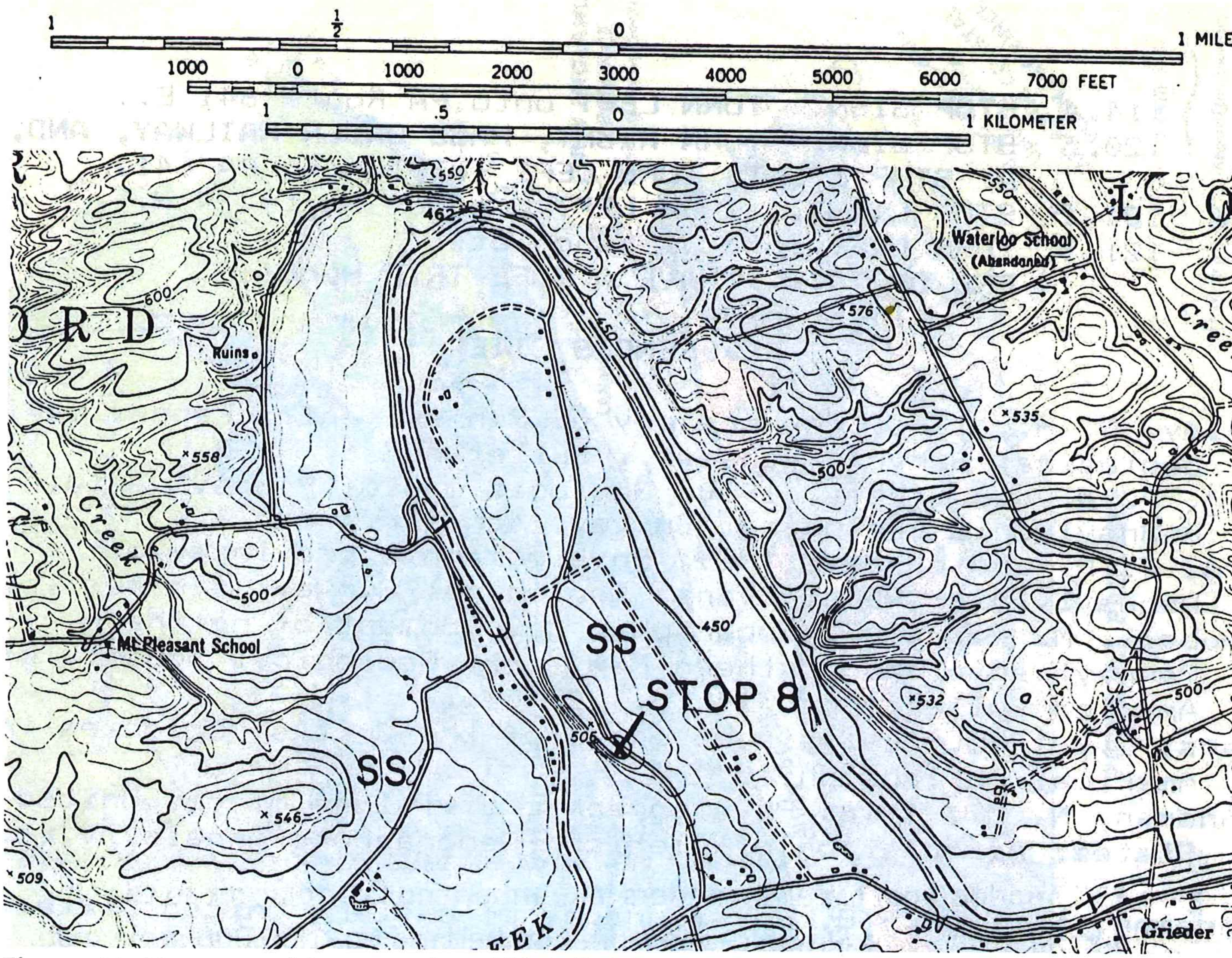

Figure 7. Topographic map view (Plainfield 7.5-minute quadrangle) of the meander seen at Stop 2. We are at the site indicated by STOP 8. The illustration was taken from Sevon (1991, p. 21).

We want to give further consideration to the CC meanders. If we look at the topographic expression of meanders close to the Susquehanna River, meanders we will not see on this trip, we see that they have a very uniform orientation (Figure 8).

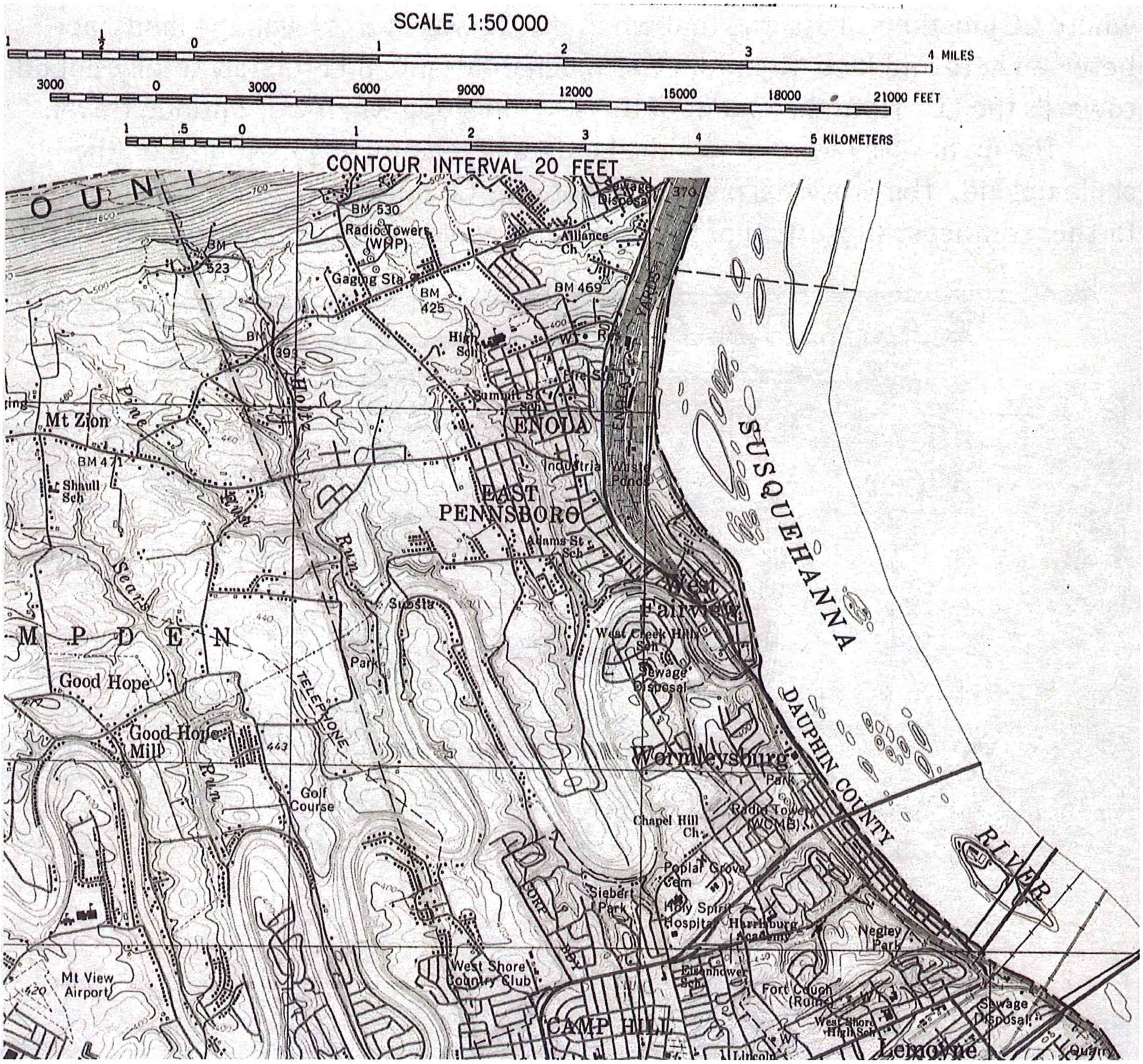

Figure 8. Conodoquinet Creek meanders in Cumberland Co. adjacent to the Susquehanna River. Topographic map from Cumberland Co. 1:50,000-scale map.

Note in Figure 8 the very strong orientation of the long parts of the meanders. Approximating the orientation for 8 meander lengths gives an orientation of N70°W. The orientation of Blue Mtn. is N83°E. Thus the meanders are close, but not exactly at a 90° angle to the mountain crest. The structure parts of the geology works of Becher and Root (1981; 1982) and Root (1977; 1978) do not give enough information to make any evaluation of the significance of joints in the orientation of the meander lengths. I suspect that the joints do control the orientations, but have no proof. The orientations are also more or less normal to the structural axes in the area and that may also be an influence. Farther to the SW the meanders are not as regular in orientation and other factors may be involved.

LEAVE STOP 2. PROCEED STRAIGHT AHEAD following Grahams Woods Road.

1.0 26.7 Cross Conodoquinet Creek. Good outcrops of Martinsburg Fm. along the creek bank.

0.3 27.0 Major right bend in road. Follow Grahams Woods Road to right. Do not turn left onto Frytown Road. Outcrop of Martinsburg on left.

0.6 27.6 Intersection. **TURN LEFT** onto Wildwood Road.

0.4 28.0 **STOP SIGN. TURN RIGHT** following Wildwood Road.

0.6 28.6 This road becomes Baughman Drive when Wildwood Road turns right.

0.3 29.0 **STOP SIGN.** Center of Bloserville. **CONTINUE STRAIGHT AHEAD** onto PA 944. Views ahead of higher elevations to S, lower to N.

0.6 29.6 Road forks and PA 944 goes right. **TURN LEFT** onto Mohawk Road.

1.1 30.7 **STOP SIGN.** Intersection with Brick Church Road. **TURN RIGHT.**

0.1 30.8 **STOP 3.** Tuscarora Fm. boulders on Martinsburg upland. Pull off onto right side of road onto the lawn of the small house. Do not disturb the chickens!

The purpose of this stop is to examine the presence of Tuscarora rocks in the road-cut and to view the landscape immediately ahead that shows that the surface across which the rocks were transported has been subsequently eroded. Figure 9 shows three of these boulders in the east side cut-bank.

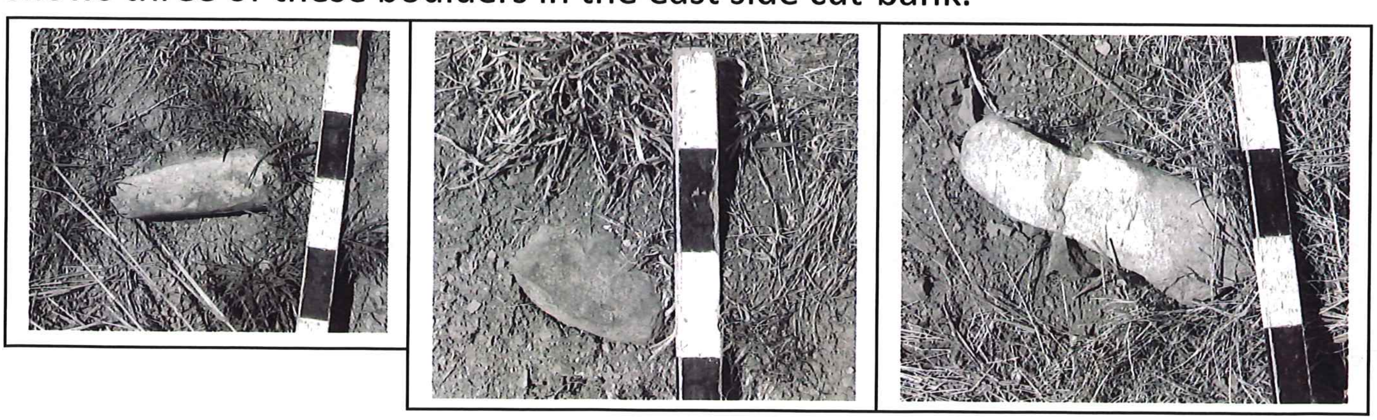

Figure 9. Tuscarora quartzite boulders in weathered Martinsburg shale in a cut-bank on the east side of the road at Stop 3 along Brick Church Road. Scale is divided into 10 cm lengths.

The site is well shown in Figure 10 where the degree of erosion between the site and Blue Mtn. to the north is obvious. The site is about 60 feet higher than the area to its immediate north.

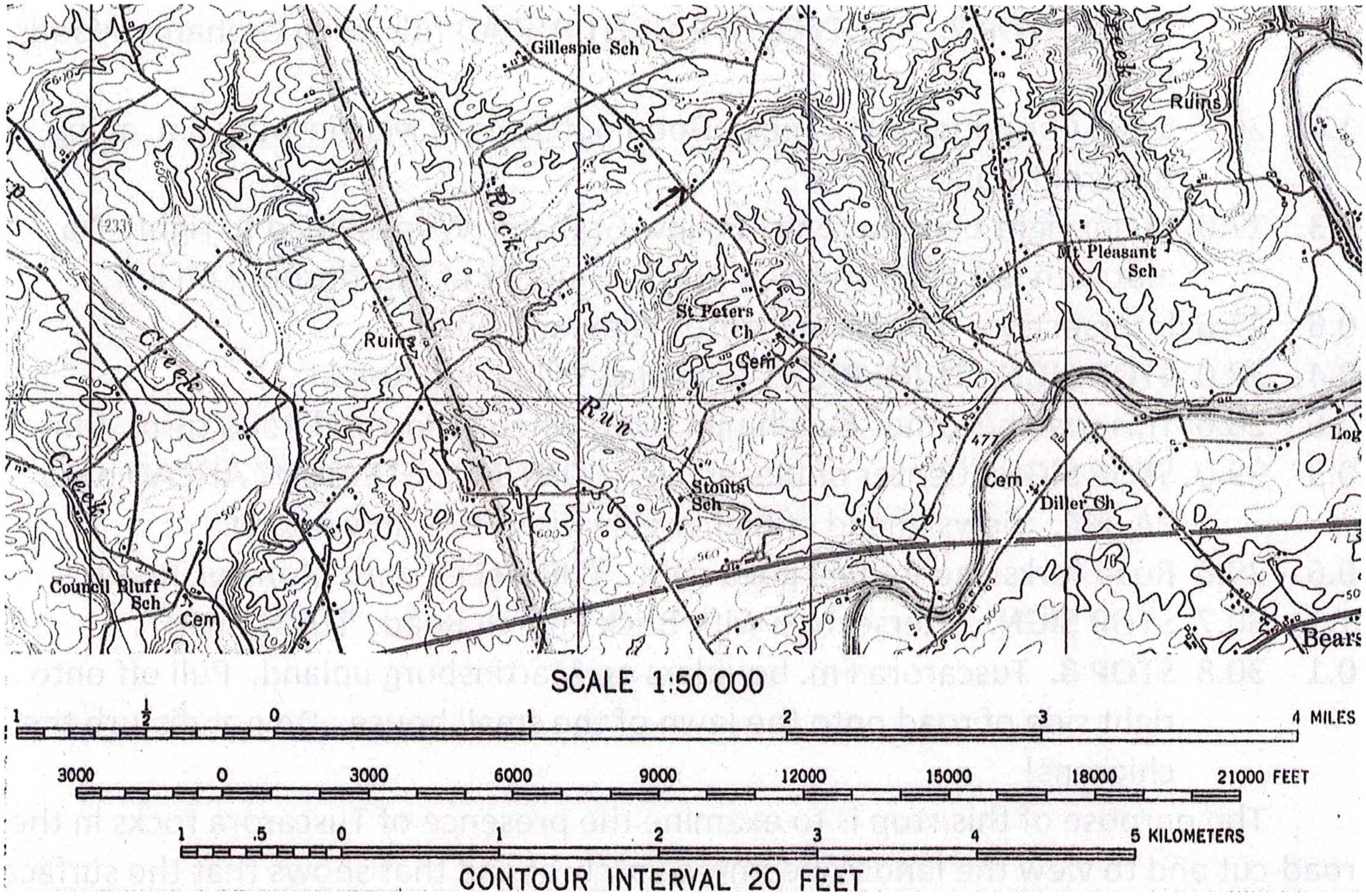

Figure 10. Topographic map of the area around Stop 3. The small arrow points to the stop site. Note the 600 foot contour and its relationship to the site.

There are a number of places on the Martinsburg Fm. in Cumberland Co. where similar situations occur. This is possibly the best because of the visual aspect of the boulders and the downhill slope to the north. I believe that sites like this argue strenuously for the former presence of a sloping surface across which the boulders and cobbles were transported from Blue Mtn. and deposited at places on the former surface.

Figure 11 to the right gives an excellent view of the landscape ahead toward Blue Mtn. at Stop 3. Note the boulders in the right side road-cut.

LEAVE STOP 3. PROCEED STRAIGHT AHEAD.

1.1 31.9 **STOP SIGN** at intersection. **TURN RIGHT** onto PA 944 and Enola Road.

2.2 34.1 Follow PA 944 to Bloserville. **STOP SIGN. PROCEED STRAIGHT AHEAD** onto Baughman Drive.

0.4 34.5 Baughman Drive ends. **PROCEED STRAIGHT AHEAD** on Wildwood Rd.

0.5 35.0 **STOP SIGN. TURN LEFT** following Wildwood Road.

0.4 35.4 **STOP SIGN. PROCEED AHEAD** on Wildwood Road.

0.5 35.9 **STOP SIGN** at Old Mill Road. **PROCEED AHEAD** on Wildwood Road.

0.2 36.1 Wildwood Road turns left. **PROCEED LEFT FOLLOWING** Wildwood Road.

0.7 36.8 **STOP SIGN. TURN LEFT** following Wildwood Road.

0.9 37.7 **Y FORK IN ROAD.** Wildwood Road turns left. **PROCEED STRAIGHT AHEAD** onto Pinedale Road.

1.7 39.4 **TURN RIGHT** at onto Ponderosa Road then an Immediate **LEFT** into a pull-off area.

STOP 4. Opossum Lake drainage basin view and St boulders.

We have already established that boulders have been transported from Blue Mtn. across an older Martinsburg shale surface and left behind as the surface has been subsequently eroded. At this stop we are within the Opossum Creek drainage basin, the area that I have studied the most. In the cut-bank by the pull-off into the tower are Tuscarora boulders as well as some piled at the base of the tree. Figure 12 gives two views at this stop.

This site is at about 600 feet elevation and the elevations to the north drop more than 50 feet on the uplands while Opossum Creek cuts below 500 feet. Thus the evidence is good that the surface across which the boulders were transported has been considerably eroded. Figure 13 gives a good view of the area to the north. Figure 14 shows the overall topography of the basin.

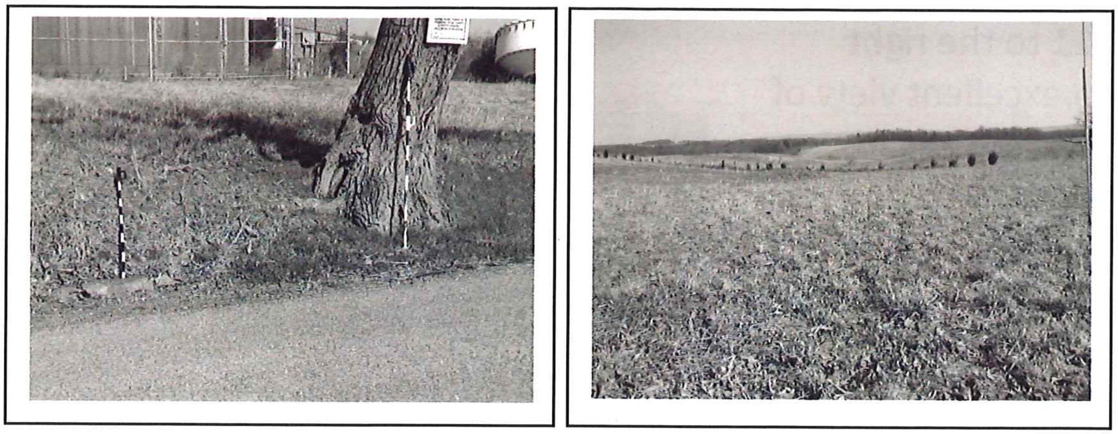

Figure 12. Photo on the left shows a large St boulder in the road-cut at Stop 4. Scale intervals are 10 cm. Photo on the right is a view looking SE across the upland into a tributary draining into Opossum Creek.

Figure 13. A view across some of the upper part of the Opossum Creek drainage basin showing the irregularity of the topography and some of the lower elevations in the upper part of the drainage basin.

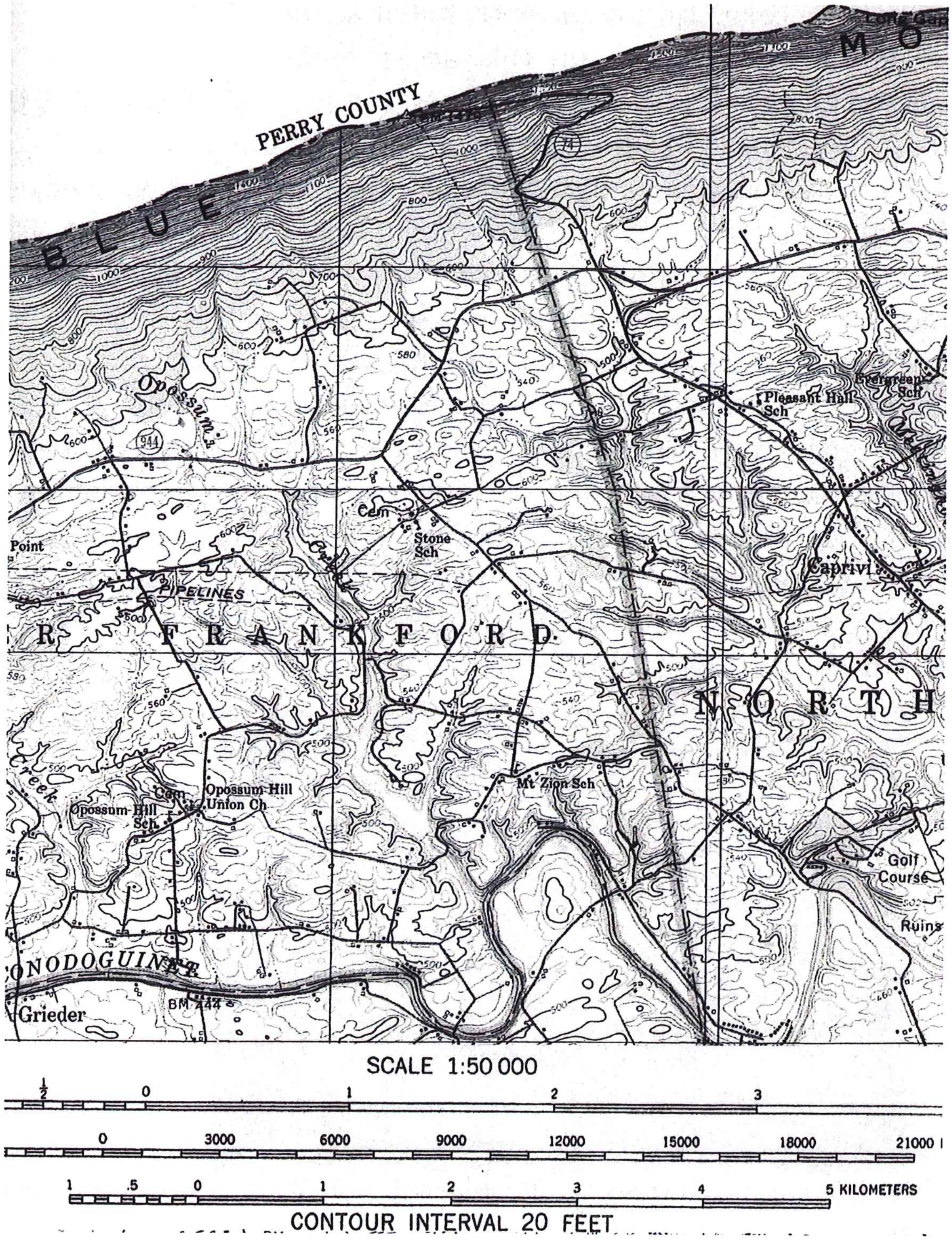

Figure 14. Topographic view of the Opossum Creek drainage basin. See cover for an aerial view of this drainage basin.

LEAVE STOP 4. RETURN to Pinedale Road. **STOP SIGN. TURN RIGHT** onto Pinedale Road.

1.4 40.8 **STOP SIGN. TURN LEFT** onto Opossum Lake Road. Now at the upper end of Opossum Lake. Route crosses where Opossum Creek enters

Opossum Lake. Lake is currently full of water.

0.3 41.1 **TURN RIGHT** into Opossum Lake access area.

0.3 41.4 **TURN RIGHT** into Opossum Lake pavilion area. **LUNCH AND STOP 5.**

Discussion of Opossum Creek drainage basin.

This topic is discussed in earlier text (p. 6-11) and need not be reviewed here. However, mention should be made of the work of Mills (1981). In "gully gravure" a stream, or several streams, flow across a surface and deposit fluvial deposits. As the fluvial deposits accumulate, the stream migrates laterally leaving the deposits behind. This mechanism is known from mountainous areas, but whether or not it is applicable on the former Martinsburg surface is unknown. I doubt that the mechanism played a part in Cumberland Co. You have seen the evidence so far and can come to your own conclusions. Pay particular attention to the landscape as you travel from Stop 6 to Stop 7 and note the low elevations near Blue Mtn. Figure 15 shows you what the lake bottom looked like when the water was gone in 1985. The more recent drawdown that just ended exposed the lake bottom longer and the bottom was well vegetated before the water returned.

Figure 15. The bottom of Opossum Lake when it was drained in 1985. Scale intervals are 10 cm.

LEAVE STOP 5. RETURN TO ENTRANCE.

0.3 41.7 **ENTRANCE. TURN RIGHT** onto Opossum Lake Road.

0.1 41.8 **TURN LEFT** onto Easy Road.

0.8 42.6 Follow Easy Road to intersection with McClures Gap Road. **TURN LEFT** onto McClures Gap Road.

0.8 43.4 **STOP SIGN. TURN RIGHT** onto PA 944.

1.5 44.9 **STOP SIGN.** Intersection with PA 74. **TURN LEFT** onto PA 74.

0.6 45.5 **TURN LEFT** into parking lot of North Mountain Inn.

STOP 6. Paleosols and gelufluction lobes.

Travelling to Stop 6 takes us across some interesting terrain with remnants of gelufluction lobes, periglacially produced lobate mounds. Figure 16 is a lidar image of some of the area traversed as well as the site of Stop 6.

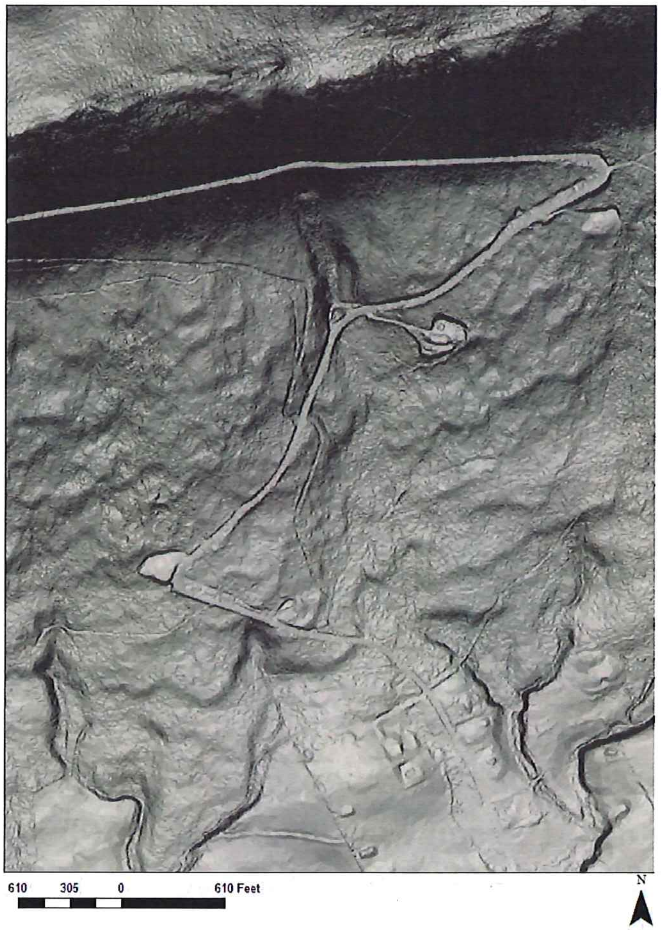

Figure 16. Lidar image of the site of Stop 6 and some of the surrounding area. Note in particular the numerous lobate forms that represent the gelufluction lobes. Route 74 that we traverse crosses one large and one small lobe. Can you detect them as we travel?

Figure 17. This cut-bank shows a paleosol overlain by a thin modern soil and rock debris that has been carried to the site by gelufluction. The red colored material is the paleosol.

The cut-bank shown in Figure 17 shows a paleosol developed on colluvium derived from weathered material on the slope of Blue Mtn. This is an exceptionally good exposure of a paleosol. The paleosol, the red material, has been truncated an unknown amount. The soil was described in 1989 by Ciolkosz, Dobos, and Pollack (Sevon, 1989, p. 40-42). The soil above the paleosol is a Typic Dystrochrept developed in Wisconsinan colluvium. The following is the profile description.

	Horizon	cm	Description
1.	A	0-5	Dark brown (10 YR 3/3) very gravelly loam; weak fine granular structure; friable, nonsticky, nonplastic; 35 % rock fragments (mainly near surface); pH=4.6; abrupt wavy boundary.
2.	E	5-20	Yellowish brown (10 YR 5/4) gravelly, sandy loam; weak medium subangular blocky structure; friable, nonsticky, nonplastic; 20 % rock fragments; pH=4.6; clear wavy boundary.

3. Bwl 20-99 Mixture of red (2.5 YR 4/6) very gravelly clay loam and and strong brown (7.5 YR 5/6) very gravelly loam; weak medium subangular blocky (red) and very weak medium subangular blocky (brown) structure; firm and brittle, slightly plastic (clay loam), nonsticky, nonplastic (loam); 45 % rock fragments; pH=5.0; many vesicular pores; few thin clay films in pores; common black coating on ped faces and on rock fragments; diffuse wavy boundary.

4. Bw2 99-120 Mixture of strong brown (7.5 YR 5/6) very gravelly loam and red (2.5 YR 4/6) very gravelly clay loam; very weak medium subangular blocky (brown) and weak medium subangular blocky (red) structure; firm and brittle; nonsticky nonsticky, nonplastic (brown) slightly sticky, slightly nonplastic (red); pH=4.6); many vesicular pores; few thin clay films in pores; commonblack coatings on ped faces and on rock fragments; diffuse wavy boundary.

5. Bw3 170-236 This horizon is the same as Bw2 except it has 55% rock Fragments, pH=4.6 (red and brown) and a clear wavy boundary.

6. Bt1b 236-325 Red (2.5 YR 4/8) gravelly clay loam; weak subangularblocky structure; firm and brittle; slightly sticky, slightly plastic; 25 % rock fragments; pH=4.6; many vesicular pores; few black coatings on ped faces and rock fragments; with a lens (5-30 cm thick) of strong brown (7.5 YR 4/6) massive loam at the base of the horizon; abrupt wavy boundary.

7. Bt1b 325-360 Red (2.5 YR 5/8) gravelly heavy clay loam; moderate medium subangular blocky structure; firm, sticky, and plastic; 30% rock fragments; pH=4.6; common thin clay films on ped faces and on rock fragments; clear wavy boundary.

8. Bt2b 360-398 Yellowish red (5 YR 5/8) gravelly clay loam; weak medium subangular blocky structure; firm, slightly sticky, slightly plastic; 30% rock fragments; pH=4.6; few thin clay films on ped faces and rock fragments; gradual wavy boundary.

9. BC1b 398-444 Yellowish red (5 YR 5/6) gravelly loam; weak medium subangular blocky structure; friable, slightly sticky, slightly

plastic; 30% rock fragments; pH=5.2; few thin clay films on rock fragments; common black coatings on peds and rock fragments; gradual wavy boundary.

10. BC2b 444-525 This horizon is the same as BCib except it is reddish brown (5 YR 5/4).

The color of this palesol indicates that it is old. Years ago it would have been assigned a post-Illinoian glacial age. As a result of more knowledge, we would now assign this soil to a post-pre-Illinoian glacial age. The pre-Illinoian glaciation would have occurred more than 780,000 years ago. That is why, even with some or a lot of soil removed, the paleosol is so thick. There is no evidence of a post-Illinoian soil. That is probably because it was quite thin and was destroyed by coll-uviation during the Late Wisconsin.

LEAVE STOP 6. TURN RIGHT onto PA 74.

0.6 46.1 **TURN LEFT** onto PA 944.

5.4 51.5 **STOP SIGN.** Intersection with PA 34. **TURN LEFT** onto PA 34 and PA 944.

0.4 51.9 Carlisle Springs. **TURN RIGHT** following PA 944 and Wertzville Road.

3.2 55.1 Intersection. **TURN RIGHT** at following PA 944. Pass through Donnellytown.

1.2 56.3 Climb hill. At top of hill **TURN RIGHT** onto Deer Lane. Turn is at crest of hill and with limited visibility of oncoming traffic. Turn is into a moderately narrow road.

0.2 56.3 **STOP 7.** Diabase on Ironstone Ridge.

This stop is on a narrow, steep-sided, elongate hill that is composed of diabase. In some respects this stop area is unique because diabase rocks are present at the surface. They do not represent outcrop, but rather weathered rock. The diabase is part of a dike that extends across the Cumberland Valley from Boiling Springs and continues northeastward through Blue Mtn., across the Susquehanna River, and eventually ends in the Millersburg quadrangle (Hoskins, 1976). The diabase is little seen along the extent of the dike.

Davidson (2010) refers to Smith et al (1975) and says that this is Rossville-type diabase. The diabase has intergranular to subophitic groundmass textures with numerous subhedral plagioclase laths 0.11 mm and 1 mm long. The weathered surfaces of the rock we see here have a fine grained, sandy surface texture, brown color, and show no surface mineralogy.

The rocks are presumably material moved when the current road was constructed. If one follows Deer Lane north across PA 944, you do not see any more rock at the surface, nor will you see it as we proceed south on Deer Lane after this site. The hill stays narrow and steep-sided to the north, but flattens out to the south. Figure 18 gives an indication of the topography in the area.

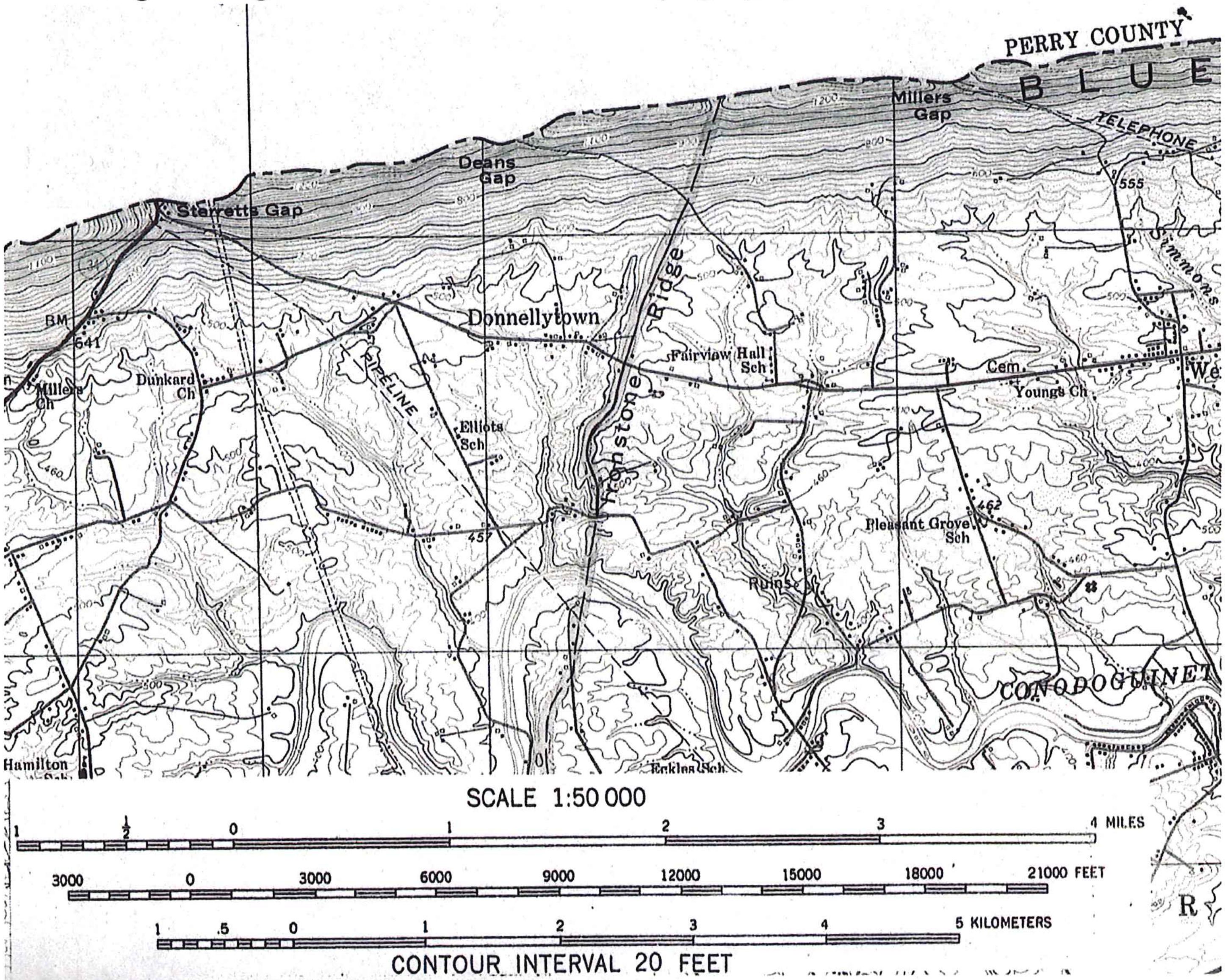

Figure 18. Topographic map of Ironstone Ridge. Note the height of the narrow ridge. The stop site is adjacent to the letter n in Ironstone.

The left photo shown in Figure 19 shows the diabase distribution over part of the surface along Deer Lane. The right photo shows a view looking north along the road that gives an idea of the narrowness of the ridge.

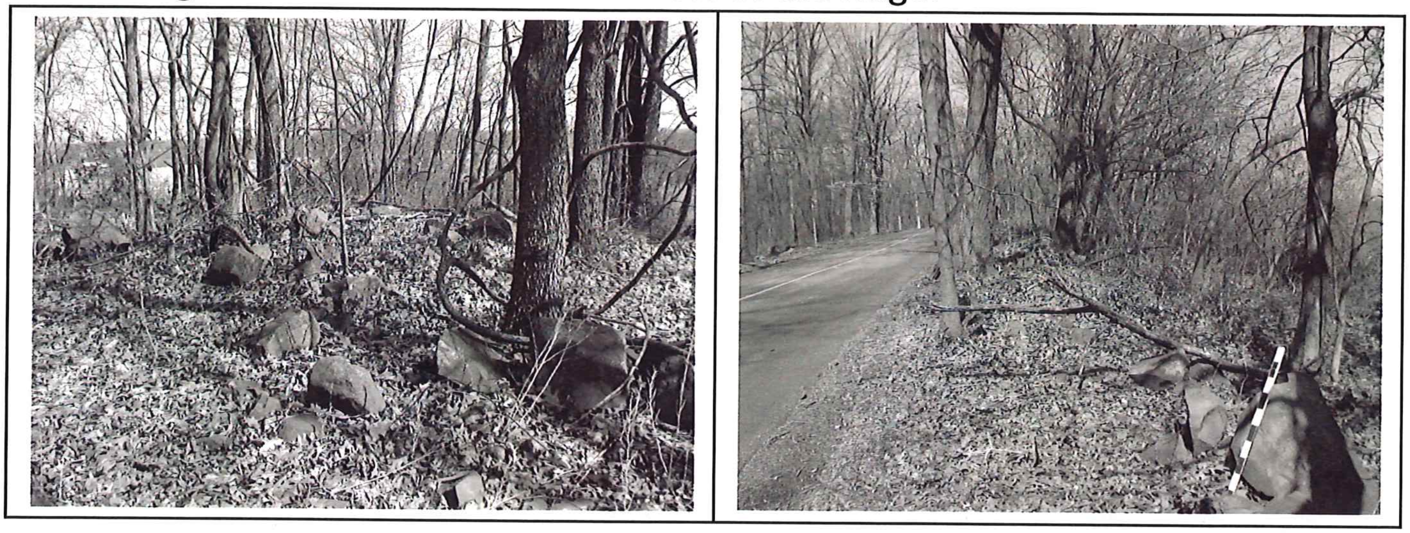

Figure 19. View of diabase boulders on Ironstone Ridge (left) and the width of the ridge looking north along Deer Lane.

LEAVE STOP 7. PROCEED STRAIGHT AHEAD.

0.5 57.0 **STOP SIGN. TURN RIGHT** onto Sherwood Drive.

2.2 59.2 **STOP SIGN. TURN LEFT** onto Wertzville Road (PA 944). There is a Y at this intersection on the left. Be sure to stay right.

1.7 60.9 **TURN LEFT** onto PA 34.

6.2 67.1 Follow PA 34 back through Carlisle to Carlisle Commons Mall and starting point. **END OF FIELD TRIP.**