FOURTEENTH ANNUAL

FIELD CONFERENCE OF PENNSYLVANIA GEOLOGISTS

Harrisburg, Pa.

May 28-30, 1948

GUIDEBOOK

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*EXCURSION 1. South Mountain.

*EXCURSION 2. Pennsylvania Turnpike.

EXCURSION 3. Cornwall Mine.

*EXCURSION 4. Susquehanna-Juniata Rivers.

HOST

Pennsylvania
Topographic and Geologic Survey

*Itinerary incorporated in guidebook.

FIELD CONFERENCE OF PENNSYLVANIA GEOLOGISTS

Harrisburg, Pa.

Friday afternoon, May 28, 1948

SOUTH MOUNTAIN EXCURSION

Leaders: R. M. Foose (Franklin & Marshall)
formerly of the Penna. Topog. & Geologic Survey
F. M. Swartz (Penn State)
Coöperating Geologist, Penna. Topog. & Geologic Survey
R. C. Stephenson, Penna. Topographic & Geologic Survey

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Much of the trip geology presented in this itinerary drawn from published geologic literature. Credit is given especially to George W. Stose for the mapping of the Cambro-Ordovician limestones traversed between Harrisburg and Boiling Springs.

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PLEASE USE AS LITTLE TIME AS POSSIBLE GETTING TO AND FROM CARS

REFERENCES FOR SOUTH MOUNTAIN EXCURSION

Foose, R. M., Mining and treatment of a clay near Mt Holly Springs, Pa. A.I.M.E. Tech. Paper 1655, 1944.

__________, Iron-manganese ore deposit at White Rocks, Cumberland Co., Pennsylvania. Pa. Topog. & Geol. Surv. Bull. M26, 1946.

__________. Manganese minerals of Pennsylvania. Pa. Topog. & Geol. Surv. Bull. M27, 1946.

Stephenson, R.C., A pyrophyllite deposit in Adams County, Pa. Presented at A.I.M.E. meeting, New Yor, 1948 (in manuscript).

Stose, G.W., Geology & mineral resources of Adams Co., Pa. Pa. Topog. & Geol. Surv. Bull. C1, 1932.

__________ & F. B. Bascom, Fairfield-Gettysburg Folio. U.S.G.S.Folio 225, 1929.

__________ & A. I. Jonas, Geology and mineral resources of York County, Pennsylvania, Pa. Topog. & Geol. Surv. Bull. C67, 1939.

Miles

Miles	
	Heading west on driveway in front of South Office Building.
0.0	Turn right on Walnut Street.
0.3	Crossing Walnut Street Bridge (Toll 5 cents).
1.0	Turn left on U.S.15.
1.1	Stop sign. Bear right under PRR, Martinsburg shale poorly exposed to right.
1.3	Stones River limestone exposed on right.
1.7	CAUTION, bear left on U.S. 15, 0.2 of mile beyond traffic light.
2.6	Sharp left over PRR, then right.
3.6	Beekmantown limestone exposure on left.
3.95	Abandoned quarry in Beekmantown on left.
4.0	Bear left on U.S. 15.
4.2	Pennsylvania Industrial School on left.
5.1	Stonehenge limestone cropping in school yard to right, road for next mile parallels an overturned fold which brings the Conococheague limestone to the surface.
6.4	Stonehenge limestone on right.
6.9	Low hill to left is topographic expression of Martinsburg shale, contact with limestone approximated by base of slope.
7.6	Martinsburg shale exposed in road cut.
8.8	Note Triassic Diabase capped Conewago Hills rising several miles to southeast.
9.0	Passing through Shepherdstown.
10.1	Turn right, leaving U.S. 15.
10.3	STOP 1. Good view of South Mountain. Brief discussion of the salient features of South Mountain Geology.
10.6	Elbrook limestone on right.
11.1	Elbrook limestone in road cut.
11.4	Cross road, stop sign.
11.7	Crossing over Dillsburg Branch, Reading RR.

Miles	
12.6	Elbrook limestone cropping in low hills.
13.5	Stop sign, turn left on Pa. 174.
14.55	Elbrook limestone on right.
14.8	Limestone sink in field to left.
15.05	Churchtown, turn left at center of town.
15.55	Approaching South Mountain.
15.7	CAUTION. Stop sign, continue straight ahead.
15.85	Stop sign, continue straight ahead.
16.1	White Rocks synclinal reëntrant straight ahead (iron-manganese deposit; see Topog. & Geol. Surv. Bull. M 26, by R.M.Foose)
16.6	CAUTION. Cross railroad along Yellow Breeches Creek.
16.8	Crossing Yellow Breeches Creek, White Rocks to left.
17.5	Limestone cropping in road.
17.75	Limestone sink left of road.
17.8	Turn left to Ege bank.
18.4	STOP 2 Ege ore bank.
18.9	Retracing path, turn left on hard surfaced road.
19.75	Turn right along Reading RR.
19.85	Cross railroad and Yellow Breeches Creek.
19.9	Remains of old iron furnace on right, about 500 feet back from road.
20.0	Boiling Springs, turn right onto street paralleling lake. Old Ege Mansion to right, across lake.
20.25	Pause momentarily for view of Boiling Springs which yield an estimated 13,000 to 20,000 gpm from the Elbrook limestone.
20.3	Stop sign, turn left, go one block, then left again.
22.1	Crossing Yellow Breeches Creek.
22.8	Note sand quarry in Antietam Quartzite on mountain slope to left.
24.0	Large limestone sink hole on left.
24.4	Viewing Mt Holly Gap to left, note sand quarries.

Miles	
24.75	Crossing Mountain Creek.
24.85	Stop sign, turn left on Pa. 34, entering Mt Holly Springs.
25.4	Bear left.
25.7	STOP 3, at Deer Lodge to see Antietam Quartzite on right.
25.9	Crossing Mountain Creek.
26.1	Heavy Montalto quartzite talus on left.
26.4	Bear right on Pa.34.
26.6	Medlar iron ore banks in woods just left of road.
28.2	Crossing Hunters Run.
28.4	Turn right on dirt road.
28.7	CAUTION, railroad crossing.
29.05	Stop sign, bear right on black top.
29.4	Turn right to Toland operation of the Philadelphia Clay Co.
30.1	STOP 4. Mine of Philadelphia Clay Products Company.
30.8	Turn right on highway, returning from clay mine.
31.7	Abandoned clay drifts on right.
32.05	Path to left of road leads to abandoned dolomite quarry where fluorite may be collected.
33.0	Henry Clay iron ore banks on left; road cuts through old waste dumps in the next one-quarter mile.
34.3	Old ore pit on left.
34.6	STOP 5. Road cut in pre-Cambrian rhyolite.
35.1	Schistose rhyolite on right.
35.35	Rhyolite on right.
35.55	STOP 6. Greenstone schist.
36.5	Rhyolite to left of road.
36.8	Slow, turn left, then right at bottom of hill.
37.0	STOP 7. Pine Grove Furnace.

Miles	
37.05	Leaving the furnace, turn right, then left.
37.15	CAUTION, rejoin hard surface road. Relax, enjoy nature for next six miles.
40.7	Leaving Cumberland County, entering Adams County.
43.3	Turn left on gravel road.
44.0	CAUTION, sharp curve to right.
44.4	CAUTION, steep grade, curve to left. Loudoun quartzite exposed in cut on left contains abundant rhyolite fragments.
44.9	Epidotized rhyolite boulders piled to right of road.
45.1	Turn left on hard road. Note abundant greenstone float between here and school house.
46.7	STOP 8. Piedmontite locality. Epidote and chrysotile may also be found.
48.6	Good view ahead into north end of Buchanan Valley, an anticline in rhyolite forms Bear Hill, bordering valley on east.
49.1	On right, vein quartz in field to west of church, Wenksville.
49.8	On left, vein quartz cutting sericite-chlorite schist.
50.3	Outcrop of strongly foliated rhyolite.
51.1	Sericitic rhyolite with slightly folded cleavage exposed in drive on left.
51.6	Massive rhyolite exposed on left.
52.6	Entering Bendersville.
53.0	Bear 45 degrees to left and up hill.
53.4	Triassic lowlands off to east.
53.8	Stop sign, turn left on Pa. 34.
54.5	Massive rhyolite well exposed on left.
56.4	Road cut in rhyolite.
57.95	Idaville, turn right toward York Springs.
57.1	Exposure of rhyolite.
57.6	Passing through area mapped as Triassic fanglomerate.

Miles	
58.6	Rhyolite float in woods to left.
58.8	Turn left.
59.3	STOP 9. Gargol pyrophyllite deposit.
59.65	Turn right on gravel.
60.05	Rhyolite in field to right.
60.3	Rhyolite in road bed, easternmost extremity of occurrence in South Mountain.
60.6	CAUTION, Stop sign, turn left on hard road.
61.1	Valley to left underlain by Beekmantown limestone; abandoned quarry on right.
61.3	Good view of South Mountain to left.
61.5	Abandoned limestone quarry on left.
62.6	Stop sign, right on Pa. 94 into York Springs.
63.5	Stop sign, turn left on U.S. 15.
64.5	Road passes through Triassic Gettysburg red shales most of way to Dillsburg.
67.8	Sandy member in Gettysburg shale.
70.1	Travelling now over diabase-capped ridge.
71.4	Sandstone in Gettysburg shale on right.
72.1	Dillsburg, turn right, following U.S.15.
72.25	Bear to left, leaving Dillsburg. The Dillsburg magnetite mineralization lie about one mile east of town. There are very few surface indications of the ores.
74.8	Triassic diabase which caps hill is exposed in road cut.
75.1	Excellent Triassic diabase exposure.
75.4	Martinsburg shale.
76.25	Cross road, retracing original route from here to Harrisburg Follow U.S. Route 15.
86.3	Harrisburg, END OF EXCURSION. Either bridge may be used to enter Harrisburg. East-bound traffic on the Market Street Bridge usually moves more quickly.

FIELD CONFERENCE OF PENNSYLVANIA GEOLOGISTS

Harrisburg, Pa.

MAY 1948

PENNSYLVANIA TURNPIKE EXCURSION*

Leader: A. B. Cleaves

MAY 29, 1948

SAFETY FIRST

Do Not Cross Highway! Do Not Walk on Highway!

YOUR COOPERATION IS ESSENTIAL

Material presented in this guide is extracted from the forthcoming revised and expanded "Guidebook to the Geology of the Pennsylvania Turnpike" by Dr. Cleaves, Coöperating Geologist, Pennsylvania Topographic and Geologic Survey, Department of Internal Affairs.

*This excursion is being made toll-free with compliments of the Pennsylvania Turnpike Commission.

GEOLOGY ON THE PENNSYLVANIA TURNPIKE
By A. B. Cleaves

Section 1. Middlesex ---- Blue Mountain Tunnel (27.1 miles)

The easternmost section of the Turnpike lies wholly within the Cumberland Valley Section of the "Great Valley", which is actually a part of the Valley and Ridge Physiographic Province. In this area, it is underlain by limestones of Cambrian and Ordovician age, shales and sandstones of Ordovician age, and some igneous intrusive basalts of Triassic age, which occur as dikes or locally as sills.

The original valley floor or erosion surface is known as the Harrisburg peneplain, but subsequent uplift has resulted in youthful dissection of this surface. As a result, this ancient erosion surface is today represented by a general accordance of flat-topped hills throughout the valley. The old peneplane surface stood higher in the section across the valley from Blue Mountain Tunnel than close to the Susquehanna River because the surface was graded to the level of the cross-cutting drainage.

Stream grades were very gentle on the Harrisburg peneplain surface, hence stream-meanders were abundant. The Conodoguinet was a typical stream, but with general uplift throughout the area, this old stream became rejuvenated and entrenched its meanders in the surface to a depth of 140 feet. These features are prominently displayed on the topographic maps covering the area. The creek is crossed by the Turnpike several times.

The bed-rock in the valley is strongly folded. One passes over numerous minor anticlines and synclines throughout the eastern 27 miles of the Turnpike.

On the north, the skyline is dominated by the crest of Blue Mountain. The strata of which this mountain is composed stand nearly vertical. Younger than the rocks in the valley, they are overturned toward the north in the vicinity of Sterretts Gap and in part broken by thrust-faulting in Blue Mountain Tunnel. The mountain at Doubling Gap has a sharp "Z"-shaped pattern which is the surface expression of a local, "tight" anticlinal and synclinal fold. This reëntrant is almost due north of mile-post 16 (west-bound) or 144 (east-bound), but may be seen at many other stations.

The southern skyline is marked by the serrated South Mountain ridges. South Mountain is underlain by ancient Pre-Cambrian volcanic rocks, much older than any of the rocks exposed along the Turnpike.

Cumberland Valley is noted chiefly for its agricultural wealth, but it is not lacking in mineral wealth. A number of scattered limestone quarries operate throughout the area. On the flanks of South Mountain an iron industry flourished in the early eighteen hundreds, utilizing residual iron-manganese ores, appreciable reserves of which remain today.

Mileage West-bound		Mileage East-bound
0.0	Leaving U. S. Route 11.	160.0
0.4	Route 11 passes under the Turnpike at Middlesex and the eastern terminus. Martinsburg shale.	159.6
1.4	Martinsburg shale, platy, calcareous, grading into black siliceous shale. Approximate contact between the Cambro-Ordovician limestones and the Martinsburg. Turnpike travelling at the level of the Harrisburg peneplane.	158.6
2.5	CARLISLE INTERCHANGE. Ticket booth. Route 34 passes under the Turnpike. Carlisle, county seat of Cumberland County, is famous in Colohial and Civil War History. It is the home of Dickinson College (founded in 1783), and was the site of "Public Works", a cavalry post for a century (founded in 1777), that later became the Carlisle Indian School, and which, has since been enlarged and converted into a U. S. Army Medical Department Field Service School.	157.5
3.0-3.2	Cambro-Ordovician limestone, dark-gray, somewhat argillaceous, solution pits on bedding planes. Exposed in long cut. Strike N82W, Dip 62°NE.	156.8-157.0
5.25	Cambro-Ordovician limestone and an old lime kiln.	154.75
5.45	Cambro-Ordovician limestone, crystalline, dove-gray, porous, platy. Strike N43E, Dip 27°SE.	154.55
5.85	West boundary, Carlisle Quad.; east boundary, Newville Quad.	154.15
7.58	Cambro-Ordovician limestone, bluish-black, platy to medium-bedded. Strike N28E, Dip 18°SE.	152.42
7.8	PLAINFIELD GAS STATION (eb) J. S. Diller, Geologist of U.S.Geological Survey, 1883-1928, is buried in cemetery to south of highway.	152.2
9.25	Cambro-Ordovician limestone, at bridge over the Turnpike. Impure, blue-gray limestone, some lensing, strongly fractured and cut by calcite veins. Platy limonite developed in residuum. Strike N61E, Dip 40°SE.	150.75
10.48	Cambro-Ordovician limestone, blue-gray, dense, crystalline Strike N68E, Dip 47°NW.	149.52
10.95	Cambro-Ordovician limestone, weathers light-gray, grainy structure on weathered surface. Strike N23W, Dip 21°NE.	149.05
11.7	Ordovician (Trenton?) limestone. Dense, blue, highly fossiliferous. Strike N60E, Dip 71°SE.	148.3

Mileage West-bound		Mileage East-bound
11.75	Bridge over the Turnpike. The Contact between the Martinsburg and the Cambro-Ordovician (Trenton) limestones occurs just west of this bridge.	148.25
11.85	Conodoguinet Creek bridge crossing. Martinsburg shale.	148.15
12.4	Martinsburg shale, black, siliceous, pencil fragments. Used extensively for shoulder material. Strike N65E, Dip 79°NW.	147.6
12.8	Newville Maintenance Building	147.2
15.0	Martinsburg shale in long deep cut. Black siliceous shale, and hard, massive sandstone interbeds. Exposed surfaces on the sandstone show "mud-flows" contemporaneous with deposition, north side of road. Strike N52E, Dip 82°SE.	145.0
16.0	View of Doubling Gap to north.	144.0
17.3	Martinsburg shale in long cut, black, siliceous. Strike N53E, Dip 70°SE.	142.7
18.45	Martinsburg shale, siliceous with occasional sandy beds. Strike N56E, Dip 78°NW.	141.55
19.25	West boundary, Newville Quad.; east boundary, Shippensburg Quad.	140.75
19.65	Martinsburg shale in cut and in the banks of the underpass beneath and north of the Turnpike. Showing numerous minor folds, the shale is fissile and in part arenaceous. Strike N65E, Dip 73°NW.	140.35
19.8–24.0	Throughout these miles numerous low cuts show outcroppings of weathered Martinsburg shale. At wb 21.8 (eb 138.2) miles, view to northeast, up Doubling Gap Valley; note winding crest of ridge.	136.0–140.2
24.5	Blue Mountain Gas Station (wb)	135.5
25.7	Blue Mountain Interchange connects with State Route 944. Martinsburg, black shale.	134.3
27.5	East Portal Blue Mountain Tunnel. Martinsburg, black, siliceous, pencil shale. Strike N45E, Dip 38°NW.	132.5
28.35	West Portal Blue Mountain Tunnel. Rose Hill (Clinton) weathered shales, extremely fossiliferous in the cut above the portal building. Strike N46E, Dip°55 NW.	131.65

Section 2. Blue Mountain — Allegheny Mountain (76.15 miles)

This stretch of the Turnpike passes through the "Ridge and Valley Physiographic Province". It is so named because differential erosion of the intensely folded and crumpled bed-rock has resulted in a surface featured by parallel, sharp-crested ridges and narrow, deep valleys. The general concordance of the elevations of these ridge crests has been interpreted as an expression of an erosion surface known as the Schooley Peneplain. Much has been written pertaining to this ancient surface and ingenious techniques have been developed for the purpose of postulating its extent, subsequent warpings and ultimate dissection.

The bed-rock exposed include strata dating from the Cambrian to the Pennsylvanian Coal Measures. The latter occur as an outlier, remote from the general area of their outcrop west of the Allegheny Front, in the Broad Top Syncline. The Broad Top Coal Field is located in the area between Sideling and Rays Hills, but the Turnpike crosses near the southern extremity of the structure, hence, the youngest strata seen along the road are Pocono and Mauch Chunk.

Cambrian strata may be seen among the limestones outcropping between Everett and Bedford. For many years these limestones have been poorly differentiated, consequently, they have been generally called the Cambro-Ordovician limestones. The writer has followed this common practice, but hope is entertained that confusion relative to these strata is about to end. The writer has been informed* that two independent workers have been successful in determining

*Personal communication from Professor Frank M. Swartz, State College, Penna.

the various Cambrian and Ordovician strata in these limestone sequences. Consequently, it is hoped that publication will be rapid and the necessity of "lumping" these strata will be ended. In Path Valley, between Kittatinny and Tuscarora Mountain Tunnels, the exposed limestones belong at the top of the Cambro-Ordovician section, and near the contact with the overlying Ordovician, Martinsburg, shales. They are very fossiliferous.

Folding of the strata in this section of the Turnpike has been associated with faulting. Some of the faults are low-angle thrusts (as in Blue Mountain), but others are normal strike-slip, tear, and transverse faults. The fault of greatest magnitude, "Great Cove Fault", crossed by the Turnpike near Burnt Cabins, in Fulton County, apparently brings Upper Devonian into contact with Middle Silurian. A more comprehensive study of the faulting than possible in this report is desirable.

The economic resources of the area are chiefly silica sand, from the Tuscarora and Oriskany formations, north and south of Bedford and Everett; limestone for road metal and other purposes; coal in the Broad Top Field; low-grade iron ores; and natural gas, possibilities of which are being actively investigated today. The iron ores assumed some importance in Colonial days and during the Civil War, but promise no serious potentiality for the future until high-grade deposits in other parts of the United States are exhausted.

Mileage West-bound		Mileage East-bound
28.5	East Portal Kittatinny Tunnel and Gunter Valley. At this portal the Bloomsburg red shale is faulted into position against the Rose Hill formation. The structure through Blue and Kittatinny tunnels being synclinal, the development of the valley may be attributed in part to faulting and to the work of Trout Run parallel to the axis of the syncline.	131.5
29.4	West Portal Kittatinny Tunnel. Martinsburg, black siliceous shale. Strike N55E, Dip 68 to 90°SE. Amberson Valley to the north.	130.6
29.9	Martinsburg shale on the northeast end of Timmons Mountain, a synclinal spur of Kittatinny Mountain which noses out just south of the Turnpike. The shale is splintery, siliceous, black, and contains hard sandstone interbeds. Strike N60E, Dip 42°SE.	130.1
30.5	Note cove on south, minor plunging anticline.	129.5
30.8	North end of Timmons Mountain, rising syncline, crest of Tuscarora and flanks of Martinsburg.	129.2
32.2	Martinsburg shale, strongly weathered with a veneering of stream gravels, along valley of West Branch of Conococheague Creek.	127.8
33.2	Gravel deposit, stream terrace.	126.8
33.85	Gravel deposit, stream terrace.	126.15
34.25	West boundary, Shippensburg Quad., east boundary, Orbisonia Quad.	125.75
34.9	Nose of synclinal Knob Mountain on north. The crest ofthe mountain is Tuscarora Sandstone, the underlying Martinsburg shale forming the lower part of the nose of the syncline.	125.1
35.2	Martinsburg shale, as above without sandstone interbeds.	124.8
35.4	Martinsburg shale, in cut. Fissile, black, siliceous shale with interbedded sandstone units occurring near the base. The sandstone is cross-bedded. Strike N25E, Dip 42°SE.	124.6
36.0	Cambro-Ordovician limestone (Trenton?), platy, very fossiliferous on the north side of the road at the west end of the cut. On the south side of the road, Martinsburg black shale outcrops. Contact with the Martinsburg. Strike N37E, Dip 46°SE. Approximately	124.0

Mileage West-bound		Mileage East-bound
	on the line of strike to the north, one mile south of Spring Run, there is a large quarry opened in these limestones. The strata at the top of the series exposed are very fossiliferous (Trenton?). Strike N41E, Dip 43°SE.	
37.1	"Rosebud" concretions in open fields and borrow pit, 50 feet north of the Turnpike near the country road underpass. Note large blocks of light-gray, dense, massive limestone weathering almost white.	122.9
37.4	Cambro-Ordovician limestone, light-gray, thick-bedded. Strike N55E, Dip 26°SE.	122.6
38.4	Willow Hill Interchange. Cambro-Ordovician limestones. The Turnpike is aligned with the crest and axis of an anticline. At the ticket booth to the southeast, the strata strike N52E and dip 27°SE (these beds are replete with "Rosebud" siliceous concretions varying in size from marbles to basket-balls). In the interchange underpass, northwest side of the Turnpike, the strata strike N45E, and dip 46°NW.	121.6
39.1	Path Valley Gas Station (eb)	120.9
39.65	East Portal Tuscarora Tunnel. Black, siliceous, Martinsburg shale, thin-bedded. Strike N33E, Dip 64°SE.	120.35
40.75	West Portal Tuscarora Tunnel. Wills Creek red and yellowish-green, soft shales crop in the approach cut to the tunnel. Dip 78°W.	119.25
41.0	Burnt Cabins Maintenance Building.	119.0
41.1	Tonoloway (ribbon) limestone, exposed under the footings of the bridge which carries a township road over the Turnpike.	118.9
41.8	Tonoloway (ribbon) limestone, gray, thin-bedded.	118.2
42.0-42.8	Wills Creek interbedded red and greenish-yellow, soft shales.	117.2-118.0
42.8	Keefer quartzite resting on Rose Hill (Clinton) and underlying the McKenzie. This exposure is at the eastern end of the structure carrying the Turnpike over the Fannettsburg-Burnt Cabins Road. The Keefer is also exposed at the western end of this structure. The Rose Hill is best exposed in the cut beneath and northwest of the bridge, where it is fossiliferous. The weathered shales overlying the Keefer, probably represent the McKenzie; they are in	117.2

Mileage West-bound		Mileage East-bound
	part faulted out. They are fossiliferous. Strike N55E, Dip 57°SE. Keefer appears three times in the next one-half mile west-bound.	
43.3	Keefer quartzite, cream-colored, and the fossiliferous Rose Hill shale and sandstone. These strata are locally, complexly folded and faulted. Strike E-W, Dip 44°N.	116.7
43.4	Wills Creek, interbedded red shale and greenish-yellow shale with ripple-marked surfaces. Strike N83E, Dip 57°NW. The village of Burnt Cabins immediately north of the highway.	116.6
43.4-44.0	Great Cove Fault, sometimes called the Fulton County Fault. There is a concealed interval in this area, but the presence of a fault is inescapable. The first strata west are Upper Devonian, those adjacent to the east are Silurian; studies made in the valley north of Burnt Cabins and Penna. Second Geological Survey Reports, all substantiate strong faulting here. Actually, this is the fault of greatest magnitude known, to date, anywhere along the line of the Turnpike.	116.0-116.6
44.9	Brallier (Upper Portage Group) shale, in part arenaceous, green, fossiliferous.	115.1
45.1	Brallier shale with thin sandstone interbeds. Dark green, occasional fossils. Strike N27E, Dip 69°SE.	114.9
45.4	Gobblers Knob (1,954 feet) on north, point of rising anticline in Tuscarora (Upper Medina) sandstone.	114.6
46.0	Brallier shale.	114.0
46.1	Portage (Brallier) Sandstone, argillaceous, mottled red and green. Strike N18E, Dip 48°SE.	113.9
46.6	Burket, black, thin-bedded, arenaceous shale. Buchiola, Manticoceras, etc. Strike N15E, Dip 27°SE.	113.4
46.9	Local anticline with residual soil bounding a strongly shattered, bluish-gray limestone which is thought to be Tully. Occasional fragmentary fossils are found. The limestone on the east side of the road strike N70E and dip 41°SE; the limestone on the west side of the road strike N34E and dip 28°NW. The strong fracturing and development of clay suggests that this anticline of Tully (?) may in part be faulted into position.	113.1

Mileage West-bound		Mileage East-bound
47.4-47.65	Fort Littleton Interchange — connects with U.S.Route 522. Harrell shales, black, fissile, thin-bedded. Barren. Strike N30E, Dip 26°SE. These shales are strongly jointed, the fractures striking N85E and standing vertical. Scrub Ridge (1,600-1,850 feet) on southeast forms west flank on an anticlinal mountain which plunges toward Turnpike north of Sidney's Knob.	112.35-112.6
48.1-48.3	Clay, orange and bluish-gray. It is suggested that a minor fault passes through this area. In the same cut calcareous shale and a strongly slickensided blue limestone (both fossiliferous) are found. The anticlinal structure is plainly seen, the easterly beds strike N67E and dip 49°SE, the westerly strata striking N25W and dipping 32°SW. The limestone is believed to be Tully, the intervening shale, Upper Hamilton (Moscow), with an underlying slightly conglomeratic Hamilton sandstone.	111.7-111.9
48.8	Portage shale, green, soft, interbedded with thin-bedded argillaceous sandstone. Strike N31E, Dip 19°SE.	111.2
49.6-50.0	Portage shales and interbedded, thin sandstone. Strike N36E, Dip 37°SE. A few hundred yards north across the Hustontown Road, the Helderberg limestones are quarried, and Oriskany beds outcrop. Known faults occur in this area, but locally may decrease in magnitude so that the Portage is scarcely affected at this point on the Turnpike.	110.0-110.4
49.9	West boundary, Orbisonia Quad.; east boundary, Broad Top Quad.	110.1
50.15-50.25	Portage shales consisting of greenish shale and interbedded, slabby sandstone. Strike N23E, Dip 87°NW. "Spirifer" mucronatus var posterus, Chonetes, etc.	109.75-109.85
50.8	Portage shales. Olive-drab shale with occasional interbeds of grayish-green sandstone. Much of the shale breaks down into pencil fragments. Fossils. On the north side of the road, faulting complicates the structure. There is a fault on the west limb of a small syncline. The strata dip east; west of the fault the dip is 16°E and east of the fault 50°E. The east limb of the syncline is seen striking N15E and dipping 26°NW.	109.2
51.6	Bridge over the Turnpike. Cut in Chemung, interbedded red sandstone and greenish-gray shale.	108.4
51.7	Approximate Contact "Catskill" facies with Chemung. Fossils at 108.35. Interbedded green shale, red shale, gray-green sandstones, and "mud-chip" beds. A one-foot conglomeratic bed is also present.	108.3

Mileage West-bound		Mileage East-bound
52.9-53.2	"Catskill" facies, consisting of soft red and arenaceous shales with interbedded sandstone. Strike N57E, Dip 34°NW.	106.8-107.1
55.5	Cove Valley Gas Station (wb). Note high-terrace gravels on red shales near viaduct.	104.5
55.9	"Catskill" facies. Red shale and sandstone. Contact with Pocono concealed to the west. In this cut the strata is strongly fractured and folded. Strike N20E, Dip 11°SE.	104.1
56.45	East Portal Sideling Hill Tunnel. This is the longest tunnel on the Turnpike (6,632 feet). The entire tunnel is driven through the Pocono formation. The sandstone which dips west at a low angle into the Broad Top Syncline, is complicated by faulting.	103.55
57.7	West Portal Sideling Hill Tunnel. Approach cut and tunnel in the Pocono sandstones and shale. Minor folding and faulting cause varying strikes and dips. In the approach cut one strike is N42E, and dips vary from 16°NW to 26°SW.	102.3
58.4	Rim of Broad Top coal field seen in distance to north.	101.6
59.3	Pocono, platy sandstone, brought to the surface in a minor anticline (Mauch Chunk crops both east and west). Strike E-W, Dip 26°N.	100.7
61.0	Mauch Chunk red shales.	99.0
61.6	East Portal Rays Hill Tunnel (length 3,396 feet). Mauch Chunk is exposed at portal. Red and soft yellow and red shale, thin-bedded. Strike N16E, Dip 34°SE. In this tunnel the Pocono sandstone rises sharply to the west. The Mauch Chunk is exposed at the east portal, the tunnel is driven mostly through Pocono and the underlying Catskill is exposed at the west portal. The area between Rays and Sideling Hill is in a gentle syncline, complicated by a minor anticline that brings the Pocono to the surface approximately midway between the tunnels. To the north, in this basin, progressively younger strata occur so that the productive coal measures are found, in this, the Broad Top Coal Field.	98.4
62.25	West Portal Rays Hill Tunnel. "Catskill" facies. Soft earthy, and arenaceous red shale. Strike N16E, Dip 38°SE.	97.75
63.6	South boundary, Broad Top Quad.; north boundary, Needmore Quad.	96.4

Mileage West-bound		Mileage East-bound
63.65	Crossing the Lincoln Highway, Route 30.	96.35
64.2	Breezewood Interchange to U. S. Route 30.	95.8
65.1	West boundary, Needmore Quad.; east boundary, Clearville Quad.	94.9
65.6	"Catskill" facies, red sandstones and shale. Dip 10°E.	94.4
67.5	"Catskill"facies, sandstone and red shale. Dip 7°W.	92.5
69.4-69.6	"Catskill" facies — bridge over the Turnpike at wb 69.5 (eb 90.5) miles, near the axis of a minor syncline, one limb dipping 24°NW with local steepening to 64°NW, and the other limb dipping 38°NE, flattening to 10°NE.	90.4-90.6
70.0	"Catskill" facies, red sandstones and shales in all cuts from Rays Hill westward to Clear Ridge. Considerable folding is evident in many cuts, hence numerous minor synclines and anticlines can be mapped in this area. At wb 69.8 (eb 90.2), the strata dip 50°NE. At wb 70.0 (eb 90.0) the strata dip westward 10°, 44°, and 9°.	90.0
70.5	North boundary, Clearville Quad.; south boundary, Everett Quad.	89.5
70.5-70.9	Clear Ridge Cut, 153' deep and 2,475' long. This is the deepest highway cut in eastern United States. "Catskill" strata at the east end of the cut transitional westward into Chemung interbedded sandstone and shale. Strike N32E, Dip 53°SE. Note, at the west end of the cut a fill 98' high.	89.1-89.5
71.6	Chemung in a cut 25 to 30' deep. Green shales and interbedded chocolate-red sandstone and shale. Pterinea chemungensis. Dip 42°SE.	88.4
71.7-71.9	Portage shales. Soft olive-drab shale, barren. Tully and Harrell beds are concealed in the valley to the west. In this cut, the strata are thrown into a syncline, the east limb dipping 47°W and its west limb dipping 44°E. There is an overhead bridge in the middle of the cut at wb 71.8 (eb 88.2) miles.	88.1-88.3
72.2	Hamilton Group. In a 40' deep cut, brownish weathering gray sandstones, thin-bedded except for a massive unit near the center of the cut, are overlain by Hamilton shales in the eastern end of the cut. Strike N26E, Dip 48°SE. Locally, these beds are very fossiliferous; large "Spirifer's", Chonetes, and Tropidoleptus.	87.8

Mileage West-bound		Mileage East-bound
72.5- 72.6	Warrior Ridge. Lower Devonian strata in deep cut. The westward sequence of the strata in this cut is: — Onondaga (Needmore) black, fissile shale. 114' Ridgeley sandstone, fossiliferous. 76' Shriver chert, weathered, fragmentary. 75' New Scotland chert, weathered, fragmentary. No fossils found. 15' Coeymans crystalline, very fossiliferous limestone. Keyser? The strata Strike N36E, Dip 41^{o}SE. Across the Juniata River, from the town of Everett north, continuous exposures of Oriskany occur. It is extensively quarried at Tatesville, 3 miles north of Everett, by the Pittsburgh Silica Sand Company.	87.4- 87.5
72.8	Everett Maintenance Building and shops for the Pennsylvania Turnpike. Site of Everett-Saxton iron works. Note slag piles. Everett was former iron town.	87.2
73.1	Rose Hill (Clinton), covered but under the houses on the south side of the road, there exists a filled shaft used in Colonial days for mining the "Clinton" iron ore.	86.9
73.4- 73.75	Aliquippa Gap-Tussey Mountain, the nose of which at this point is called Mt. Dallas. In this gap a sequence of strata is exposed from the Tuscarora quartzite (east) through the Bald Eagle (Oswego) on the west, same as in the Bedford Narrows, but with the sequence reversed. The strata strike N22W and the dip varies from 44 to 64^{o}NE. Some faulting and shearing is apparent. The Tuscarora white quartz sandstone and quartzite (ganister) contain *Arthrophycus* (worm trails). At wb 73.7 (eb 86.3), the Bald Eagle, an easily recognizable rusty speckled sandstone, is strongly shattered and faulted. Near the west end of the cut, the contact between the sandy Upper Martinsburg and the Bald Eagle may be seen. wb 73.8 (eb 86.2). All contacts are observed although not always clear.	86.25- 86.6
75.0- 75.1	New Enterprise limestone plant (north) and quarry (south) of the Turnpike. Cambro-Ordovician limestones. Strike N27E, Dip 43^{o}SE.	84.9- 85.0
75.95	Cambro-Ordovician limestone. Strike N31E, Dip 33^{o}SE.	84.05
77.0	Residual mantle of undissolved materials from the weathered limestone - reddish-brown in color.	83.0

Mileage West-bound		Mileage East-bound
77.5	Cambro-Ordovician limestone. Bluish-gray, high magnesium limestone. Strike N50E, Dip 47°SE. No attempt has been made to differentiate the Cambro-Ordovician lime stone in the course of the Turnpike studies, however, recent detailed investigations by other workers has shown that these beds may be subdivided.	82.5
77.8	Juniata River Crossing. Contact of the Martinsburg with the Upper Ordovician limestones was observed in the core-borings for the foundations of this bridge, but are no longer exposed. The Cambro-Ordovician limestone does not reappear to the west until brought to the surface on the Cincinnati Arch.	82.2
78.05-78.4	Bedford Narrows: Long, deep cut in Tuscarora, Juniata, and Bald Eagle (Oswego). The Martinsburg shale is concealed in the flat floodplain of the Juniata River between the Lincoln Highway and the Juniata River Crossing. Near the east end of the cut, the Turnpike bridge over the Lincoln Highway (Route 30), a fault brings the Bald Eagle-Juniata transitional strata to the surface. The Bald Eagle is a greenish-brown, rust-speckled sandstone, easily distinguishable from the red Juniata. The chief fault strikes N45E and dips 34°NW. West of the fault the Bald Eagle (110' thick) appears again. It grades westward into the Juniata red sandstone which is in turn transitional (through a 60' zone) with the Tuscarora quartzite, which is 150 feet thick, massive-bedded, white, very hard, and is locally called ganister. The Tuscarora occupies the west end of the cut.	81.6-81.95
78.5	Viaduct over Dunning Creek at its junction with the Juniata. Foundations for this structure placed on Rose Hill (Clinton) strata which are no longer visible.	81.5
79.2	Oriskany (Ridgeley sandstone). Yellowish-brown sandstone and chert. Platyceras and Spirifer arenosus common. This is the east limb of a shallow syncline. Dips to west.	80.8
79.4	Onondaga (Needmore shale) ? Strongly weathered black shale.	80.6
79.7	Turnpike MIDWAY. Service stations wb and eb Pedestrian tunnel leads to restaurant.	80.3
80.0-80.1	Oriskany (Ridgeley sandstone), yellowish-brown, strongly weathered, breaks down into a sand. Occasional fossils. This is the west limb of a shallow syncline.	79.9-80.0
80.25	West boundary, Everett Quad.; east boundary, Bedford Quad.	79.75

Mileage West-bound		Mileage East-bound
80.4	Bridge over the Turnpike. Oriskany, decomposed, is exposed.	79.6
80.55-80.6	Keyser limestone. Massive, and in part cherty limestone; prominent Stromatoporoid bed. Cherty beds rest on top of the Keyser, but no Coeymans or New Scotland fossils have been reported. Strike N11E, Dip 21°SE.	79.4-79.45
80.85	Tonoloway limestone (north) in 60' cut. The Keyser limestone occurs on top of this "ribbon" shaly limestone.	79.15
81.35	Tonoloway limestone, east of underpass. Many ostracoda. Strike N10E, Dip 23°SE. Wills Mountain rises to southwest, culminating in Kinton Knob (2,642 feet).	78.65
81.4	Underpass for U.S.Route 220 to Bedford. Bedford, settled in 1752, county seat of Bedford County. Fort Bedford (built 1758) important in French and Indian War was Washington's headquarters during Whiskey Rebellion. The famous Bedford Springs summer resort is two miles south of town.	78.6
81.6	Bedford Interchange. The strata on the west side are Wills Creek consisting of greenish-yellow shale interbedded with dove-gray calcareous shale. Some cherty limestone occurs near the top of the 40' cut. Near the ticket booth is a blue limestone replete with veins of calcite, quartz veins and vugs; some ostracoda are present. Strike N11W, Dip 12°NE.	78.4
81.75	McKenzie limestone. Thin-bedded, fossiliferous limestone, interbedded with greenish-brown shale. The Bloomsburg red shale just discernable at the west end of the cut. Strike N13W, Dip 19°NE.	78.25
82.0	Colonial iron workings, pits and mounds in Rose Hill (Clinton) to north of Turnpike.	78.0
82.1	Rose Hill shale unconformably overlain by stream gravel.	77.9
82.6	Axis of anticline plunging to the north.	77.4
83.0	Rose Hill Shale. Red and greenish-brown shale. Note Colonial iron pits and refuse mounds on top of the cuts, north of the Turnpike.	77.0
83.2	Rose Hill shale. An "iron-rich" sandstone unit caps the cut. The Rose Hill here is unique in consisting of much red shale. Fossiliferous. Strike N72E, Dip 24°NW. This is on the nose of a plunging anticline.	76.8
83.4	Wills Creek greenish-brown soft shales. Shallow cut.	76.6

Mileage West-bound		Mileage East-bound
83.6	Tonoloway-Wills Creek Contact. Wills Creek at east end of 20-foot cut. Strike N34E, Dip 50°NW.	76.4
83.9	Tonoloway in a 15-foot cut, deeply weathered. Ostracoda.	76.1
84.3	Cross over Lincoln Highway, Route 30.	75.7
84.8	Helderberg Limestone Group. This cut, about 60 feet high, is chiefly in the Keyser although some New Scotland and Coeymans may be seen at the west end of the cut. Strike N25E, Dip 64°NW. To the south across the valley of the Juniata on the northern edge of the village of Manns Choice, there is "Wonderlands Cave" developed in the Keyser limestone. The cave development occurs on steeply-dipping bedding planes in the Keyser, particularly, on the top of a Stromatoporoid bed. The Strike here is N48E, Dip 82°NW.	75.2
85.0	Oriskany in a low 10-foot cut. The Oriskany consists of decomposed Ridgely sandstone and Shriver chert. Few fossils.	75.0
85.4	Onondaga (Needmore Shale). Long deep cut east of the bridge over the Turnpike at this point. The Needmore is a fissile, black shale. Strike N20E, Dip 54°SE.	74.6
85.8	The Tully outcrops 2/10 mile east of the bridge in the center of the cut - Lopholasma tullius zone. Emanuella zone, well-developed. Strike N27E, Dip 87°SE. Exposures are good on both sides of the Turnpike. Note profile of Wills Mountain which reveals the rapid plunge of the anticline.	74.2
86.0	Juniata River Crossing (Raystown Branch). Burket, Tully, and Hamilton. Excellent fossil collecting; Tully limestone 8 feet thick with overlying Burket (Genesee) and underlying Moscow (Hamilton).	74.0
89.1-89.4	Portage "flags", interbedded shale and sandstone, in 30-foot cut. Strike N7E, Dip 13°SE.	70.6-70.9
91.4-91.5	Portage. Gray, arenaceous shale, some fissile black shale. Strike N50E, Dip 17°SE.	68.5-68.6
91.8	Portage, olive-drab shale in quarry north and northwest of bridge over Turnpike at this point. Fossiliferous.	68.2
93.0	South boundary, Bedford Quad.; north boundary, Hyndman Quad.	67.0
94.85	Kegg Maintenance Building.	65.15

Mileage West-bound		Mileage East-bound
96.5	West boundary, Hyndman Quad.; east boundary, Berlin Quad.	63.5
96.8	New Baltimore Gas Station (eb). Across from the gas station, on the north side of the Turnpike, there is a small quarry of Chemung or Portage (?), olive-drab interbedded, thin-bedded shale and sandstone. Raindrop impressions, and fucoid markings or worm tubes. Dip 10°NW.	63.2
98.0	Contact: "Catskill"-Chemung. Close to the bridge over the Turnpike at the Carmelite Mission. The Chemung consists of interbedded olive-color shale and platy, chocolate red, sandstone. Fossils found include *Productella speciosa* and *Productella lachrymosa*.	62.0
98.0-102.9	"Catskill" interbedded red and green shale and red sandstone, thickness approximately 2,011 feet. The strata in this interval dip westward from 5 to 18°. Occasional Ostracoderm (armor-plated fish) plates are found, especially at wb 98.9 - 99.1 (eb 60.9 - 61.1), the New Baltimore Slide. This slide, a combination slump-rock slip slide has given constant trouble. It involves rock throughout the entire length of the cut and 1,250 feet back from the Turnpike. Many thousands of cubic yards of rock have been removed from this area. Note ripple marks on red sandstone.	57.1-62
102.9	Contact: Pocono-Catskill (Hampshire of Darton).	57.1
103.65	Allegheny Tunnel (East Portal). The rock at the portal is the Burgoon sandstone at the top of the Pocono. Dip 8°NW. Most of the Tunnel is in Mauch Chunk shales. The east face of Allegheny Mountain consists of Pottsville sandstone at the crest, Mauch Chunk shales below, resting on the Pocono sandstone at the level of the tunnel portal.	56.35

FIELD CONFERENCE OF PENNSYLVANIA GEOLOGISTS

Harrisburg

Sunday, May 30, 1948

SUSQUEHANNA AND JUNIATA VALLEYS

Leaders: Bradford Willard (Lehigh)
Frank M. Swartz (Pennsylvania State),
both Coöperating Geologists,
Topographic and Geologic Survey

This trip is designed to demonstrate the stratigraphy from the Upper Ordovician through the Silurian, Devonian and Mississippian. Appalachian structures are to be observed and physiographic features of the Appalachian Mountains illustrated. The geologic column (taken from Pennsylvania Topographic and Geologic Survey, Bulletin G8) covers the sequence and transcends it in that it includes data on Pennsylvanian, Triassic and Lower and Middle Ordovician formations not observed on the trip. These are included for completeness and for the benefit of any who may wish to extend their visit to embrace these units. The geologic section is also quoted from the same bulletin and covers the structures and the stratigraphic sequence essentially as it will be seen on the trip.

DETAILED ITINERARY

Miles

0.0 Start. South entrance of South Office Building #1 at Harrisburg, headed west. Turn right at end of driveway on Walnut Street. Continue west, crossing toll bridge (fare 5 cents) to west side of Susquehanna River. Right on Route 15 and thence north along the west bank of Susquehanna River.

1.0 West end of bridge over Susquehanna River. West of highway, opposite bridgehead, in a deep railroad cut, the basal Martinsburg beds are transitional with the underlying Chambersburg (?) limestone. Platy limestone in the lower Martinsburg suggests the limestones seen to the north are interbedded with the shale. However, in this case, the shale grades down into limestone which in turn becomes purer and fossiliferous. There are important differences between the limestone beneath the Martinsburg and those interbedded with the shale. The limestone at the base carries large phenoclasts of massive, often sandy limestone, presumably derived from the Beekmantown. The basal limestone lacks breccia (edgewise conglomerate) and oölite. This section is also interesting as it shows the degree of crushing and alteration which the lower Martinsburg has undergone.

Miles	
1.8	Crossing Conodoguinet Creek, noted for its entrenched meanders.
3.4	West Fairview. Railroad yards east of the highway occupy an abandoned river channel. The prominent hill between the yards and the river is supported by heavy sandstones of the Martinsburg. This topographic expression is exceptional since most of the sandstones of the Martinsburg have calcareous cement and break down rather rapidly.
4.5	STOP 1. Stop immediately before descending the grade from a hill with a reservoir and standpipe at its top. Walk south along the abandoned street car grade to cuts and other exposures below on the railroad. Here is exposed a limestone interbedded in the Martinsburg shale. It is a barren, highly variable member of platy limestone which includes dark shale partings, massive beds of edgewise conglomerate, oölites, and sandy, cross-bedded strata. Many beds are ripple-marked. At the south end of this exposure the limestone is in conformable contact with red and olive-gray, buff-weathering shale. A study of the ripple marks and the truncation of the cross-bedding indicates the relation of the limestone to the closely compressed strata. This limestone is one of several lenses included in the Martinsburg between the Susquehanna and Schuylkill valleys.

Continue north. Cuts expose red and non-red Martinsburg shales. View of Susquehanna Water Gap. Kittatinny Mountain is the principal ridge, supported chiefly by Lower Silurian sandstone and conglomerate. The second ridge, Little Mountain, consists of Hamilton sandstone.

7.0 STOP 2. Susquehanna Gap in Kittatinny ("Blue") Mountain, $1\frac{1}{4}$ miles south of Marysville: Exposed are Martinsburg (U.Ordovician) to Clinton (M.Silurian). Park right of highway, near south end of highway cut.

Up-ended Martinsburg shale, carrying an Eden fauna, is exposed at the south end of the cut, and is disconformably overlain by Juniata red conglomerates and sandstones having 30 feet of greenish-gray conglomerate (Bald Eagle ?) at the base. Above the Juniata is in turn white Tuscarora sandstone or quartzite.

The greenish-gray and red conglomerates and sandstones represent a marked reduction in sediments in contrast to the half-mile of strata that intervene between Eden-age shales and Tuscarora sandstone at Lewistown, 40 miles northwest of Susquehanna Gap. The uppermost Martinsburg probably is missing because of erosion; most of the thinning of Bald Eagle, Lost Run, and Juniata probably results from non-deposition.

Miles

Relations of Late Ordovician and Silurian strata from central Pennsylvania to Susquehanna Gap are discussed more fully in a separate, conference leaflet on "Silurian Relations at Susquehanna Gap".

The Tuscarora sandstone is about 350 feet thick at Susquehanna Gap, beginning at the base with 60 feet of white, cleanly sorted quartzite that makes prominent ledges in the channel of the Susquehanna River; above this are 20 feet of dark gray, in part somewhat reddish conglomeratic sandstone; then 70 feet of red sparingly conglomeratic sandstone bearing a few Arthrophycus trails; then 200 feet of whitish to greenish, Arthrophycus-bearing quartzitic sandstone, with shale interbeds increasing in abundance in the upper part.

The Clinton strata exposed at Susquehanna Gap are about 600 feet thick, without known fossils. At the base are interbedded shales and quartzose sandstones, so that the boundary with the Tuscarora is transitional and poorly defined. Beginning 180 feet above the base of the Clinton, about half of the rock is composed of purplish, iron-rich sandstone of a type characteristic of more easterly parts of the Rose Hill shale over wide areas in Pennsylvania, Maryland, and the Virginias; it is these "iron-sandstones" that summit Kittatinny Mountain in the immediate vicinity of Susquehanna Gap. A thin quartzose sandstone at the top of the Clinton may represent the Keefer sandstone. Several hundred feet of strata are concealed between the Keefer (?) and the lowest traces of Bloomsburg red beds.

7.6 STOP 3. Little Mountain. Park to right of highway.

Discussion at this stop will be divided into two parts, as follows: (A) Bloomsburg to Marcellus; (B) Marcellus and Montebello.

A. Bloomsburg to Marcellus. Poorly exposed Upper Silurian Bloomsburg red beds are about 1500 feet thick at Susquehanna Gap. There is a 200-foot concealed interval between the highest exposed Bloomsburg and lowest exposed Middle Devonian Marcellus shale; old accounts suggest that the Bloomsburg and Marcellus are in contact at Susquehanna Gap. In contrast, the Marcellus-Bloomsburg sequence near Mount Union, 40 miles west of Susquehanna Gap, is as follows in descending order: Marcellus black shale; Onondaga shale and limestone, 110 feet; Oriskany group, 250 feet; Helderberg group, 50 feet; Keyser limestone, 125 feet; Tonoloway limestone, 700 feet; Wills Creek shale, 450 feet; Bloomsburg red beds. The total thickness of these intervening strata at Mount Union is thus about 1700 feet.

Miles

Regional studies to the west and east of Susquehanna Gap show with reasonable clarity that disappearance of Late Silurian and Early Devonian formations at Susquehanna Gap is due in part to lateral change into Bloomsburg facies, in part to disconformity. There may be some faulting at the Silurian-Devonian boundary, but if so it is probably of minor significance. The regional changes of the Late Silurian and Early Devonian are summarized in a previously mentioned separate Conference leaflet.

B. Marcellus and Montebello. Walk west of highway to large abandoned sandstone quarry, exposing the Montebello sandstone of the Middle Devonian Hamilton group. A small exposure of black Marcellus shale may be seen in the gully south of the quarry.

The Montebello sandstone is coarse-grained, locally conglomeratic, and fairly fossiliferous. It is a local unit which occupies much of the Hamilton group; it forms the crest of Little Mountain, the subsidiary ridge on the north flank of Kittatinny Mountain.

8.4-8.6 Continue north through Marysville, the route crosses the end of Cove Mountain. The upper Devonian sequence is concealed from STOP 3 until red Catskill appears in the vicinity of Marysville. North of the town the Catskill passes upward into the gray Pocono sandstone, which supports Cove Mountain. Across the river a splendid view is had of the transected edges of the Pocono overturned to the north in Second Mountain (the continuation of Cove Mountain, eastward). The three-fold character of the Pocono may be observed; massive lower and upper members with a platy middle member. Proceeding northward the road crosses the lowland within the horse-shoe ridge of Cove Mountain, which is a synclinal nose. The south limb, as noted, continues across the river as Second Mountain, the north limb similarly as Peters Mountain. The lowland is underlain by the Mauch Chunk red shale, occasional glimpses of which are obtained in passing. Looking east across the river, beyond the village of Dauphin, the termination of Third Mountain may be seen. It is supported by the Pottsville conglomerate which lies at the base of the coal measures. This is the westernmost extension of the Pennsylvanian of the anthracite fields. The Pottsville on Third Mountain lies along the axis of the great syncline whose limbs are formed by Second and Peters Mountains. The whole structure is overturned slightly north.

15.1 STOP 4. Peters Mountain. Park to right. Road cuts expose the upper beds of the Pocono. Here and to the west, in an abandoned quarry and old road cuts, the transitional contact of the Pocono with the overlying Mauch Chunk red beds is seen.

Miles

In the Pocono are coaly layers and plant remains which are probably near the horizon of the thin coals which were formerly worked across the river on the south flank of Peters Mountain.

15.3 Crossing the northern limb of the Cove Mountain syncline. Across the river a large, new road cut across the end of Peters Mountain exposes the Pocono and its contact (on the north) with the top of the underlying Catskill. The two are not sharply separated, but interfinger. Along the north flank of Peters Mountain is a well-defined bench. This is supported by the Honesdale gray sandstone, which is a persistent unit within the Catskill over much of northeastern Pennsylvania.

15.8 Crossing Shermans Creek. The small hill on the left is an expression of the Honesdale. Note the large dip-slope exposure of Catskill facing the creek.

17.6 Continue north through Duncannon, then right through underpass and across Juniata River to junction of Routes 15 and 11. Confluence of Susquehanna and Juniata to southeast. Stop sign. Left on Route 15.

18.3 Crossing broad flat area of flood plane formed at the confluence of the two rivers.

19.4 Amity Hall. Bear left on U. S. Route 22. The Catskill is abundantly exposed in road cuts. The occasional thick, green lenses seen are probably in part channel deposits and often include macerated plant fragments. In the lower portion of the Catskill may be seen very thin, green shales which carry marine Chemung fossils. They are the only marine Chemung remains recognized in this section. However, it should be noted that immediately west of here in Perry County, two zones of Chemung invertebrates occur, Dellville and Kings Mill beds, in the lower 1000 feet of the Catskill.

20.5 Cut on right of road north of small gully. The vertical, yellowish to rusty band, 20 to 30 feet wide, in the midst of the red beds is a sill or dike of Triassic "diabase". The adjacent sediments are baked gray. This intrusive is believed to be continuous with the Ironstone Ridge dike to the southwest in Cumberland County, which was seen on the Turnpike excursion.

21.2 Road cuts expose chocolate-colored beds underlying the base of the Catskill red strata. These probably equal the Parkhead of the highest Portage in Maryland.

21.5 <u>STOP 5</u>. Park across highway. <u>CAUTION</u>. High rock cut along road. The cliff is Trimmers Rock sandstone with an "Ithaca" fauna. Storm rollers and fossiliferous bands may be observed.

Miles

21.8 STOP 6 at north end of cut; walk to south end.

22.0 Starting at the south end of a series of cuts from the first gully north of the cliff of Trimmers Rock sandstone at the last stop, the lower Portage shales may be studied in a complete sequence. At the north side of the gully is the Losh Run shale with a "Cladochonus-Reticularia laevis zone" correlated with that of the Maryland Portage. The type locality for the Losh Run is directly westward across the river. Immediately below the Losh Run is one of the most contorted sections in this part of the State. It consists of folded and crushed greenish shales and sandstones, the eastward, attenuated, arenaceous edge of the thick Brallier shale of Blair and Bedford counties. Farther northward, descending in section, the dark-gray Harrel shale and some sandstone with a fairly abundant Naples fauna is exposed. This is underlain by 200 feet of the black, fissile Burket ("Genesee") shale, in which almost the only fossils found are Styliolina and Buchiola. At the base of the Burket, about ten feet south of the next gully opening east from the river, may be seen a few feet of Tully shale and limestone nodules with a characteristic fauna. The Tully rests disconformably upon the highest Hamilton shale, the Moscow, which contains Pustulina and other fossils.

22.1 Crossing Hamilton sandstones and shales. The Montebello is somewhat thinner and less massive here than at Rockville. It passes over entirely to shale and thin sandstones farther up the river. Here the sandstone supports Half Falls Mountain (an anticline) and the next ridge south, Dicks Ridge, which is a fault block thrust north along the great Perry County fault.

22.4 The valley to the east is cut in downfolded Burket and upper Hamilton shales.

22.8 East of the road, the large talus slope is composed of blocks of Montebello sandstone.

23.2 STOP 7. Immediately south of a lime kiln is a secondary road, which one may follow on foot up the bank to a quarry in black limestone of the Onondaga formation, overlain in the quarry face by the black Marcellus shale. The two are separated by a thin band of sandstone which is thought to indicate a local disconformity; these formations are usually transitionally related. Neither formation contains many fossils here. Returning to the road and walking northward about 150 yards, an exposure of the upper Oriskany (Ridgeley) pebbly sandstone replete with large "Spirifer" casts is seen.

Immediately north of this outcrop is a small gully leading into the core of Half Falls Mountain. At the end of the gully is a small cave in the New Scotland limestone, highest member of the Helderberg group. It forms the north wall of the gully and is faulted against a chert which forms the

Miles

south wall. This chert was formerly correlated with the Shriver, but recent studies place it in the upper New Scotland.

23.4 The Oriskany is once more seen in the north limb of the anticline.

This station marks the northern terminus of the trip. From here the route may be retraced to Clarks Ferry Bridge, a distance of 5.7 miles.

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Silurian relations at Susquehanna Gap in Blue or Kittatinny Mountain, 5 miles north of Harrisburg, Pennsylvania

By Frank M. Swartz

Introduction

The Silurian strata at Susquehanna Gap in Blue or Kittatinny Mountain near Harrisburg, constitute a 2500-foot sequence of near-source sediments, deposited near the area of outflow of a major river system that carried great floods of clay, sand, and gravel from the easterly land, Appalachia. The sediments reflect paleogeographic-geotectonic events in the regions both of deposition and erosion.

Summary of the Susquehanna Gap section

The Silurian-Late Ordovician succession exposed along the highway on the west side of the river at Susquehanna Gap is as follows:

	Thickness feet
Middle Devonian:	
Mahantango sandstone Marcellus shale (not exposed at immediate roadside)	20
Concealed; may mostly be Bloomsburg red beds in disconformable contact with Marcellus	100
Silurian	
Bloomsburg red shale and sandstone; upper portion sparingly exposed; lower part indicated by red shale and sandstone soil	1000
Concealed; possibly includes basal Bloomsburg, Mckenzie, and upper part of Clinton	550
Clinton group:	
Greenish quartzose sandstone, suggestive of Keefer sandstone; 25 feet.	
Purplish "iron-sandstone", of type interfingering westward with fossiliferous Rose Hill shale, and interbedded greenish and some purplish shale; 400 feet.	
Thin-bedded greenish shale and medium-bedded greenish to whitish quartzitic sandstone; 4 feet of red sandstone 40 feet above base; 180 feet.	
Thickness exposed Clinton	605

Tuscarora sandstone:
Upper greenish to whitish quartzitic sandstone; upper 120 feet includes much shale and in part might be classed as Clinton, 205 feet.
Reddish, sparingly conglomeratic sandstone member, 70 feet.
Dark gray sandstone member, 20 feet.
White quartzite member, 60 feet.
Thickness Tuscarora sandstone 355

Ordovician

Juniata red sandstone and conglomerate
Upper red sandstone member; 35 feet.
Whitish quartzitic conglomerate member; 7 feet.
Lower red sandstone member, 53 feet.
Reddish conglomerate member, 40 feet.
Greenish conglomerate member, 30 feet.
Thickness Juniata formation 165

Martinsburg shale: thin-bedded shale; Cryptolithus fauna of Eden age.

Order of discussion

Upended, somewhat overturned Martinsburg, Juniata, Tuscarora, and Clinton strata are exposed in continuous succession in highway cuts in the southern part of Susquehanna Gap, and Bloomsburg beds are poorly exhibited in the northern part. The characters and regional relations of the Juniata, Tuscarora-Clinton, and Bloomsburg sediments are discussed in turn.

Characters of the Juniata sediments of Susquehanna Gap

Eden-age shales of the Martinsburg formation at Susquehanna Gap are overlain with sharp disconformity by 70 feet of green and thin reddish coarse conglomerates or puddingstones; above these are an additional 95 feet of deep red, sparingly conglomeratic snadstones. The red sandstones and conglomerates have been classed as Juniata formation by all workers; the greenish basal portion of the conglomerates was compared with the Bald Eagle formation of central Pennsylvania when Willard and Cleaves (1939) called attention to the post-Martinsburg disconformity made visible by excavation of the present highway cuts.

In the 30 feet of greenish conglomerate and succeeding 40 feet of pinkish to red conglomerate, the sand-textured matrix is of graywacke type with high proportions of chloritic, non-quartz material. Pebbles form about half of the sediment, are chunky and well rounded, and commonly range from 1 to 3 inches in greatest diameter, with a few that reach 6 inches or more. About half of the pebbles consist of milky quartz with chloritic splotches. Other types include quartz-veined, more or less vitreous metaquartzites; quartz-veined, chloritic meta-argillates, fragile as now weathered; chert; some dark, fine grained siliceous rocks. Watson after microscope examination of some pebbles, commented that the metaquartzites and meta-argillites came from a low-rank, chlorite-zone metamorphic terrane. (Letter, 1938).

In the pinkish and reddish portions of the conglomerates, there are red-stained quartzite and jasper pebbles, and red staining penetrates fractures and chloritic splotches of many of the vein-quartz pebbles. Some jasper pebbles have a gray core with an outer reddish zone that parallels the worn surface and evidently was developed during transportation. The greenish meta-argillites generally either are non-stained or else the red staining is shallow.

No red pebbles were observed in the lower 30 feet of greenish conglomerate In parts of the next higher, pinkish conglomerates, there is admixture of red-staine and non-stained detritus of both sand and pebble sizes. Converging transport eviden ly brought in both types of detritus, and further color change subsequent to deposition did not occur in these particular sediments.

Channel-cut surfaces are strikingly developed at several plages in the con glomerates. There are local sand lenses in which pebbles are few.

Pyrite occurs in some of the lower beds of the greenish conglomerates and produces some iron-stained splotches. No counterpart has been observed of the limonite-stained pits formed in many layers of the Juniata and Bald Eagle of central Pennsylvania by weathering of disseminated crystals of iron carbonate. Such carbonate crystals do occur in some layers in the lower 50 feet of the Tuscarora at Lehigh Gap.

The half-foot of weathered Martinsburg shale adjacent to the conglomerate is suggestive of an ancient regolith; but may instead reflect present-day water-percolation at the conglomerate-shale contact.

The upper 95 feet of the Juniata consists of dark-red sandstones that are sparingly conglomeratic; weak cementation reflects the graywackyish character of the matrix. At the middle of the red sandstones, the 7-foot whitish quartzitic conglomerate member is prophetic of the Tuscarora in relative excellence of winnowing of the quartz-sand matrix. Pebbles of this member include bright-green jaspers and green vitreous metaquartzites; red pebbles are rare.

The Juniata-Tuscarora contact is abrupt and well defined, but is not clearly disconformable. Some reddish material is intermingled with the whitish quartz sand of the basal foot of the Tuscarora; a half-foot bed of red sandstone occurs locally 11 feet above the base of the Tuscarora; a 70-foot Juniata-like red sandstone member occurs at about the middle of the Tuscarora.

Regional relations of the Juniata sediments

The 165 feet of Juniata strata at Susquehanna Gap represent part of the ne source, coarse-textured feather edge of Late Ordovician, non-fossiliferous red and greenish sediments that are more than 2000 feet thick near Lost Creek Gap and Lewistown, 30 to 40 miles northwest of Susquehanna Gap (see physiographic block diagram), and that are about 1800 or 1900 feet thick at Tyrone Gap near the Allegheny Front, 35 miles west of southwest of Lewistown.

Because of discontinuity of exposure, lack of faunal zones, and problems of facies, various questions plague attempts at detailed correlation. The following discussions of plausible stratigraphic-paleogeographic relations of the Juniata-Bald Eagle sediments are summarized from extended studies at many localities in central Pennsylvania, for which manuscript will be completed this summer.

At Tyrone Gap near the Allegheny Front (see stratigraphic chart, Figure 2), the Juniata formation is about 1200 feet thick. Below its topmost reddish sandstone, the upper half is mostly red siltstone, the lower half red graywackyish sandstone with one 20-foot interbody of greenish graywacke; some of the lower beds have rusty-weathering siderite crystals. Here at its type section the Bald Eagle formation is about 650 feet thick, and consists of poorly winnowed, unfossiliferous, graywackyish sandstones, virtually without pebbles except for shale-chips of intraformational type. The formation includes a middle, strong ridge-making sandstone member, underlain by a weaker shale and sandstone member.

At the top of the Reedsville shale, beneath the Bald Eagle, are shales and sandy, somewhat calcareous siltstones bearing the *Orthorhyncula stevensoni* fauna, widespread at the top of the Reedsville-Martinsburg shales in central Pennsylvania and western Virginia.

Traced eastward toward Lewistown, the ridge making member of the Bald Eagle sandstone quickly becomes conglomeratic, with pebbles of vein quartz, quartz-veined quartzites, cherts and jaspers, and rarely of quartz-veined meta-argillites. For this conglomerate, the writer is proposing the term Lost Run conglomerate, from the Lost Creek Gap area northeast of Lewistown where the formation is about 350 feet in thickness, and contains numerous beds of coarse puddingstone. Near Lewistown the Lost Run conglomerates are overlain by about 1500 feet of Juniata red beds; they are underlain by 300 feet of greenish sandstone or graywacke, seemingly representative of the lower part of the Bald Eagle near Tyrone, then by sandy beds containing *Orthorhyncula stevensoni*. The Juniata red beds above the Lost Run conglomerate are about 1600 feet thick at Lost Creek Gap, and there contain a 50-foot body of greenish sandstone in their lower part.

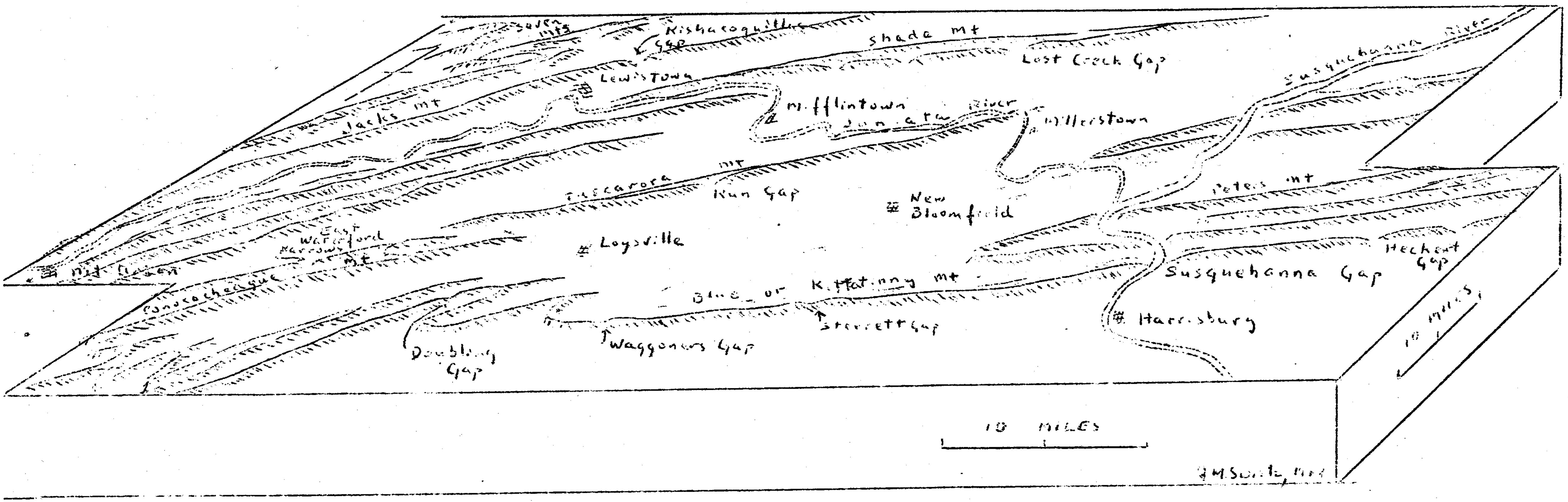
The Lost Run conglomerates are variably greenish and pinkish in the Lost Creek Gap-Lewistown area. It is not wholly clear to what extent the color change is simply variation in facies, to what extent it may reflect minor changes in age of the lower and upper limits of the gravel-bearing mass. However, where the beds are strongly conglomeratic through 200 to 300 feet of thickness, are overlain by 1400 to 1600 feet of Juniata red sandstone and shale, and are underlain by 200 to 300 feet of sandstone of Bald Eagle type and then by the *Orthorhyncula stevensoni* zone, their thickness and essential continuity merit their treatment as a distinct stratigraphic unit of comparatively constant age.

Southeastward from Lost Creek Gap the Juniata-Lost Run-Bald Eagle - Upper Martinsburg strata plunge below ground and do not again break surface until they rise along Blue Mountain near Susquehanna Gap. Latest Reedsville-Martinsburg strata, including the sandy *Orthorhyncula* zone and some lower beds, are missing by unconformity at Susquehanna Gap; this is a gentle, westerly expression of the Taconic folding uplift, and erosion, whose effects are increasingly marked toward eastern Pennsylvania, southeastern New York, and New England.

The 2000- to 2200-foot Bald Eagle-Lost Run-Juniata sequence of the Lewistown-Lost Creek Gap region is reduced to a mere 165 feet in thickness at Susquehanna Gap.

Conglomerates of Lost Run facies, 70 feet thick, rest directly on the worn surface of the Martinsburg, and are overlain by 95 feet of red sandstone.

Parllelism of the conglomerates with overlying thick Juniata, and underlying thin Bald Eagle sandstone and then *Orthorhyncula* beds, no longer exists as a guide for close correlation of the conglomerates. The gravels at Susquehanna Gap may well have been transgressive in terms of the Lost Run gravels at Lost Creek Gap, and may be appreciably younger.



Susquehanna Gap - Lewistown region

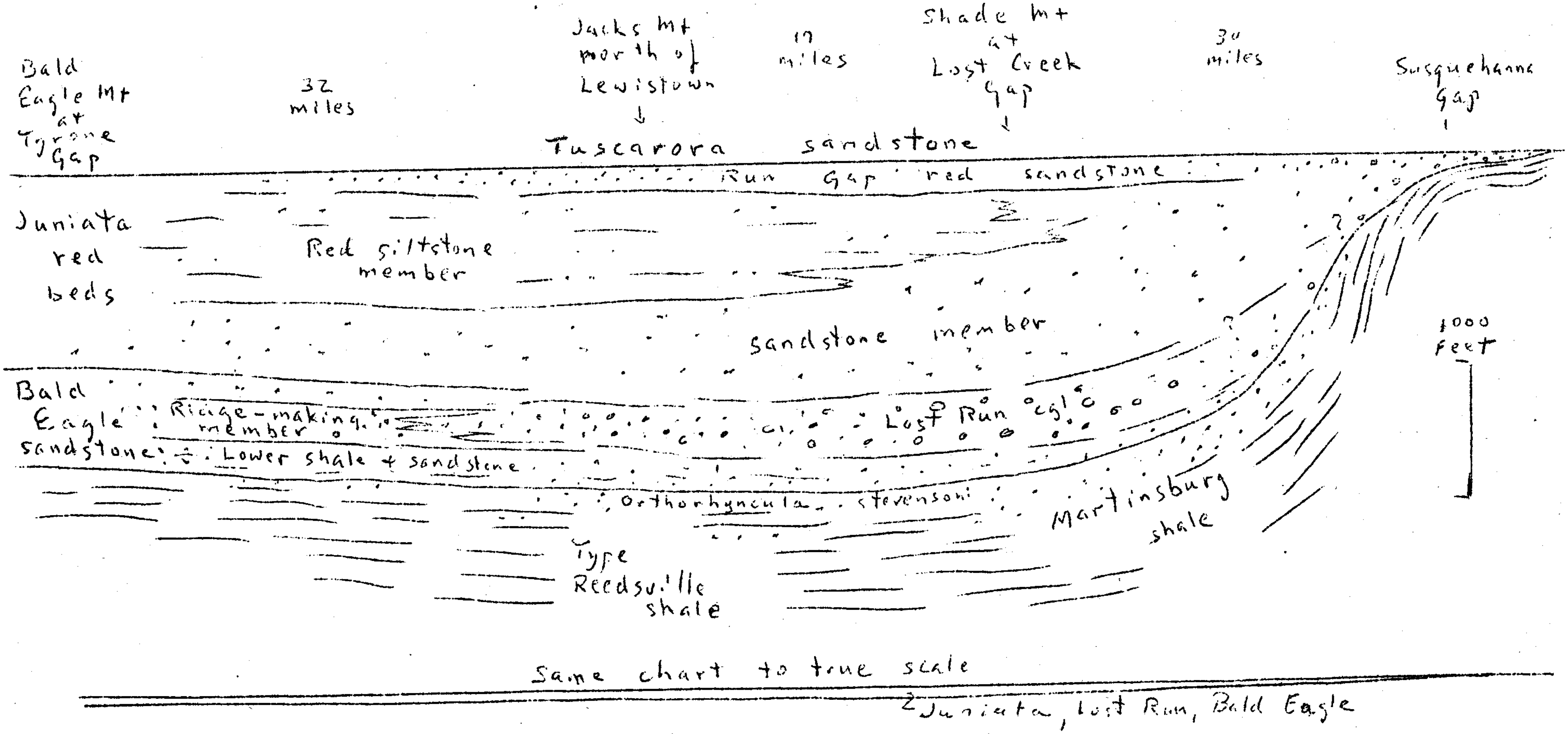


Diagram of plausible Juniata - Bald Eagle - Lost Run relationships, Tyrone Gap to Susquehanna Gap

If the conglomerates at Susquehanna Gap are equivalent in age as well as facies to the Lost Run beds at Lost Creek Gap, and if the Tuscarora strata are essential age equivalents at the two localities, then one or more disconformities should be present between the conglomerates and Tuscarora to account for the reduction of the intervening strata from 1600 to 1700 feet to less than 100 feet. Though such disconformities may be present they have not been definitely recognized. The disconformity below the gravels is well marked; if this is the only significant disconformity the conglomerates at Susquehanna Gap should be considerably younger than the type Lost Run.

Juniata sediments have not been found along Blue Mountain east of Susquehanna Gap, and must rapidly wedge out. Traced westward along Blue Mountain, the Juniata sediments thicken rapidly; the basal disconformity is well defined at least as far west as Waggoners Gap and is overlain by greenish conglomeratic sandstones. The Juniata-Tuscarora boundary is well exposed at Sterrett and Waggoners Gaps, without observed evidence of significant disconformity.

Summarizing the correlation problem, the conglomerates at the base of the Juniata at Susquehanna Gap are Lost Run in facies. Clear evidence of their LostRun age is wanting and they may be transgressively younger than the Lost Run. In view of the speculative nature of their correlation, and their subordinate thickness, the writer prefers to treat the conglomerates at Susquehanna Gap as members of the Juniata formation.

The tectonic history from Martinsburg to Tuscarora time is in some respects shown better by the relatively complete and better correlated sedimentary succession near Lewistown, than by the uncertainly correlated strata at Susquehanna Gap. The accompanying Figure 3 illustrates in a qualitative fashion the textures of coarser components in strata near Lewistown from Trenton limestone through Reedsville. shale, Bald Eagle sandstone, Lost Run conglomerate, and Juniata red sandstone and siltstone, into the Tuscarora sandstone. The larger-scale fluctuations in texture reflect changes in relief of the eroding source-lands, with modifications depending upon features of the regions of transport and deposition, and thus have their basis in tectonic events complicated by erosional reduction in relief.

Small-scale fluctuations in texture variably reflect steps in the tectonic movements as well as other factors affecting vigor of the agencies of transport.

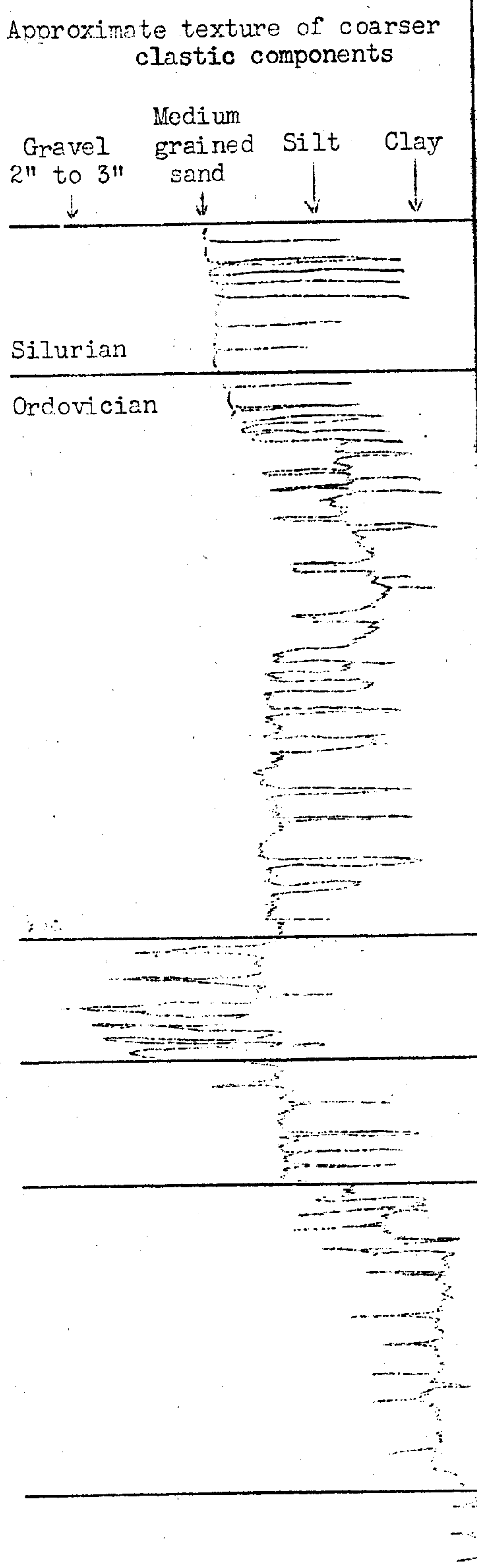
The pebbles of the Juniata conglomerates at Susquehanna Gap raise interest ing problems regarding nature and age of the parent rocks, the location and physiogr phy of the area from which the pebbles were derived, the work of the processes of erosion, transport, and deposition.

The vein-quartz, metaquartzite, and meta-argillite pebbles came from rocks that at the time of their erosion constituted an exposed chlorite-zone, low-grade metamorphic terrane. This parent-rock terrance may later have been further modified during Late Paleozoic deformations, complicating possibilities of identification.

The resistant, pebble-forming rocks of this terrane had originally accumulated as sand and sandy-clay sediments, that after cover under probably thick sedimentary overburden were deformed and transected by numerous quartz veins; then still later were uncovered by erosion before the pebbles were eroded from them.

The cherts likewise represent source rocks of sedimentary origin, their degree of metamorphism less clearly established. There are a few pebbles of sandstone showing little metamorphism.

Figure 3. Diagramatic graph of textures of land-derived clastics of Late Ordovician of Lewistown region, Pennsylvania, in relation to tectonic movements of basin and source lands.



Formation	General Relations
Tuscarora sandstone	Shallow seas transgress eastward; shifting sands excellently winnowed widely spread; marine faunas wanting - water freshened.
Run Gap sandstone	Sands fairly well-winnowed; in part reddish; source land rises.
Red siltstone member	Source land low; fluviatile silts are deposited in Lewistown region.
Juniata red beds	Iron-oxide staining develops under seasonably humid, tropical or sub-tropical climate of regions of erosion, transport and deposition.
Red sandstone member	Source land moderate in relief; fluviatile, poorly winnowed; red-stained graywackyish sands are transported to central Pennsylvania.
Lost Run conglomerate	Source land high; active rivers spread gravels well to west; acme of Taconic disturbance.
Bald Eagle sandstone (Early Bald Eagle)	Source land rises; sea retreats and fluviatile. graywackyish sands and clays spread westward.
Reedsville shale	Easterly source lands rise in initial stages of Taconic disturbance; clays and fine sands in later stages spread westward in shallow marine waters.
Trenton limestone	Some clay.

Present-day fragility of the meta-argillites suggests short transport. However, these fragments likely were moved as fresh detritus carried rapidly from eroding gorges, and if so should have been fairly tough, with a resistance to wear that resulted in considerable degree from the transecting quartz veins.

The metaquartzite and meta-argillite pebbles came from terranes more metamorphosed than the Martinsburg at present neighboring Blue Mountain. As working hypotheses, attention should be given to possibilities that the pebbles came from more southeasterly extensions of the Martinsburg, after metamorphism by the Taconic disturbance; or that the pebbles were worn from pre-Martinsburg, presumably Cambrian or Pre-Cambrian sediments, upwarped and laid-bare to erosion as a result of Taconic diastrophism.

Watson, the Stoses, and Frazer kindly examined some pebbles from extensive collections obtained in 1937 at Susquehanna Gap and other localities. Their remarks were sought because they have worked actively in southeastern Pennsylvania, in regions approaching likely source areas of the pebbles. They made comparisons with various formations of southeastern Pennsylvania, but felt unable to make any positive identifications. Even if the pebbles came from terranes of southeastern Pennsylvania rather than from more easterly areas, special difficulties arise from the fact that modern conditions of metamorphism in southeastern Pennsylvania terranes have been modified in some undetermined degree by Appalachian diastrophism, whereas the metamorphic imprint of the pebbles reflects Taconic or older deformations.

Among some of the interesting notations are Watson's previously quoted comment that many of the pebbles came from a chlorite-zone metamorphic terrane. He also remarked that some of the metaquartzites resemble rocks of the Peter's Creek formation of the Peach Bottom syncline; that some contain grains of blue quartz such as is common in Pre-Cambrian rocks of the Mine Ridge-Philadelphia region; that some of the cherts are of a type commonly found in limestones. The Stose's compared the chlorite-splotched vein-quartz with quartz veins of parts of the Glenarm; they noted absence of pebbles of a type they would expect in present-day detritus from the Cambrian quartzites of the South Mountains, though the present quartzitic character of the latter sediments may be a result of post-Juniata, not pre-Juniata processes; they called attention to the close resemblance of some arenaceous cherts from the Lost Run near Lewistown to cherts of the Cambro-Ordovician limestones of the Great Valley region. Frazer commented that various jasper and metaquartzite pebbles represent rock types that can be closely duplicated in the Lower Cambrian Hardyston quartzite of the Lehigh County region, though he emphasized that identification with the Hardyston is not warranted.

The cherts of the Juniata gravels at Susquehanna Gap, and perhaps more especially the whiter-weathering cherts and sandy cherts of the Lost Run of the Lewistown are, suggest breaching of easterly extensions of the Cambro-Ordovician limestones. The writer inclines toward the view that the quartz-veined metaquartzites and meta-argillites came from pre-Martinsburg and possibly Pre-Cambrian metamorphosed sediments, though positive identifications are not yet possible. In terms of the metamorphics of the Lost Run conglomerate of the Lost Creek Gap-Lewistown region, it would seem surprising if the Taconic uplift had at so early a date laid bare rocks metamorphosed by the Taconic deformation.

A single pebble of fossiliferous crystalline limestone was discovered in the Lost Run near Lewistown; the poorly preserved fossil fragments appear to represent a phosphatic brachiopod but otherwise are indeterminate.

Characters of the Tuscarora
sediments of Susquehanna Gap

The Tuscarora sandstone at Susquehanna Gap is about 350 feet thick, and is overlain by about 600 feet of exposed Clinton strata.

The Tuscarora sandstone has at its base a 60-foot member of white quartzitic sandstone of normal Tuscarora facies; that is, the rock consists mostly of well-winnowed quartz sand bonded by silica overgrowths. Some of this rock is grayish where freshly exposed in the highway cut, but is white where weathered. The member is resistant to erosion; it makes prominent ledges across the channel of the Susquehanna River, and forms a shoulder on the southern slopes of Blue Mountain on both sides of the Gap. In the lower and middle parts of the member there is cross-bedding of small amplitude; some higher beds are laminated parallel to the general bedding. The low amplitude cross-bedding and especially the lamination parallel to the general bedding suggest that shifting of the sediments over the floor of deposition was rapid in terms of rate of sedimentary supply. At more westerly localities wave ripple marks are common on Tuscarora surfaces where the lamination parallels the general bedding, but wave ripples were not clearly discerned at Susquehanna Gap. The writer favors the view that the Tuscarora sands of a belt crossing central Pennsylvania shifted back and forth upon the floor of shallow seas, and that much of their excellent winnowing was accomplished in this fashion.

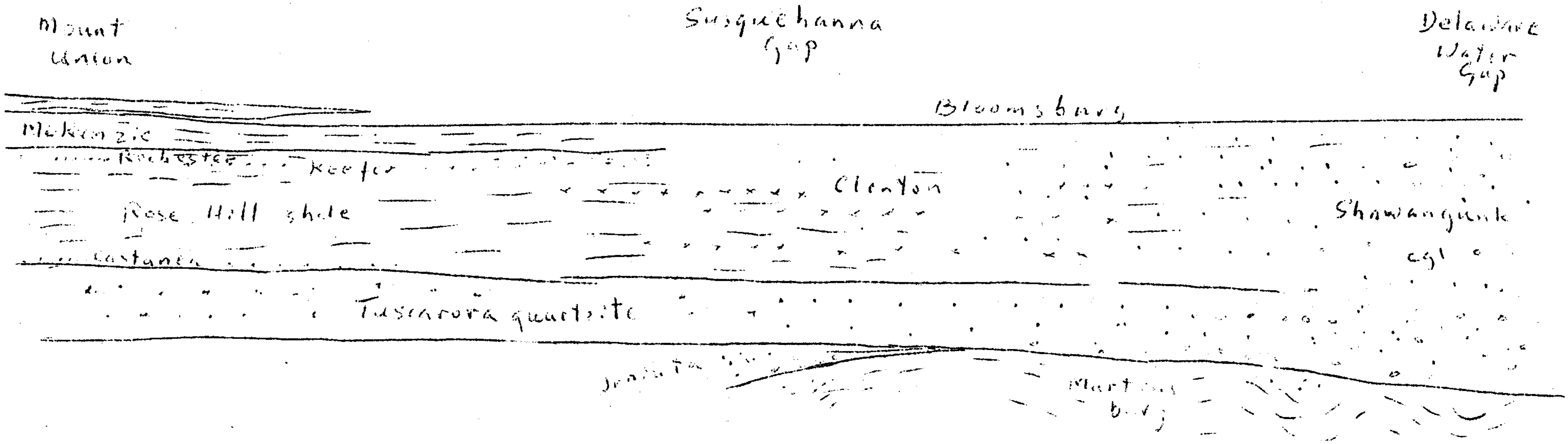
Brachiopods and trilobites of the Early Silurian age are wanting in the Tuscarora sediments. The peculiar worm trails, Arthrophycus, are moderately common, and eurypterid fragments occur in some of the shale interlayers. The fossil relations suggest that the waters were relatively fresh, possibly because of discharge from large rivers entering the basin from the east. Freshened water tends today to extend far off the mouth of the Amazon, and boiler water can be obtained in the Gulf of Mexico in the fresh water "shadow" on the western flank of the Mississippi delta. Major rivers would have had more widespread freshening effects in Appalachian mid-Paleozoic seas, if imperfect oceanic connections and shallowness of water hindered such salt water interchange as is today vigorously active near the mouths of the Amazon and Mississippi.

The argument for poor salt-water interchange must of course be balanced against the argument of shift of sands on the sea floor of Tuscarora sedimentation.

The lower quartzitic member of the Tuscarora at Susquehanna Gap is overlain by a 20-foot member of dark gray, somewhat conglomeratic sandstone, then a 70-foot red sandstone member, likewise having conglomeratic portions. In both of these members the sands are poorly winnowed, and contain numerous grains and also interstitial material from chloritic meta-argillites. The gray member is in part somewhat reddish, and one observed chert pebble has a red core with an outer gray zone, suggesting the destruction of red color by reduction. Both the gray and red sandstone members appear to the writer to represent the influx of alluvial sediments, deposited either directly by fluviatile waters, or else in water bodies locally unable to cope with and winnow the graywackyish admixtures.

The pebbles of the gray and red sandstone members include vein quartz, quartzites, cherts. Weak meta-argillites are rare or absent.

One bedding surface of the red sandstone member, about 10 feet above the west side of the highway, shows large trail-molds of Arthrophycus type, although the characteristic transverse markings are not clearly shown.



Stratigraphy of Clinton and Tuscarora sediments from Mount Union to Delaware Water Gap

Above the red sandstone member are 85 feet of greenish to whitish sandstone, then 120 feet more of similar sandstone with fairly prominent interbeds of greenish shale. The upper 120 feet might alternately be classed as Clinton with much interbedded sandstone of Tuscarora type, rather than as Tuscarora with interbedded shale. Whatever the selected boundary surface, it is clear that the change from Tuscarora to Clinton sedimentation was transitional in a pulsating fashion, and not abrupt.

The sandstones of the upper member of the Tuscarora consist of fairly well winnowed quartz sand, cemented by silica overgrowths. Some chloritic meta-argillite type of material is present, and presumably is more abundant in the greener layers.

Well preserved Arthrophycus trails occur at a number of levels. Commonly they are best shown by molds on the bottom surfaces of sandstones resting on shale interlayers.

Characters of the Clinton sediments
of Susquehanna Gap

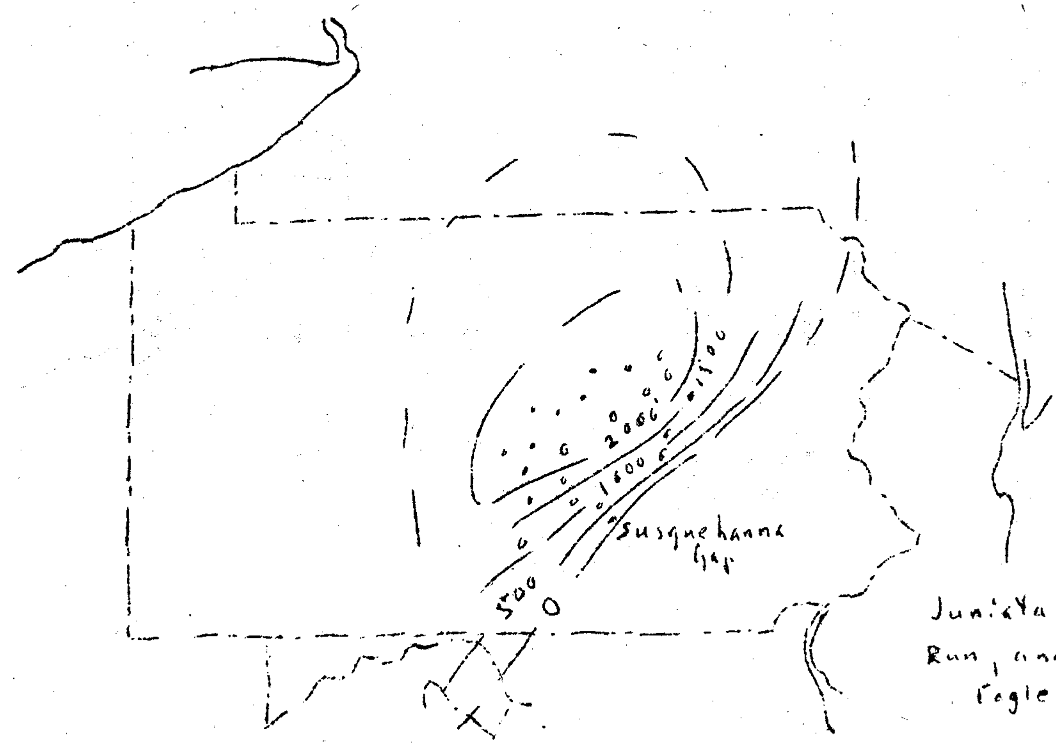
About 600 feet of Clinton sediments are exposed along the highway on the west side of Susquehanna Gap. The next higher 350 feet of strata are concealed; much of this interval may be Clinton in a broad sense.

At the base of the Clinton are 180 feet of thin-bedded greenish shale, containing in the lower part interbeds of whitish to greenish quartzitic sandstones of Tuscarora type. Next higher are 400 feet of greenish and some purplish shales with a great deal of interbedded purplish "iron-sandstone". At the top of the exposed Clinton beds are 25 feet of slumped, more or less quartzitic sandstone, the middle part concealed.

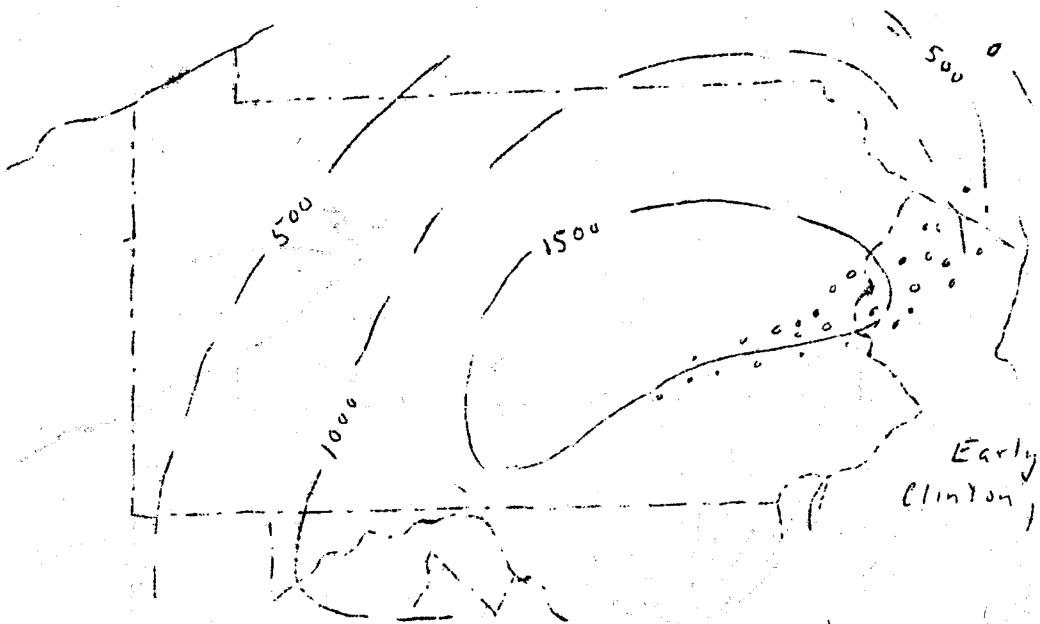
The especially striking feature of these Clinton rocks is the prominence of the purplish, moderately iron-rich sandstones, known as iron sandstones since the days of the Second Geological Survey of Pennsylvania. These strata include some 4- to 6-foot, especially strong beds, and support the crest of Blue Mountain in the immediate vicinity of Susquehanna Gap.

The purplish iron sandstones are of peculiar type, and west of Susquehanna Gap are interbedded with fossiliferous shales of the Rose Hill formation of the Clinton group. In a thin section of one of the strong iron sandstone beds at Susquehanna Gap, quartz sand grains form about 85 to 90 per cent of the rock, and are strongly interlocked by silica overgrowths. There are a moderate number of grains of chloritic, phyllitic rocks, but virtually no clayey, interstitial material. Much of the iron oxide occurs as blade-like crystals of blood-red hematite, within the silica overgrowths of the quartz veins. In some other iron sandstones of the region, the iron oxide crusts are thicker without blade-like hematite grains, and there is some increase in non-quartz clastic elements. The iron-sandstones represent a facies related to the accumulation of the thin iron ores of the Clinton group.

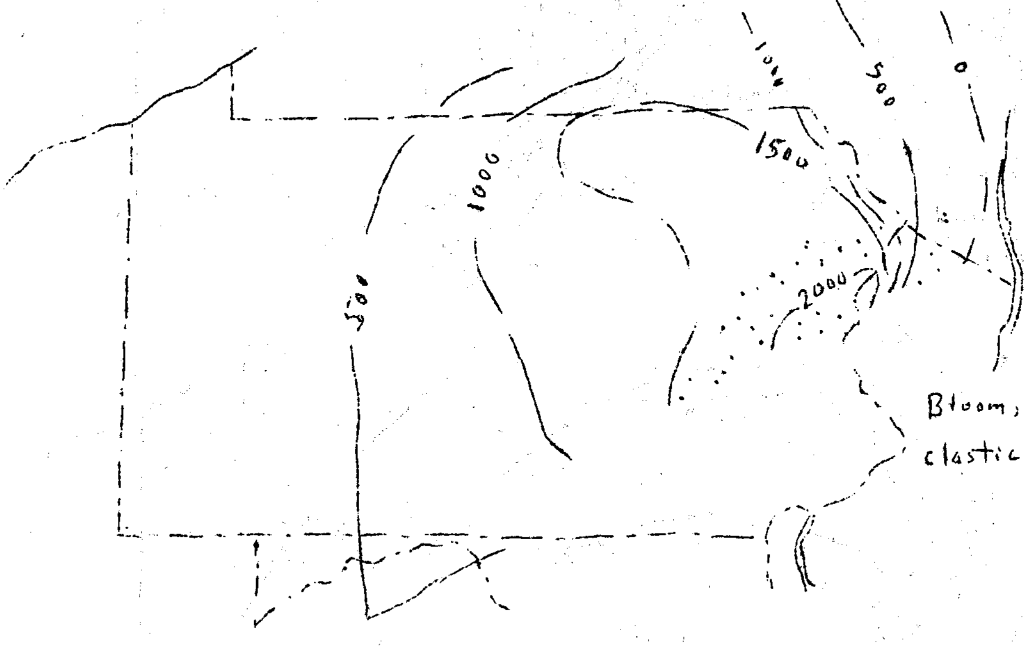
The 25-foot greenish sandstone at the top of the exposed Clinton suggests the Keefer sandstone of more westerly area s, but may represent an earlier sandy tongue. The next higher, 550-foot concealed interval may include representatives of the highest Clinton; the McKenzie formation which 20 miles to the west consists of shales and limestones; and also some basal parts of the Bloomsburg red beds.



Juniata, Lost Run, and Bald Eagle



Early McKenzie, Clinton, and Tuscarora clastics



Bloomsburg and clastic correlatives

No fossils have as yet been discovered in the Clinton beds at Susquehanna Gap. Fossils are certainly rare, but as weathering progresses any specimens that are present may become more readily observable. To the west, brachiopods, ostracodes, and trilobites occur in some layers of the iron sandstones, as well as in associated shales.

Regional relations of the
Tuscarora and Clinton sediments

The Tuscarora and Clinton deposits of Susquehanna Gap, as compared to their correlatives in central Pennsylvania, represent nearer-source phases of the Early and Middle Silurian sediments of the Appalachian trough. Thus the gray and reddish Tuscarora sandstone members at Susquehanna Gap include poorly winnowed and in part conglomeratic sands, in contrast to the clean quartz sands typical of the formation farther to the west. The Clinton deposits consist of unfossiliferous, almost subequal shale and sandstone, whereas near Mount Union and Lewistown they are clay shale with some thin 1- to 3-inch sandstone and limestone interbeds, in addition to the 20- to 30-foot tongue of the Keefer sandstone. The iron sandstone beds of the Clinton at Susquehanna Gap represent a facies persistent along the strike southwestwards across Maryland, northeastern West Virginia, and western Virginia.

Traced eastward from Susquehanna Gap along Blue or Kittatinny Mountain, further changes take place in the Tuscarora and Clinton sediments. At Lehigh and Delaware Water Gaps, the Tuscarora-age sediments are increasingly conglomeratic, and in part decidedly graywackyish. The Clinton-age sediments become increasingly sandy, the iron-sandstones disappear, and conglomerates eventually develop so that the Clinton joins with the Tuscarora to become the Shawangunk conglomerate.

Various special problems remain concerning the Tuscarora and Clinton at Susquehanna Gap.

The red sandstone member of the Tuscarora at Susquehanna Gap is wholly unknown east of that locality. Twelve miles to the west of Susquehanna Gap, at Sterrett Gap, the white Tuscarora quartzites are 330 feet thick, without interbedded red sandstones. At their summit, however, are 25 feet or so of poorly exposed red sandstones, the color suggestive of the red Tuscarora member at Susquehanna Gap. It is possible that the red tongue of the Tuscarora at Susquehanna Gap is continuous with the red sandstone at the summit of the Tuscarora at Sterrett Gap; if so the higher part of the Tuscarora at Susquehanna Gap is actually an arenaceous facies of the basal part of the Clinton of the Sterrett Gap region. The writer attempted to trace out the red sandstone member by walking the summit of Blue Mountain between the two localities, but did not obtain decisive results.

O. F. Tuttle (1940) in 1939 made heavy-mineral studies of samples from the writer's extensive rock collections from Susquehanna Gap. Using Krynine's (1940) arrangement of Paleozoic heavy minerals into metamorphic, crystalline, and Cambrian suites, Tuttle found that the red tongue at Susquehanna Gap shows significant increa in the metamorphic and crystalline heavy mineral suites, and that it is in this respect as well as in its color suggestive of the Juniata formation. Tuttle concluded that these relations may result from reworking of Juniata formation debris, or possibly from flare-ups of declining source areas of the red detritus responsible for the Juniata. He further showed that there is a markedly close agreement in percentage distributions of 13 types of tourmaline found in the Tuscarora sandstone proper, with those found by Krynine in the Late Cambrian Gatesburg formation in central Pennsylvania.

It seems plausible to the writer that the flare-up of Juniata-like heavy minerals in the red tongue of the Tuscarora is related to the influx of unwinnowed chloritic metasediments in these same beds. The Tuscarora-age sands and gravels transgress widely beyond the limits of the Juniata. It seems doubtful to the writer that the Juniata extended en masse beyond its present limit in the vicinity of Susquehanna Gap, though there may have been patches of the red gravelly sands along drainage courses, and these may have furnished some materials for reworking as local lenses in the Tuscarora.

The marked similarity of tourmalines in the Tuscarora and Gatesburg seems to have a complex rather than simple significance. The Tuscarora sands were derived from the east, as shown by the geographic distribution of textural changes. Faunal evidence indicates that the sandy Gatesburg dolomites of central Pennsylvania merge southeastwards with the somewhat silty Conococheague limestone of the Great Valley region, giving evidence that the Gatesburg sands were derived from the north and northwest (Swartz, 1948). This stratigraphic evidence also suggests that the northwardly-derived Gatesburg sands did not themselves extend into the easterly areas that became the source lands of the Tuscarora materials. If these interpretations of source relations and distribution of the Tuscarora and Gatesburg are correct, then the Gatesburg-type tourmalines of the Tuscarora must have come not from the Gatesburg itself, but from other easterly sediments, possibly representing easterly extensions of the Lower Cambrian Chickies-Hardyston or even from some Pre-Cambrian terrane.

Characters of the Bloomsburg sediments of Susquehanna Gap

Red Bloomsburg sediments are at least 1000 feet thick at Susquehanna Gap, and an additional 200 to 300 feet of the formation may be concealed in covered intervals at the upper and lower limits.

The formation is poorly exposed, and a considerable part of the estimated thickness is based on the distribution of the characteristic red soil. Here as at neighboring localities, the Bloomsburg sediments consist of red silty mudstones and some sandstones, in general poorly bedded and tending to break into irregular, hackly fragments. Fossils are unknown in these Bloomsburg strata. The Bloomsburg sediments are believed to be continental deposits, probably fluviatile in large part, formed in a warm and humid climate.

Regional relations of the Bloomsburg sediments, and nature of their contact with overlying Devonian strata

The regional relations of the Bloomsburg and the structural nature of its contact with overlying Devonian strata, raise problems of much interest.

Near Lewistown and Mount Union, 40 to 50 miles northwest and west of Susquehanna Gap, the Bloomsburg beds are overlain in ascending order by 450 feet of Wills Creek shale, 700 feet of Tonoloway limestone, 150 feet of Keyser limestone, 50 feet of Helderberg limestone and shale, 200 feet of Oriskany sandstone and chert, 125 feet of Onondaga shale and limestone, and then by Marcellus black shale. The

Bloomsburg formation itself increases from 150 feet at Mount Union to nearly 350 feet at Lewistown.

On the west side of Susquehanna Gap there is a concealed interval of about 100 feet or slightly more between the highest visible Bloomsburg and lowest exposed Marcellus, and Willard reports that the gap is as little as 5 or 10 feet east of the river.

Thus as the Silurian and Early Devonian strata are followed from Mount Union and Lewistown to Susquehanna Gap, the Bloomsburg sediments increase in thickness from 150 feet to more than 1000 feet, and formations disappear that are some 1500 feet thick at the westerly localities.

Part of this marked stratigraphic change is due to modification of facies; part has variously been attributed to either fault or unconformity.

East of Mount Union, red tongues appear at higher and higher levels in the Wills Creek shale, and then in beds believed to represent the basal part of the Tonoloway as well. The lower and middle parts of the Tonoloway become decidedly argillaceous. Thickening of the Bloomsburg is accompanied by concomitant thinning of the Wills Creek and Tonoloway with their eventual disappearance about 10 or 15 miles west of Susquehanna Gap. Because of very poor exposures, the details of the final disappearance are obscure.

East of Susquehanna Gap, the Bloomsburg sediments thicken further, reaching nearly 2000 feet in the region of Lehigh Gap and Delaware Water Gap, where there is increase in quantity of sand and appearance of some fine gravel.

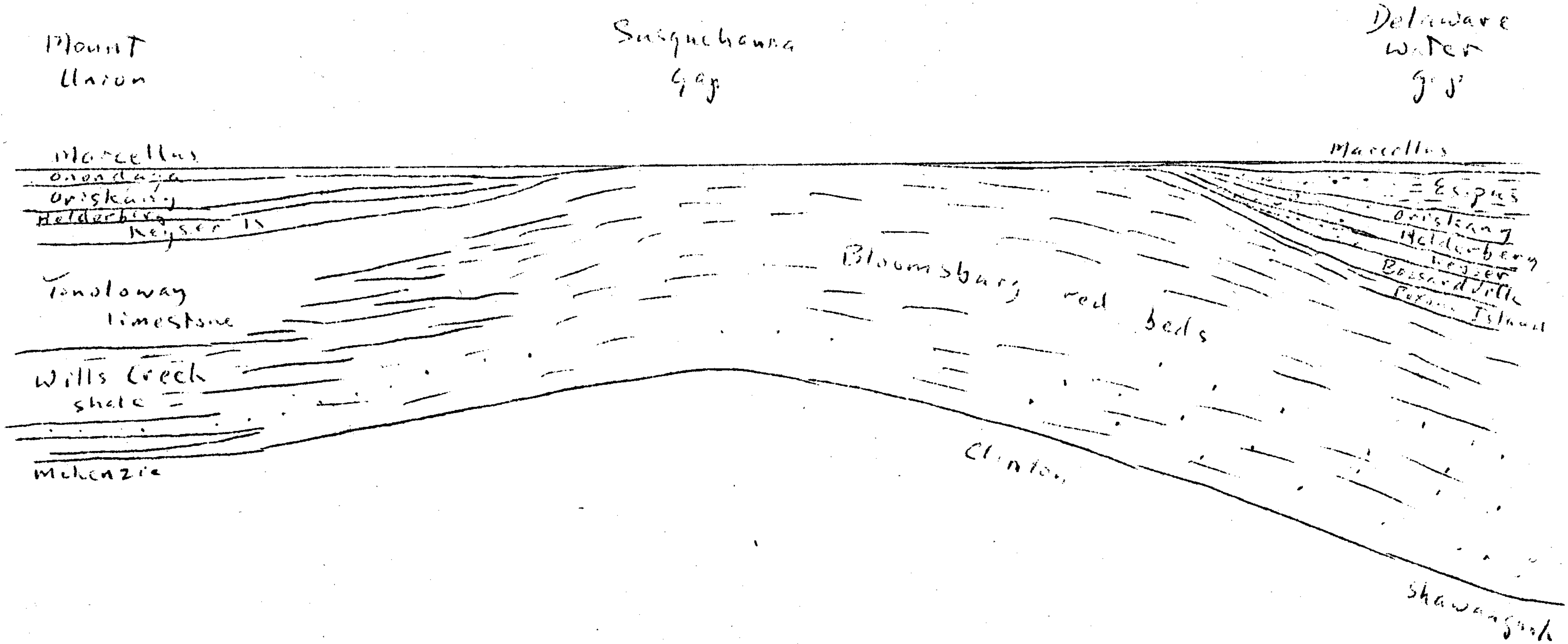
The maximum thickness of the Bloomsburg red beds centers in eastern Pennsylvania, and is believed to represent the general region of outflow of a major river discharging from Appalachian

There is no evidence that Keyser or younger strata pass laterally by facies change into the Bloomsburg red beds; on the contrary, the available data indicate with considerable clarity that the Keyser, Helderberg, Oriskany, and Onondaga must disappear at Susquehanna Gap in other fashion.

Most of these formations are absent along the northern flank of Blue Mountain from somewhere near Sterrett Gap, eastward for some 60 miles past Susquehanna Gap and Swatara Gap to and beyond Schuylkill Gap. The break in succession at Susquehanna Gap appears to be part of a regional problem, and is not simply a local matter.

The stratigraphic changes observed in the earlier Devonian and Late Silurian in approaching Schuylkill Gap from the east are especially instructive. At the Delaware Water Gap, Marcellus black shale is underlain by 300 feet of Esopus silty shale, 350 feet of Oriskany and Helderberg strata, about 100 feet of limestones and sandstones of Keyser age, then by a total of about 300 feet of Bossardville limestone and Poxono Island shale. Below the latter formations the Bloomsburg red beds are nearly 2000 feet in thickness.

Traced westward toward the Schuylkill, various horizons become increasingly arenaceous or even conglomeratic, then thin and disappear. This type of change is strikingly exhibited by the Esopus and its Palmerton sandstone correlative, by the Oriskany strata, and by the Coeymans sediments of the Helderberg group. The rate of change or disappearance is especially rapid where the outcrop shifts from a more northwesterly to more southeasterly fold.



Stratigraphy of Early Devonian and Late Silurian sediments from Mount Union to the Delaware Water Gap

As a result of the accumulative disappearance of strata, an 800-foot Late Silurian-Early Devonian succession at the Delaware Water Gap is reduced to about 100 feet near Schuylkill Haven north of Schuylkill Gap, then to about 2 feet near Auburn just north of the Gap. At the latter place, Onondaga limestone is underlain by 1 or 2 feet of sandstone provisionally classed as Oriskany, and this restsdiscon-formably upon the Bloomsburg.

Relations both to the stratigraphic changes in approaching Auburn from the east, and to complexly looping belts of crop, show that absence of the concerned formations near Auburn is due to disconformity and not to faulting. Accordingly, the writer in 1929 and 1939 used the term, Auburn promontory, in paleogeographic-isopachous discussions and maps for the Keyser and Helderberg sediments.

It appears reasonably certain to the writer that the disconformity associated with emergence of the Auburn promontory persists westward to and beyond the Sus quehanna Gap region; and that throughout this distance the disconformity is the prim reason for absence of latest Silurian and Early Devonian sediments along the norther side of Blue Mountain, Minor local variations occur in sequences adjacent to the di conformable surface.

Marked agreement in formations and faunas in areas east and west of the un-conformable belt shows that the emergent surface was not a barier between basins but rather a promontory projecting slightly into the basin of deposition, skirted down the present dip by subsurface extensions of the sediments. Even the seeming projection of the promontory is accentuated by relation of the outcrops to offsetting across folds.

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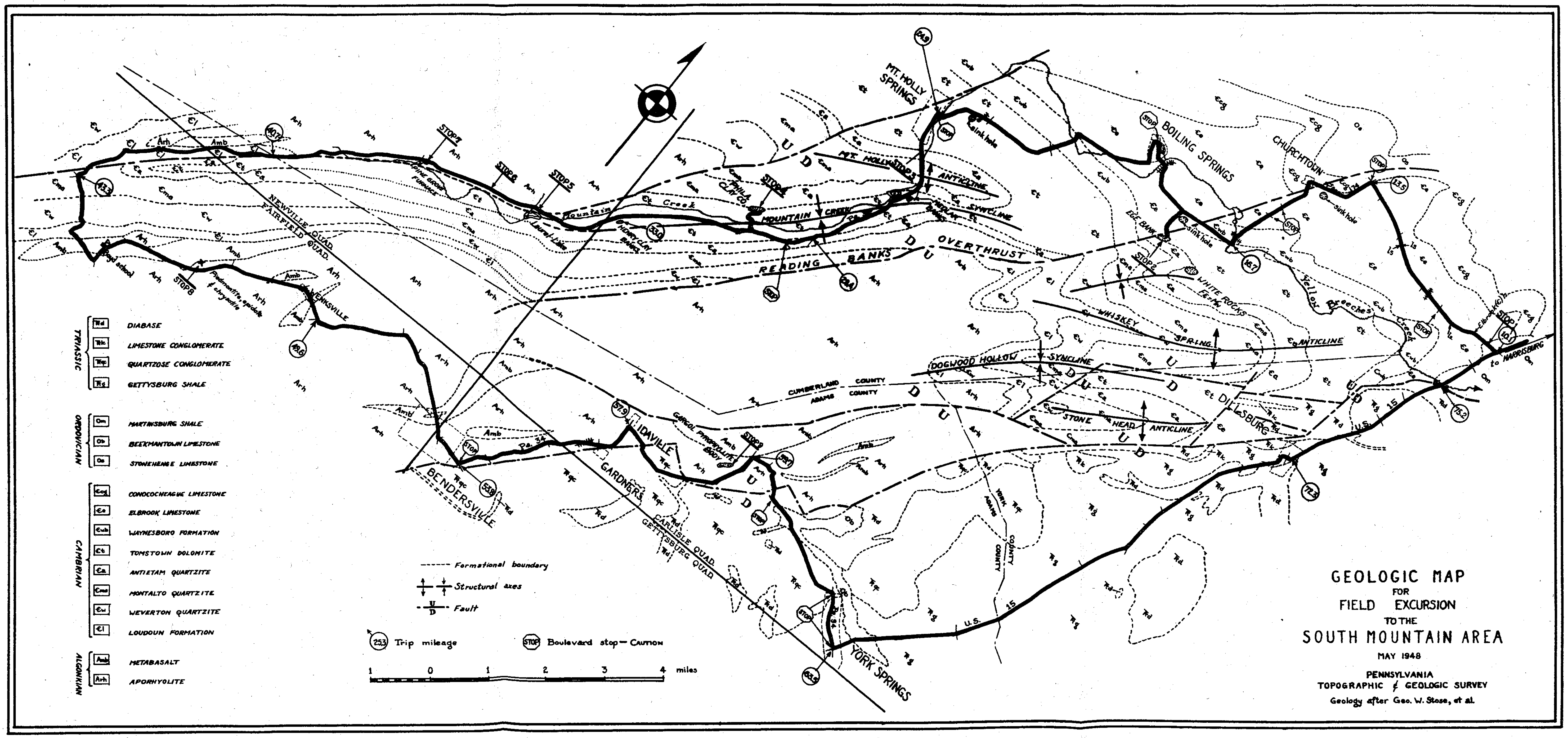
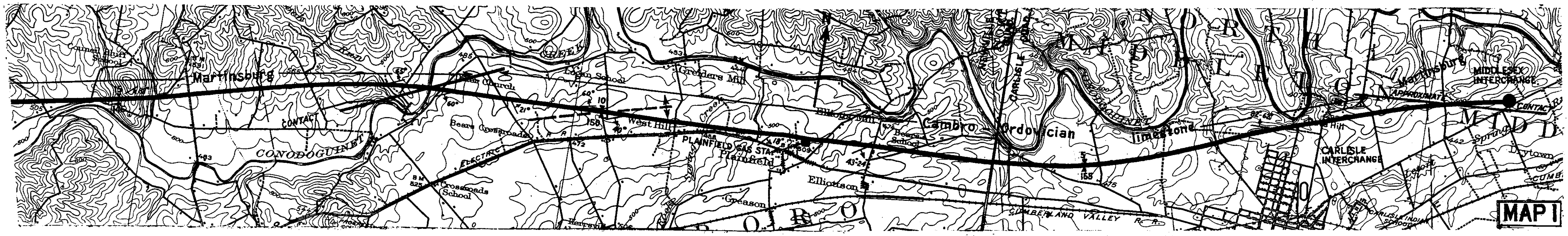
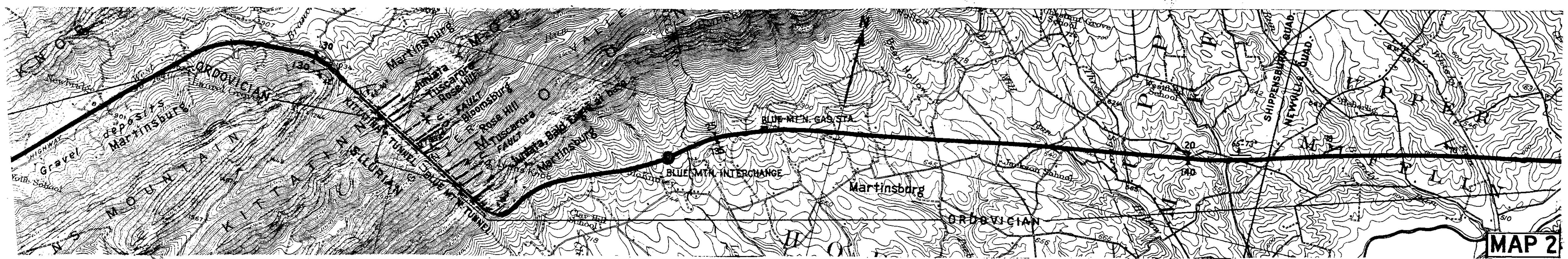
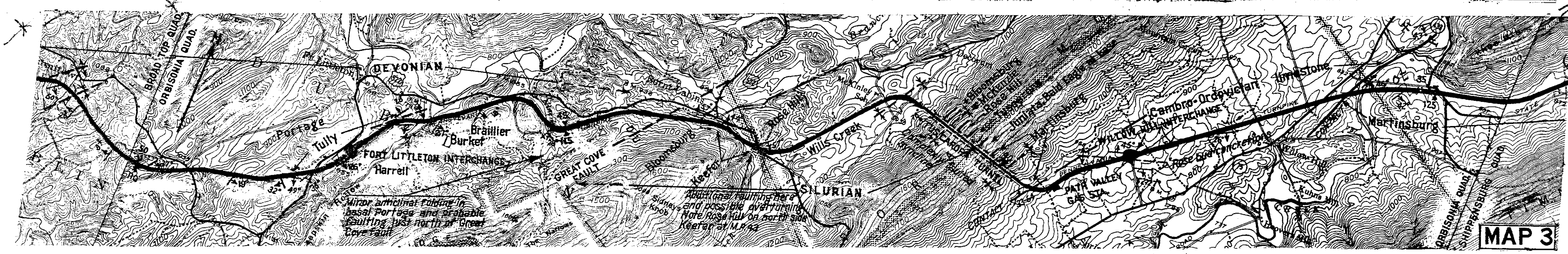

GEOLOGIC MAP
FOR
FIELD EXCURSION
TO THE
SOUTH MOUNTAIN AREA
MAY 1948
PENNSYLVANIA
TOPOGRAPHIC & GEOLOGIC SURVEY
Geology after Geo. W. Stose, et al.
TRIASSIC
DIABASE
LIMESTONE CONGLOMERATE
QUARTZOSE CONGLOMERATE
GETTYSBURG SHALE
ORDOVICIAN
MARTINSBURG SHALE
BEEKMANTOWN LIMESTONE
STONEHENGE LIMESTONE
CAMBRIAN
CONOCOCHEAGUE LIMESTONE
ELBROOK LIMESTONE
WAYNESBORO FORMATION
TOMSTOWN DOLOMITE
ANTIETAM QUARTZITE
MONTALTO QUARTZITE
WEVERTON QUARTZITE
LOUDOUN FORMATION
ALGONKIAN
METABASALT
APORHYOLITE
Formational boundary
Structural axes
Fault
Trip mileage
Boulevard stop—Caution
miles
MT. HOLLY SPRINGS
BOILING SPRINGS
CHURCHTOWN
READING BANKS OVERTHRUST
MOUNTAIN CREEK
WHITE ROCKS
WHISKEY SPRING
DOGWOOD HOLLOW SYNCLINE
STONE HEAD ANTICLINE
DILLSBURG
CUMBERLAND COUNTY
ADAMS COUNTY
IDAVILLE
GARDNERS
BENDERSVILLE
YORK SPRINGS
NEWVILLE QUAD.
FAIRFIELD QUAD.
CARLISLE QUAD.
GETTYSBURG QUAD.
U.S. 15
to HARRISBURG
Yellow Breeches Creek
STOP 1
STOP 2
STOP 3
STOP 4
STOP 5
STOP 6
STOP 7
STOP 8
STOP 9



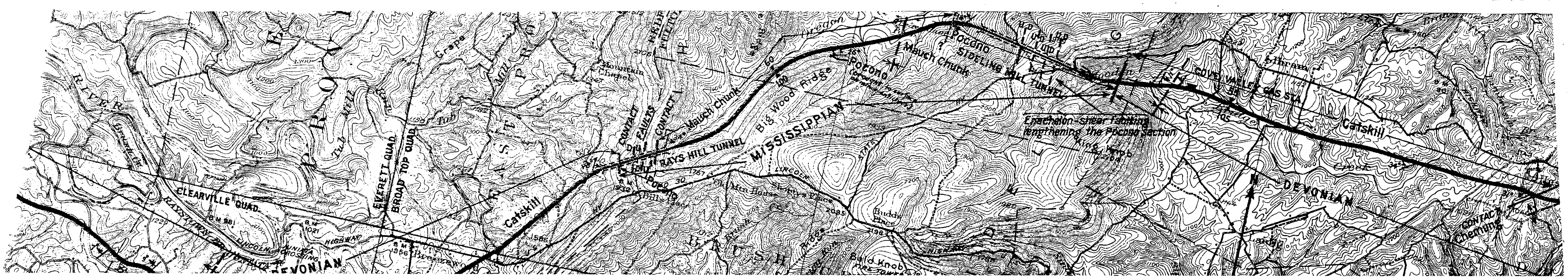
Martinsburg
CONODOGUINET
PLAINFIELD GAS STA.
Cambro-Ordovician
limestone
CARLISLE INTERCHANGE
MIDDLESEX INTERCHANGE
MAP 1



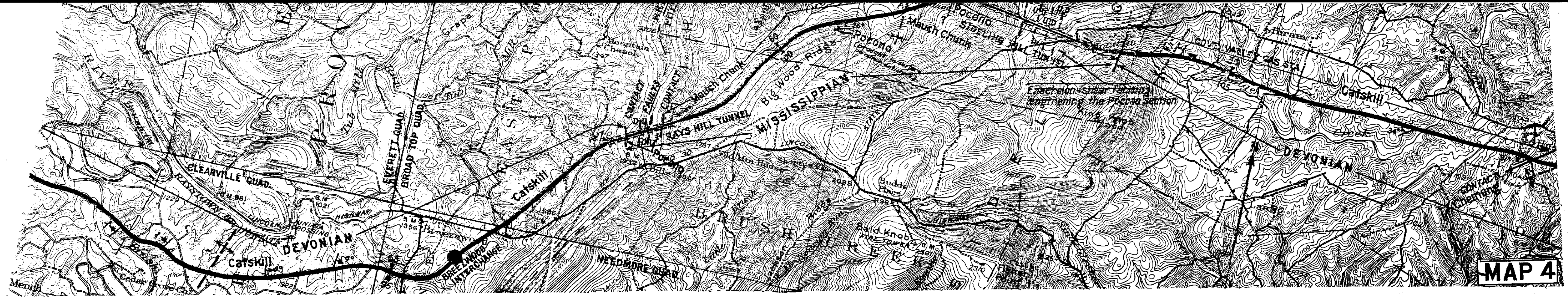
ORDOVICIAN
Gravel deposits
Martinsburg
KITTATINNY TUNNEL
SILURIAN
BLUE MT. N. GAS STA.
BLUE MTN. INTERCHANGE
Martinsburg
ORDOVICIAN
SHIPPENSBURG QUAD.
NEWVILLE QUAD.
MAP 2

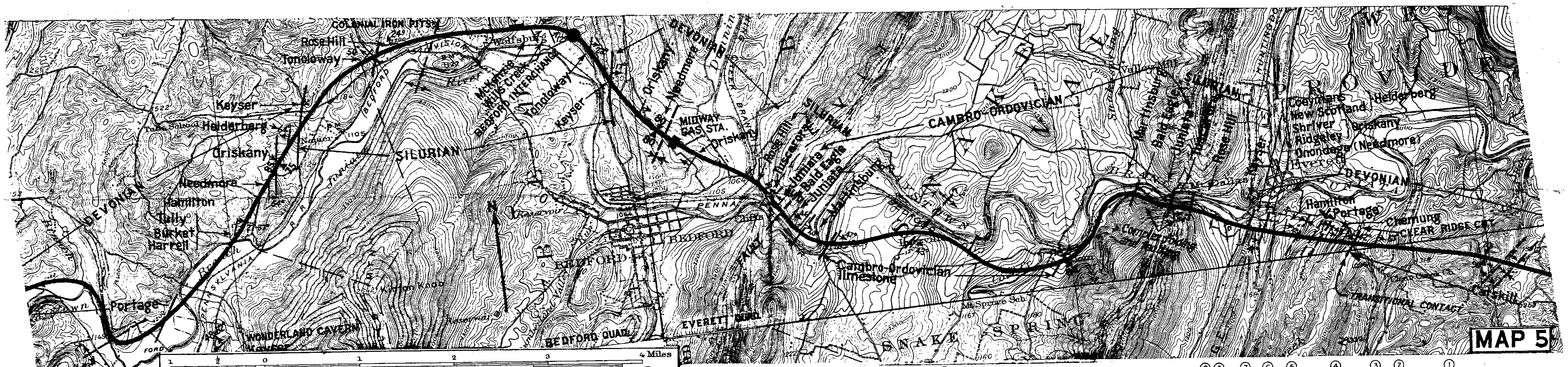


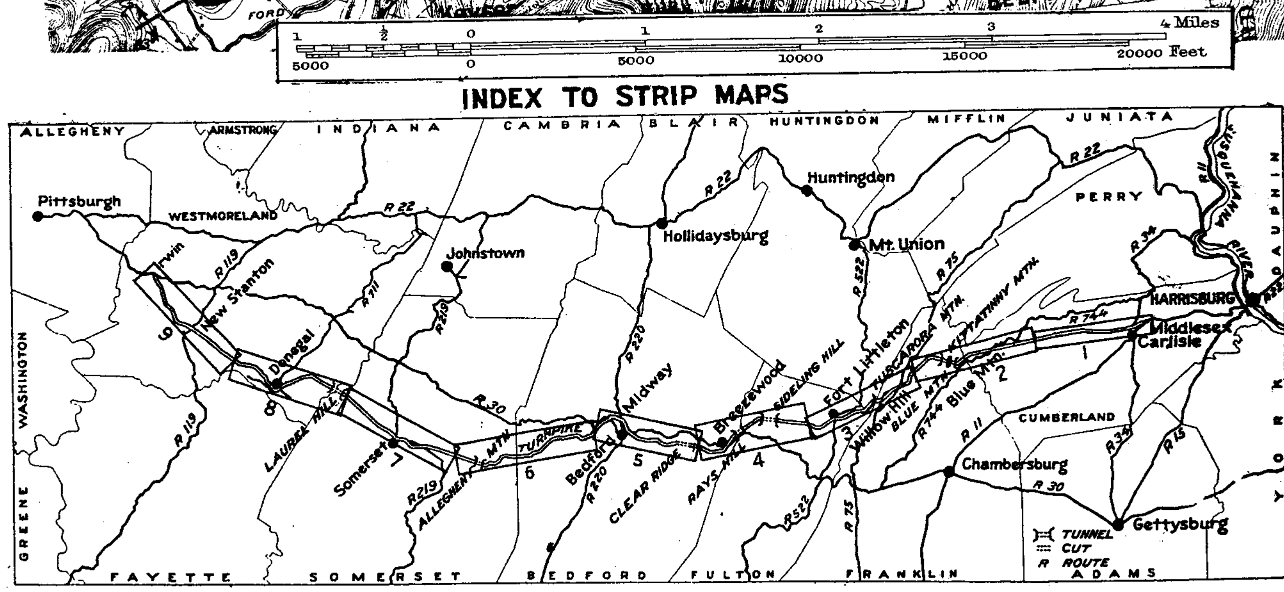
BROAD TOP QUAD.
ORBISONIA QUAD.
DEVONIAN
Portage
Tully
FORT LITTLETON INTERCHANGE
Harrell
Brallier
Burket
GREAT COVE FAULT
Bloomsburg
Wills Creek
SILURIAN
Minor anticlinal folding in basal Portage and probable faulting just north of Great Cove fault
Additional faulting here and possible overturning. Note Rose Hill on north side Keefer at M.P. 43
Cambro-Ordovician
limestone
PATH VALLEY GAS STA.
Martinsburg
ORBISONIA QUAD.
SHIPPENSBURG QUAD.
MAP 3

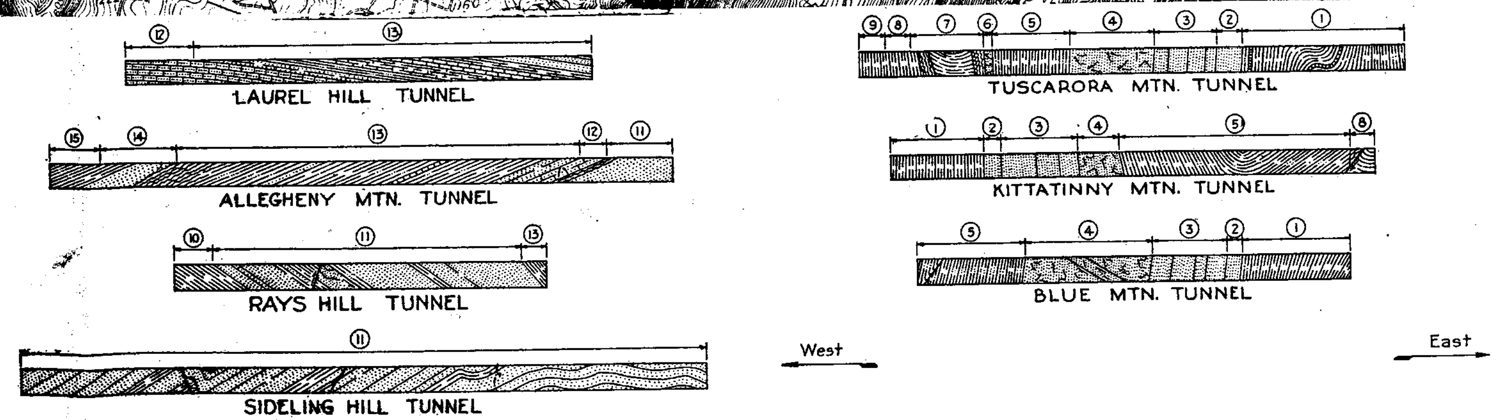


CLEARVILLE QUAD.
EVERETT QUAD.
BROAD TOP QUAD.
DEVONIAN
Catskill
RAYS HILL TUNNEL
MISSISSIPPIAN
Big Wood Ridge
Mauch Chunk
Pocono
SIDELING HILL TUNNEL
Enechelon-shear faulting lengthening the Pocono section
COVE VALLEY GAS STA.
Catskill
DEVONIAN









LEGEND

● Interchange ■ Gas station Tunnel Mile posts (5 West-bound, 155 East-bound)

LEGEND

Shale, Sheared Shale, Limestone, Sandstone, Sandy Shale, Shaly Limestone, Sandy Limestone, Quartzitic Sandstone

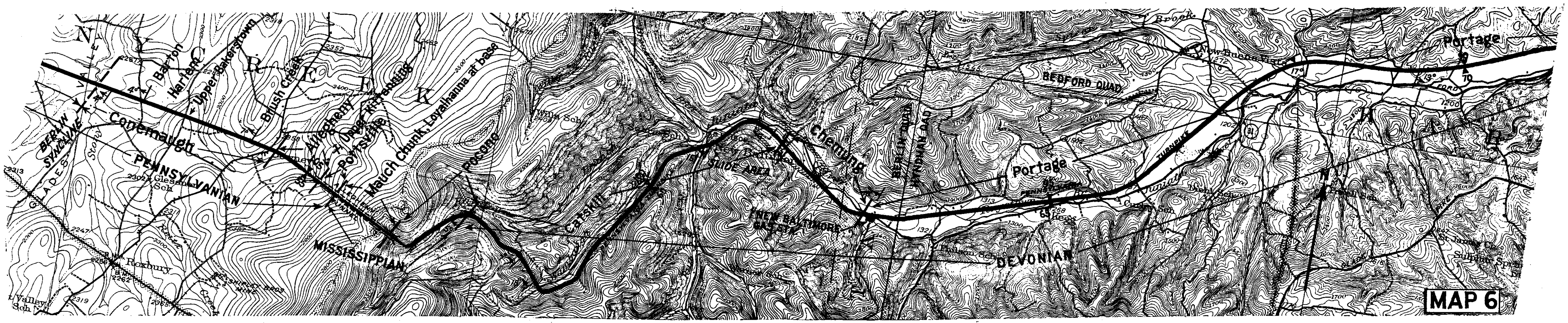
FORMATIONS

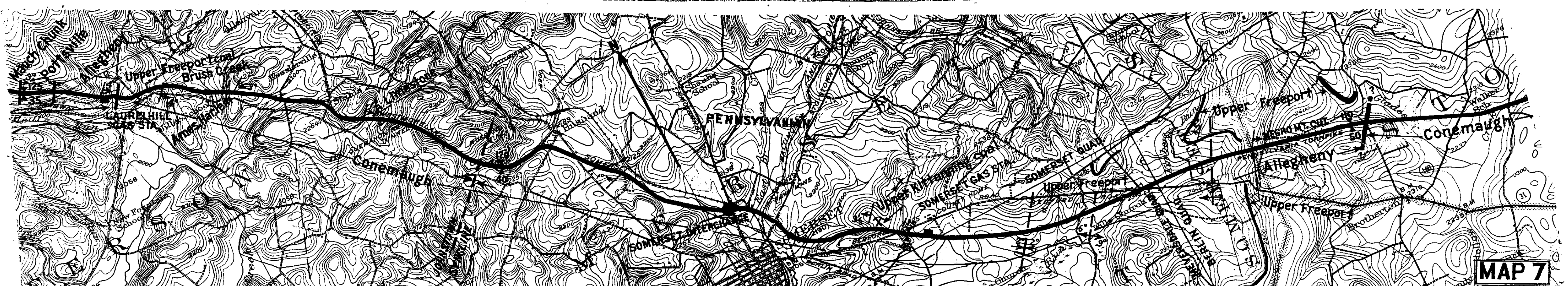
① MARTINSBURG	⑥ KEEFER	⑪ POCONO
② BALD EAGLE	⑦ McKENZIE	⑫ LOYALHANNA
③ JUNIATA	⑧ BLOOMSBURG	⑬ MAUCH CHUNK
④ TUSCARORA	⑨ WILLS CREEK	⑭ POTTSVILLE
⑤ ROSE HILL	⑩ CATSKILL	⑮ ALLEGHENY

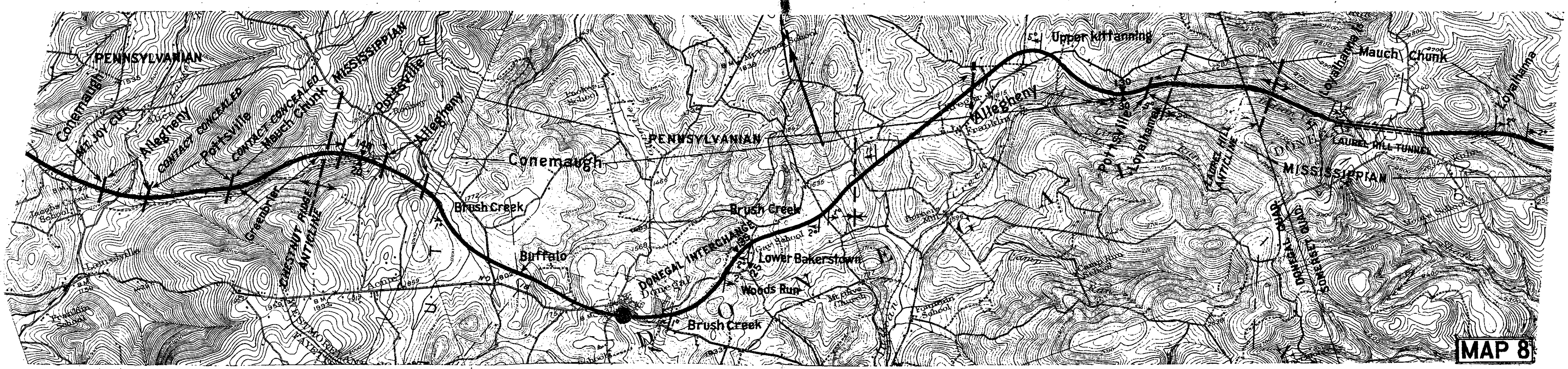
PENNSYLVANIA TURNPIKE
PRELIMINARY STRIP MAP
May 1948

Pennsylvania Topographic & Geologic Survey

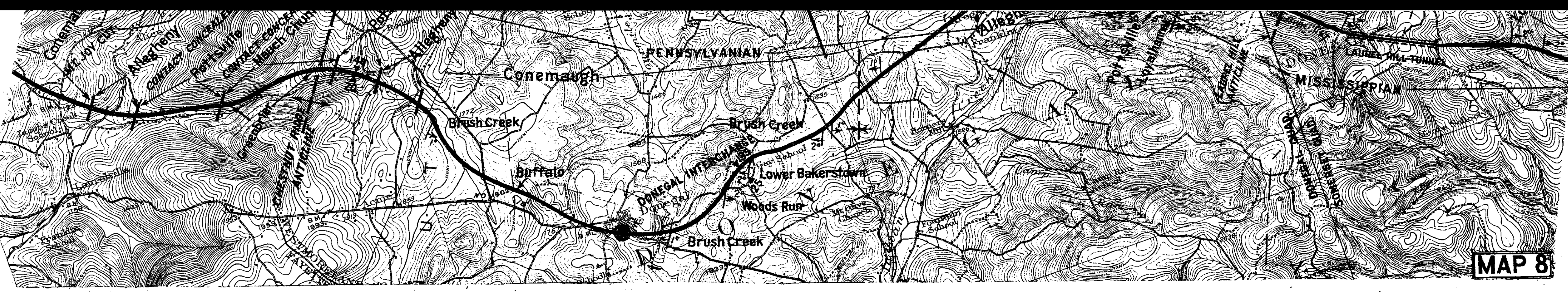
Geology by A. B. Cleaves

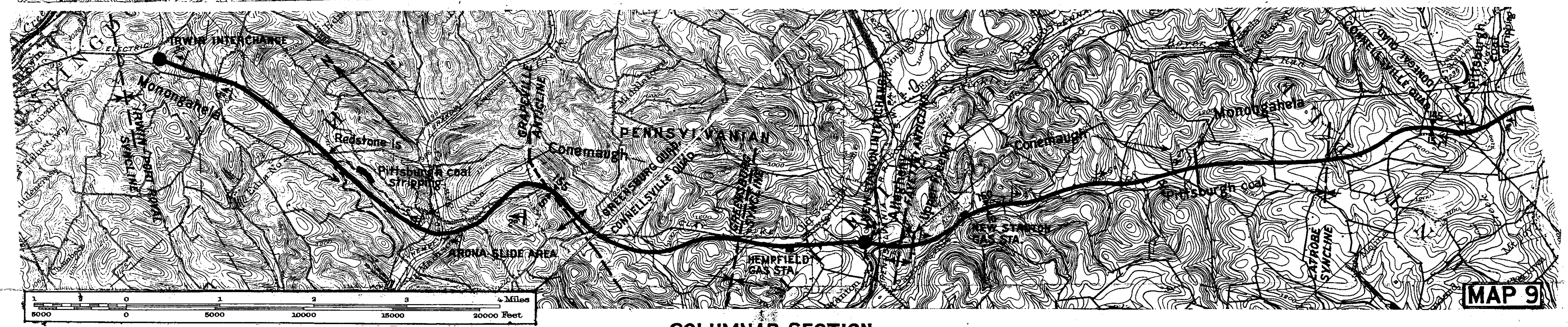

MAP 6
Conemaugh
PENNSYLVANIAN
Barton
Harlem
Upper Bakerstown
Brush Creek
Allegheny
Upper Kittanning
Pottsville
Mauch Chunk, Loyalhanna at base
Pocono
MISSISSIPPIAN
Catskill
SLIDE AREA
NEW BALTIMORE
Chemung
BERLIN QUAD
HYNDMAN QUAD
Portage
BEDFORD QUAD
DEVONIAN


MAP 7
Mauch Chunk
Pottsville
Allegheny
Upper Freeport coal
Brush Creek
LAUREL HILL GAS STA.
Ames-Harlem
Limestone
Conemaugh
SOMERSET INTERCHANGE
PENNSYLVANIAN
Upper Kittanning coal
SOMERSET GAS STA.
SOMERSET QUAD
Upper Freeport
BERLIN QUAD
Allegheny
Conemaugh


MAP 8
PENNSYLVANIAN
Conemaugh
Allegheny
CONTACT CONCEALED
Pottsville
Mauch Chunk
MISSISSIPPIAN
Greenbrier
CHESTNUT RIDGE ANTICLINE
Brush Creek
Buffalo
DONEGAL INTERCHANGE
Lower Bakerstown
Woods Run
Upper Kittanning
Loyalhanna
LAUREL HILL ANTICLINE
DONEGAL QUAD
SOMERSET QUAD
LAUREL HILL TUNNEL
Mauch Chunk
Loyalhanna


IRWIN INTERCHANGE



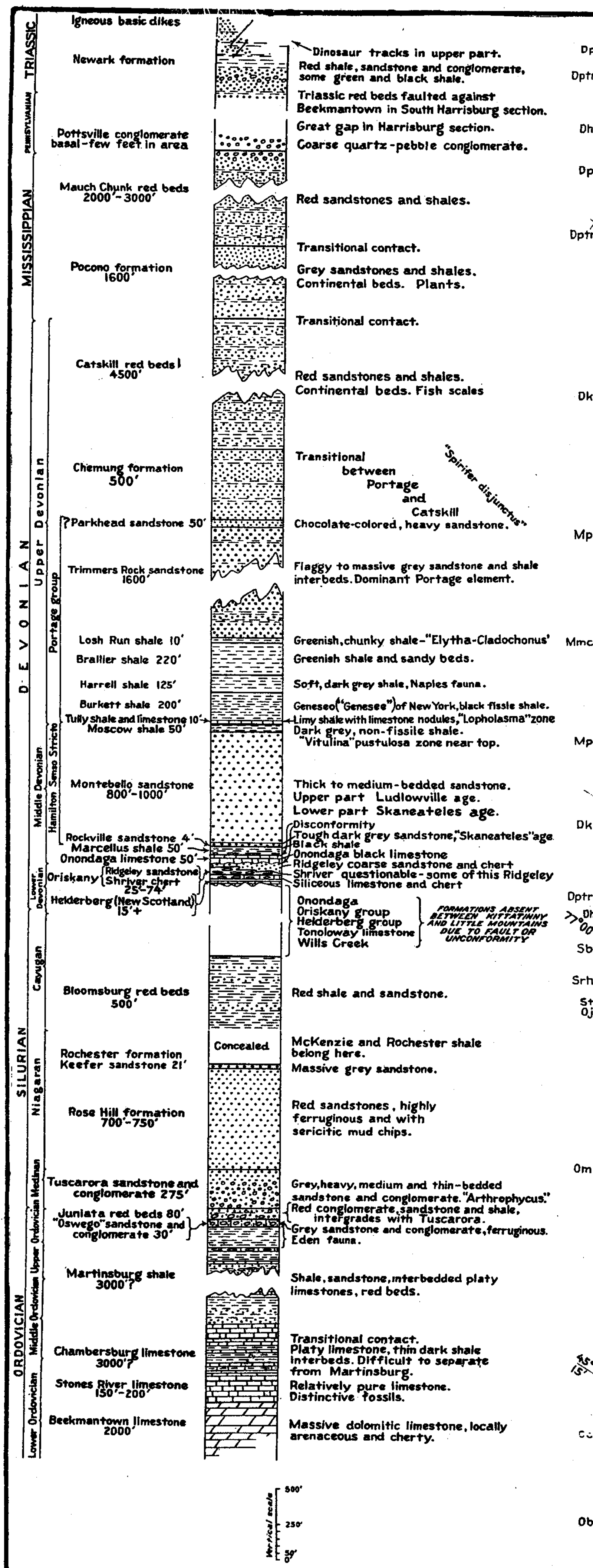


COLUMNAR SECTION

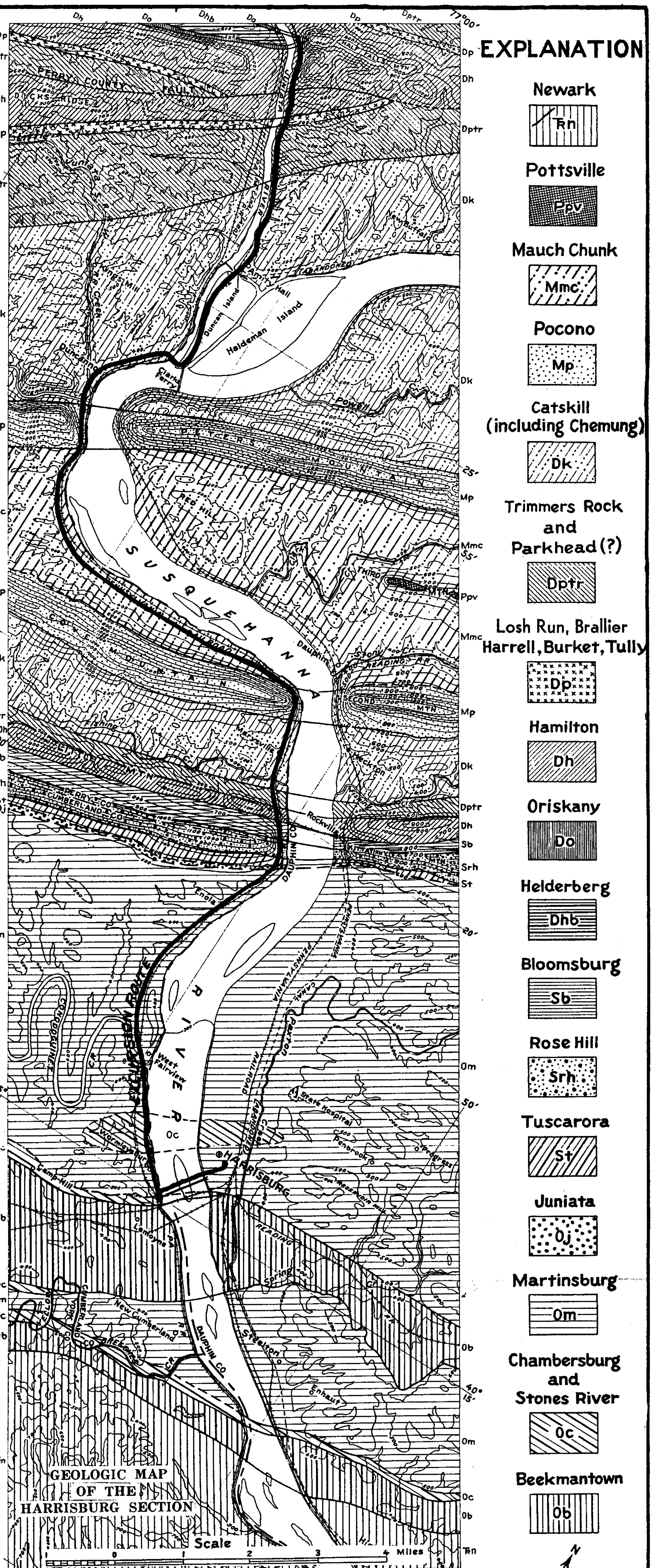
	Thickness in feet
Carboniferous age	
Pennsylvanian system	
Pittsburgh series	
Monongahela group. Upper coal group with Pittsburgh coal bed at base	250 to 400
Conemaugh group. Shales, sandstones, some limestones, and a little coal, 600-900 feet	650
Allegheny group (Freeport, Kittanning, Clarion coals, clays, limestones, and sandstones)	300
Pottsville series. Mostly sandstone, crest of Allegheny Mountain. Up to 7,000 feet thick in Southern States, here	50 to 250
Mississippian system	
Mauch Chunk (Chester) series. Red and greenish-gray sandstones and shales (contains Greenbrier limestone, 5 to 25 feet), hill and valley topography	262 to 606
Loyalhanna, cross-bedded, sandy limestone or calcareous sandstone, 37 to 62 feet	50
Pocono, massive, hard, gray and blue, cross-bedded sandstones (basal part is uppermost Devonian); mountain maker	1,230
Siluro-Devonian age	
Devonian system	
Catskill facies. Red shales and sandstones with interbedded green shales and sandstones; tends to make high, hilly land, 2,500 feet at Allegheny Mountain; at east	4,500
Chemung facies. Alternating sandstones and shales Source of most of oil and gas found in Pennsylvania	2,200
Portage facies. Brown and gray to black shales and sandstones, valley-maker. (Genesee black shale and Tully limestone at base)	2,100
Hamilton, massive and thin-bedded gray to tan sandstone interbedded with multicolored shales. Valley-maker. (Marcellus black shale at base)	1,575
Onondaga, black and gray shales at base, limestone at top	150
Oriskany, consisting of the Ridgeley, white to bluish gray, calcareous sandstone, and the Shriver, blocky, grayish-black, impure, cherty limestone	125
Helderberg limestone, consists here of the New Scotland cherty limestone, and above the Coeymans, a very crystalline limestone	70
Silurian system	
Keyser, massive gray and blue gray limestone	150
Tonoloway, bluish-gray, thin-bedded shaly limestone, in places entirely gray shale	700
Wills Creek, soft, thin, green and yellow shales which vary to dove gray and red shale at places; calcareous at top	209
Bloomsburg, unfossiliferous, soft, thin-bedded red shales, interbedded with sandstone	207
McKenzie, green to gray limestone, interbedded with greenish shale that weathers brown; full of fossils	259
Keefer, massive-bedded sandstone to cream-colored, fossiliferous quartzite	48
Rose Hill (Clinton), mostly thin-bedded red shale and thin, inter-bedded sandstones	575
Tuscarora, heavy-bedded, white and gray sandstone and quartzite (upper Medina), hard and resistant; therefore a mountain-maker	395
Cambro-Ordovician age	
Ordovician system	
Juniata, red sandstone and shale (middle Medina). Subordinate valley-maker	608
Bald Eagle (Oswego, lower Medina), greenish gray, massive and medium-bedded sandstone, subordinate mountain-maker on Turnpike	119
Martinsburg, dark tan to rust-colored shales which weather to thin, splintery, and hackly fragments. It is interbedded with thin, tan sandstones; in valleys	1,500
Chambersburg, platy beds of dense gray limestone interbedded with dark gray shale, 100-750 feet; in valleys	500
Canadian system	
Stones River, semi-massive, bluish limestone in valleys; fossils, 675-1,050 feet	1,000
Beekmantown, blue-gray to blue, heavy-bedded, often cherty dolomite in valleys; fossils rare	2,300

Older rocks are exposed further east, and further northeast of Allegheny Mountain, but not along the Turnpike. Exact figures in the above table represent accurate measurements made possible in the excavation of the tunnels or highway cuts.

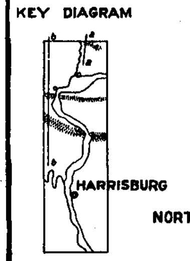
PENNSYLVANIA TURNPIKE
PRELIMINARY STRIP MAP
May 1948
Pennsylvania Topographic & Geologic Survey
Geology by A.B.Cleaves

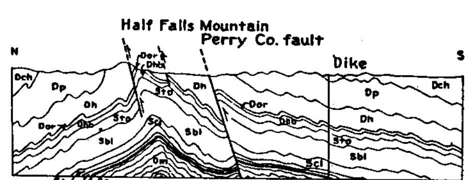


COLUMNAR SECTION ON SUSQUEHANNA-JUNIATA RIVERS BETWEEN HALF FALLS MOUNTAIN AND HIGHSPIRE

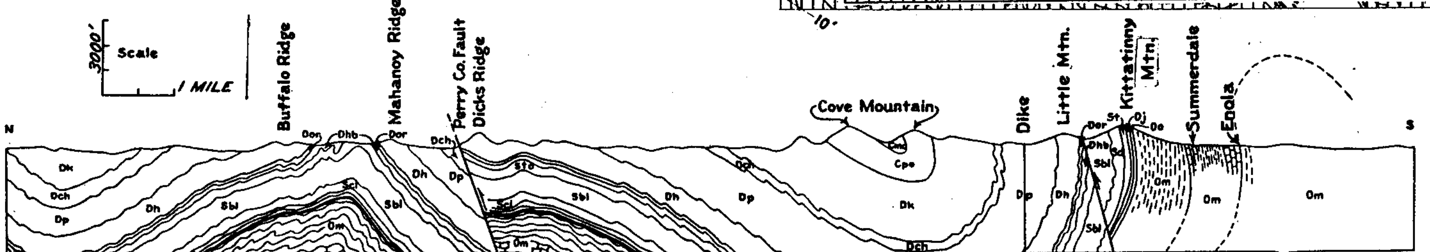


KEY DIAGRAM

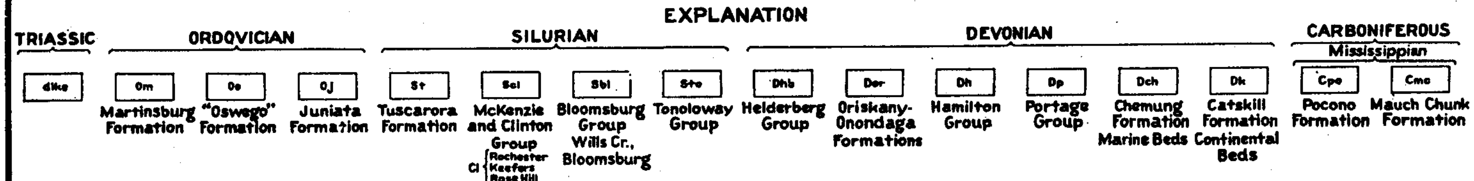




NORTH-SOUTH SECTION THROUGH HALF FALLS MOUNTAIN ANTICLINE
Section a-a



NORTH-SOUTH SECTION THROUGH THE CENTRAL PART OF THE NEW BLOOMFIELD AREA
Section b-b



STRUCTURE SECTIONS