

GUIDEBOOK

30th. Annual Field Conference Of Pennsylvania Geologists

October 8 & 9, 1965
Pittsburgh, Pa.



Hosts:

**U.S. GEOLOGICAL SURVEY
PENNSYLVANIA GEOLOGICAL SURVEY**

**Guidebook for the 30th Annual Field Conference of
Pennsylvania Geologists**

October 8 - 9, 1965

**STRATIGRAPHY OF THE PENNSYLVANIAN AND PERMIAN ROCKS
OF WASHINGTON, MERCER, AND LAWRENCE COUNTIES, PA.**

By

**B. H. Kent
J. B. Roen
S. P. Schweinfurth
L. D. Carswell**

United States Geological Survey

Hosts: U. S. Geological Survey and Pennsylvania Geological Survey

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FIELD TRIP I

**Stratigraphy of Upper Pennsylvanian and Lower Permian
rocks, Washington County, Pennsylvania**

With a section on the Pleistocene Carmichaels Formation

B. H. Kent

J. B. Roen

S. P. Schweinfurth

Hosts: United States Geological Survey

**Prepared in cooperation with
The Commonwealth of Pennsylvania
Department of Internal Affairs
Bureau of Topographic and Geologic Survey**

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Introduction

In 1960 the State of Pennsylvania* and the U.S. Geological Survey established a cooperative program of detailed geologic 7½-minute quadrangle mapping and subsidiary research in southwest Pennsylvania. The purpose of this field trip is to acquaint the participants of the 30th Annual Field Conference of Pennsylvania Geologists with the stratigraphic section involved. The sequence to be examined extends from the base of the Pittsburgh coal bed upward into the lower part of the Greene Formation; the geologic age ranges from Late Pennsylvanian to Early Permian (fig. 75-2). The Carmichaels Formation of Pleistocene age will be examined briefly.

Investigations to date have been concentrated in the southern and eastern parts of Washington County (fig. 3). The main objectives are: (a) to achieve a better understanding of the stratigraphy of the northern part of the Dunkard basin, which is relatively low in coarse clastic sediments; (b) to establish mappable units and extend them southward and westward; (c) to establish the sedimentologic history and paleogeography by determining distribution patterns of the various sedimentary rocks and their facies relations; and (d) to refine correlations of the Upper Pennsylvanian and Lower Permian stratigraphy of southwest Pennsylvania with that of Ohio, where detailed work was done in Belmont County by H. L. Berryhill, Jr. (1963, Geology and Coal Resources of Belmont County, Ohio: U.S. Geol. Survey Prof. Paper 380, 113 p.).

*

Department of Internal Affairs, Bureau of Topographic and Geologic Survey

The stratigraphic nomenclature follows that set forth by H. L. Berryhill, Jr., and V. E. Swanson, the original staff of the Southwest Pennsylvania Cooperative project. Their article is reprinted in this guidebook.

At the localities chosen for visitation, rock characteristics are representative of the overall sequence and should provide the participants with an appreciation of the vertical and lateral distribution of the rocks above the Pittsburgh coal bed. The rocks below the Pittsburgh coal bed--the Conemaugh Formation--do not crop out extensively in the area of investigation and have not been studied in detail. A detailed report on the Conemaugh Formation by N. K. Flint will be published by the Pennsylvania Geological Survey.* Only the lower part of the Greene Formation is included because detailed mapping has not yet reached the areas where thick sections of the Greene are exposed.

References covering topics discussed on the trip follow the article by Berryhill and Swanson and the discussions of the individual stops.

*
in Bulletin C56a, Geology and Mineral Resources of Southern Somerset County, 1965

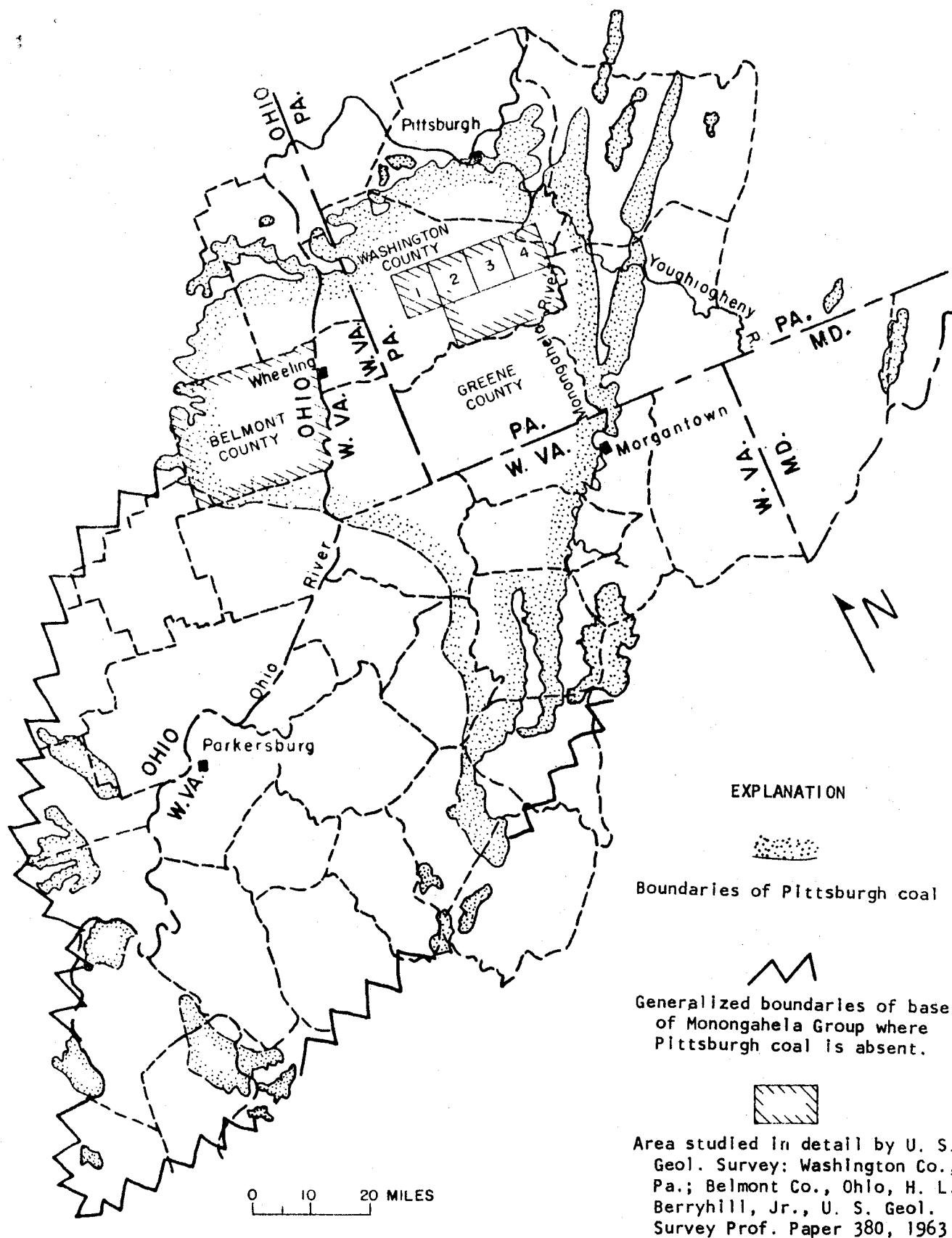


Figure 3.-- General index map of Pittsburgh coal bed and limits of "Dunkard basin." Numbers in mapped area of Washington County refer to field trip index maps: 1. Washington West (see p. 44), 2. Washington East (p. 45), 3. Hackett (p. 46), and 4. Monongahela (p. 47) quadrangles.

75. REVISED STRATIGRAPHIC NOMENCLATURE FOR UPPER PENNSYLVANIAN AND LOWER PERMIAN ROCKS, WASHINGTON COUNTY, PENNSYLVANIA

By HENRY L. BERRYHILL, JR., and VERNON M. SWANSON, Denver, Colo.

Work done in cooperation with the Pennsylvania Topographic and Geologic Survey

Reprinted from U. S. Geological Survey Professional Paper 450-C, 1962

Current geologic mapping in southern Washington County, Pa. (fig. 75.1), has yielded data that permit the establishment of a revised nomenclature and classification for the Pennsylvanian and Permian rocks. The existing nomenclature and classification (fig. 75.2, left side) were first proposed by Stevenson (1876) and have since been modified by Clapp (1907), Griswold and Munn (1907), Stevenson (1907), Shaw and Munn (1911), and Munn (1912); the reader is referred to Wilmarth (1938) for the history of names, definitions, and type localities of the named units. The revised classification described here meets mapping requirements in Washington County and is consistent with the concept of cyclic sedimentation.

The coal-bearing strata of Washington County are cyclic sequences of coal or carbonaceous shale, mudstone, impure sandstone and siltstone, impure limestone, and clay (fig. 75.2, columnar section). Coal beds and carbonaceous layers are the most persistent units. Fresh-water limestone beds occupy much or all of the intervals between some coal beds in the lower

and upper parts of the section, and thin, lenticular fresh-water limestone beds are interbedded with the sandstone and siltstone in other parts of the section. The limestone was deposited in a predominantly lacustrine-marsh environment; the sandstone and finer grained clastic units were laid down in a fluvial-delta plain environment. Sandstone becomes increasingly abundant southward in West Virginia where the environment of deposition was predominantly deltaic (Arkle, 1959, p. 122-123).

These rocks were originally classified on the basis of the presence or absence of minable coals. Names were first given to the minable coal beds, and subsequently to most of the thicker and more persistent limestone units and to a few of the sandstone units. Most of the sandstone, siltstone, and mudstone units have not been named. Elsewhere in southwestern Pennsylvania and in eastern Ohio and West Virginia, more than 80 names have been applied at one place or another to the strata shown in the generalized geologic section on figure 75.2. Continued use of this multitude of names would tend to perpetuate many names of units that cannot be mapped or correlated; and it also would violate article 11(c) of the code of the American Commission on Stratigraphic Nomenclature (1961), which prohibits the use of the same geographic name for more than one lithologic unit in the same area. "Waynesburg," for example, has been assigned to 6 different stratigraphic units, including rocks of 3 different lithologies.

Mapping in Washington County has demonstrated that coal beds are the most distinctive and most easily correlated units; further, the many intervening sandstone and limestone units are so monotonously similar that they can be correlated only when related to an underlying or overlying coal bed. Therefore, the basic mapping unit for field classification includes the several rock types between coal beds, and the basic unit represents a sedimentary cycle. This unit is defined as the rock sequence from the base of a coal bed or carbonaceous layer to the base of the next overlying carbonaceous unit. Because many of the units thus defined represent relatively thin or incomplete cycles, and because facies changes are common within many of the coal-to-coal sequences, these units are designated as members rather than as formations. Where



FIGURE 75.1.—Location of Washington County, Pa.

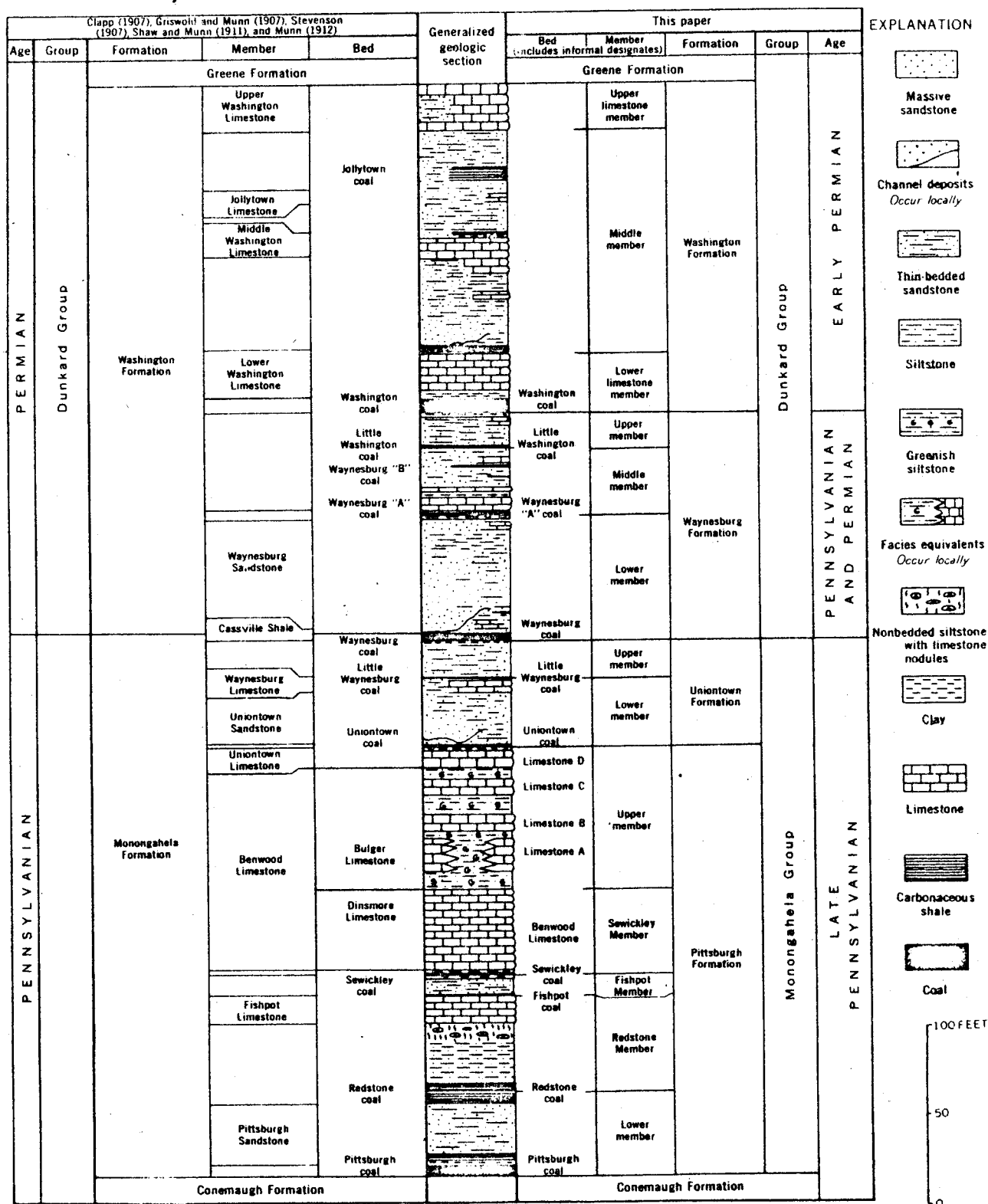


FIGURE 75.2.—Revision of stratigraphic nomenclature for Upper Pennsylvanian (Carboniferous) and Lower Permian rocks, Washington County, Pa.

possible, the member has been assigned the name of the coal bed at its base, thus retaining long-established names and relating the member name to its most easily mapped unit. These changes eliminate the confusing duplication of geographic names. Where coal beds are nonpersistent or where rapid facies changes preclude positive correlation, members have not been named but are informally designated as upper, middle, or lower members.

Because the basal unit of a member as here defined is a coal bed, it follows that the basal unit of a formation must also be a coal bed. In Washington County, the formation boundaries are placed at the base of the most important and persistent thick coal beds, and the name assigned to the formation is that of the major coal bed at its base. Further, the formation includes two or more members that represent sets of similar and related sedimentary cycles.

On the basis of the above principles, the Monongahela Formation in Washington County has been divided into two formations and raised to group rank. The lower, predominantly limestone part of the Monongahela, which represents lacustrine deposition, is here named the Pittsburgh Formation; the upper, predominantly clastic part, which represents fluvial-delta plain deposition, is named the Uniontown Formation.

Similarly, the basal part of the Dunkard Group can be divided into two mappable formations. The Waynesburg Formation at the base includes the Waynesburg coal bed and overlying rocks to the base of the Washington coal bed. The overlying Washington Formation includes the Washington coal and overlying rocks to the base of the Greene Formation.

In summary, all names of stratigraphic units shown on the left side of figure 75.2 have been redefined and their usage restricted to southwestern Pennsylvania; the names Dinsmore and Bulger are hereby abandoned. The revised nomenclature and stratigraphic classification are shown on the right side of figure 75.2.

PITTSBURGH FORMATION

The Pittsburgh Formation is named for the general area of Pittsburgh, Pa. The reference section for the formation is just west of Elco, Washington County, Pa. (California quadrangle) along the north bank of the Monongahela River and in road cuts of State Route 88. Previously the name "Pittsburgh" has been applied to several thin lithologic units in the basal part of this sequence. As redefined, the Pittsburgh Formation includes a sequence of beds 230 to 250 feet thick that extends from the base of the Pittsburgh

coal bed to the base of the Uniontown coal bed, or to the top of the brecciated limestone beneath the coal horizon in areas where the Uniontown coal bed is represented by carbonaceous shale or clay. The formation includes five members (fig. 75.2): an unnamed lower member; the Redstone, Fishpot, and Sewickley members, named after the basal coal beds; and an unnamed upper member.

The Pittsburgh Formation is a cyclic sequence in which fresh-water limestone beds and clay beds occupy much of the intervals between coal beds. The Benwood Limestone Bed of the Sewickley Member has an aggregate thickness of 45 to 60 feet. Farther west, in western Washington County, Pa., in the panhandle area of West Virginia, and in east-central Ohio, limestone beds extend down to the Pittsburgh coal. The upper member of the Pittsburgh Formation is characterized by several persistent greenish siltstone layers, of which the lowest is the most conspicuous; locally, as in the section at Elco, the two lowest green siltstone layers merge to form a greenish massive sandstone.

UNIONTOWN FORMATION

The Uniontown Formation is named for the general area of Uniontown, Pa., where the name was originally applied to a coal bed, to a sandstone member, and to a limestone member. The name is retained because of its long established usage, but is redefined to describe a formation comprised of an upper and a lower member representing two sedimentary cycles. The formation is 55 to 70 feet thick and includes strata from the base of the Uniontown coal bed to the base of the Waynesburg coal bed.

The Uniontown Formation typically has two persistent layers of thin-bedded sandstone and siltstone separated by a limestone and a thin coal bed; the coal bed, long known as the Little Waynesburg, is the basal bed of the unnamed upper member. The Waynesburg coal bed, formerly included as the uppermost bed in the Monongahela Formation, is now considered as the basal bed in the overlying Waynesburg Formation to conform to the principles of classification adopted for this area.

WAYNESBURG FORMATION

The rocks from the base of the Waynesburg coal bed to the base of the Washington coal bed, formerly included in the basal part of the Washington Formation, are here redefined as the Waynesburg Formation. The type area is Waynesburg, Pa., and its environs.

The Waynesburg Formation in southern Washington County is 100 to 130 feet thick and is divided into 3 members. A thick, locally massive sandstone (for-

merly Waynesburg Sandstone Member) is the main unit in the lower member; several lenticular impure coal beds and patchy fresh-water limestone beds comprise the middle member; and a persistent plant-bearing sandy siltstone-sandstone unit with a thin impure coal bed (Little Washington) at its base comprises the upper member.

In the past the strata above the Waynesburg coal bed have been dated Early Permian, based on floral studies by Fontaine and White (1880). The lenticular shales above the Waynesburg coal bed contain many plant fossils with Permian affinities, but they also contain all Pennsylvanian species characteristic of sediments below the Waynesburg coal bed. The diagnostic Permian plant form, *Callipteris conferta*, has not been found below the Washington coal. Because the floral evidence indicates a transition in plant forms from Pennsylvanian to Permian time, and because there is no profound lithologic change above the Waynesburg coal bed as claimed by Fontaine and White, the age of the strata between the Waynesburg and Washington coal beds is redesignated as Pennsylvanian and Permian.

WASHINGTON FORMATION

As redefined in this report, the Washington Formation includes the sequence of beds 160 to 180 feet thick between the base of the Washington coal bed and the top of the upper limestone member. This sequence represents the upper part of the Washington Formation as formerly described. The Washington Formation, particularly the lower limestone member with the Washington coal bed at its base and the upper limestone member, is well exposed in and near the city of Washington, which is the type area. The middle unnamed member consists of several impure

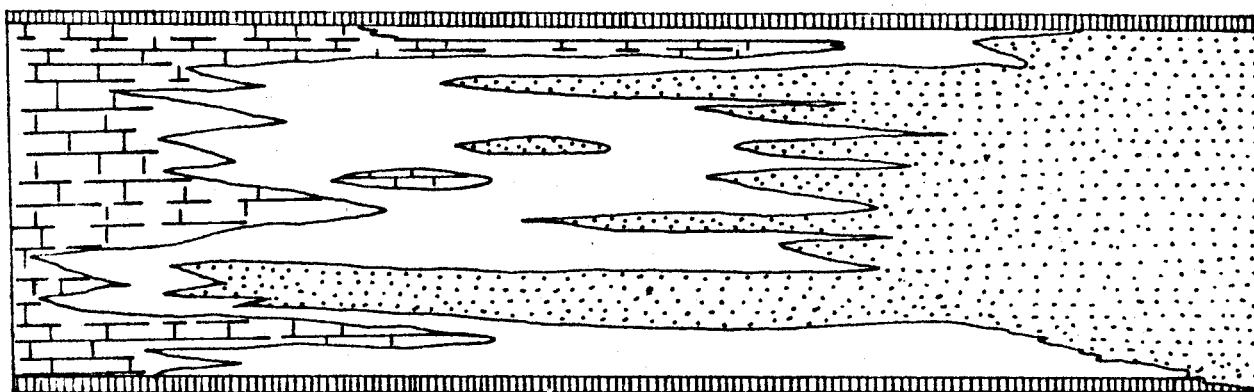
sandstone beds, a unit of highly impure limestone beds near the middle, several lenticular thin limestone beds, and three impure coal and carbonaceous shale beds.

The Washington coal bed at the base of the formation is stratigraphically the highest persistent thick coal in the Pennsylvanian-Permian sequence of Eastern United States. The Washington coal and the overlying rocks are probably of Early Permian age.

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EXPLANATION

-  Coal or carbonaceous shale,
laterally persistent
-  Mudstone, clay, and shale
-  Limestone, argillaceous
-  Sandstone

Figure 4.--Generalized cross section of the basic mapping unit used for field classification and correlation of Upper Pennsylvanian and Lower Permian coal-bearing strata in southwest Pennsylvania. The unit consists of the rock sequence from the base of a coal (or carbonaceous layer) to the base of the next overlying coal (or carbonaceous layer). As outlined in the preceding article by Berryhill and Swanson, the unit represents a thin sedimentary cycle and is of member rank. Because facies changes are rapid and can occur in any direction from a given point, the rock sequence in any given coal-to-coal interval will vary from place to place.

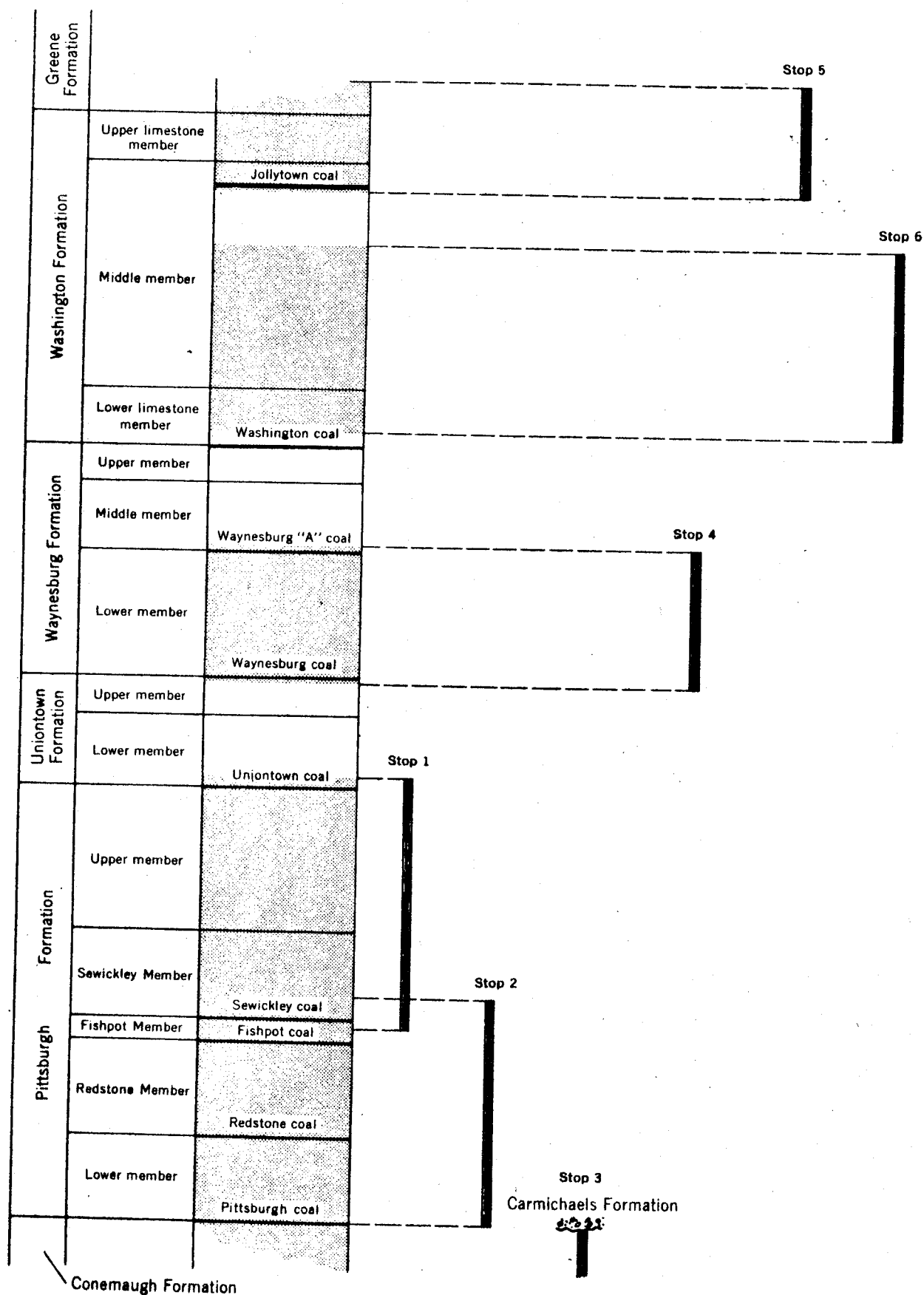


Figure 6.--Diagram showing the parts of the geologic section covered by the 6 stops.

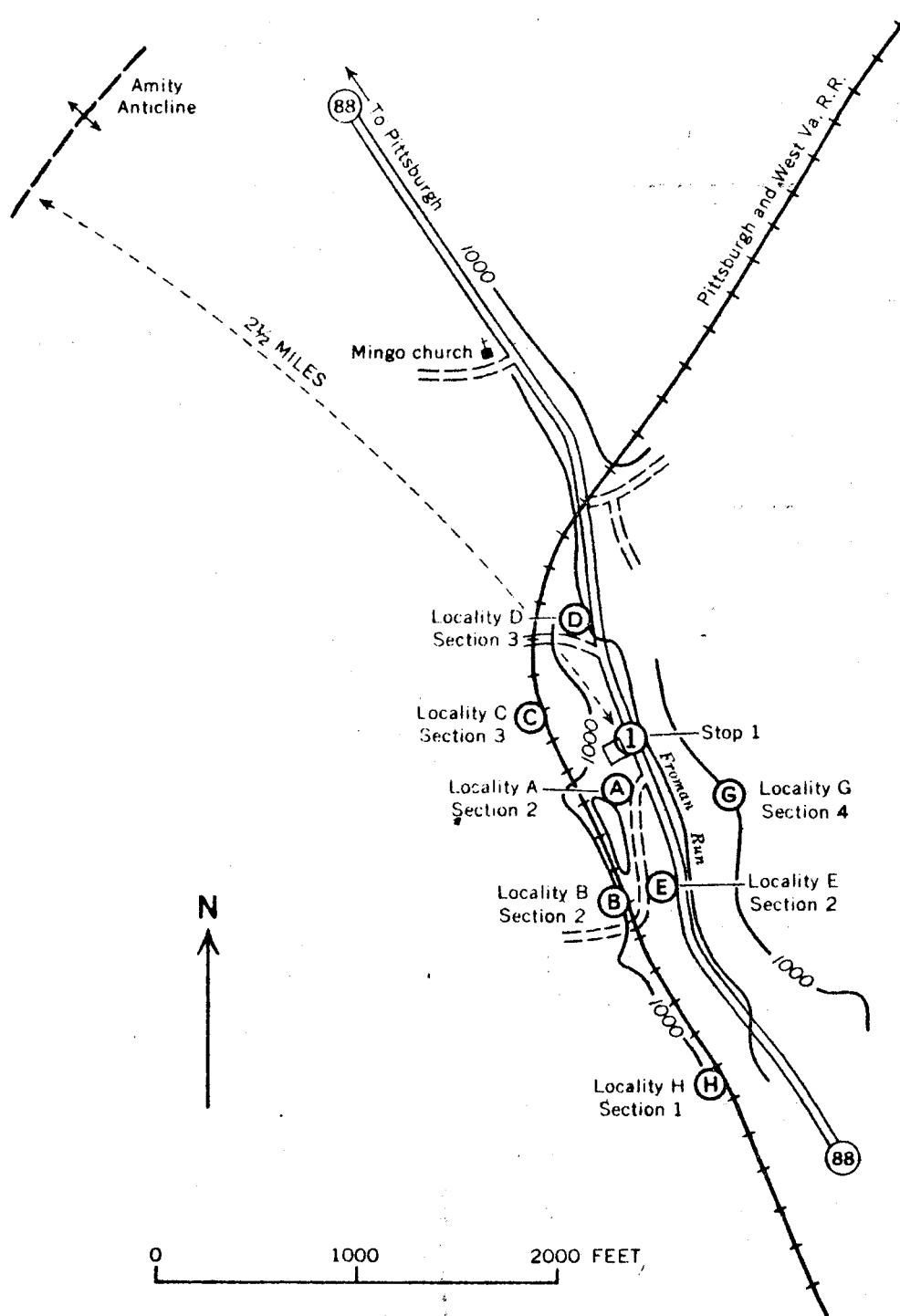


Figure 7.--Sketch map of Stop I. Localities A, B, C, D, E, and G are keyed to the columnar sections shown on Figure 8.

ROAD LOG

<u>Time</u>	<u>Approximate mileage</u>	From conference headquarters Webster Hall Hotel, Pittsburgh, Pa.
8:15 a.m.	0	Buses will leave at 8:15 a.m. from front of the Webster Hall Hotel, via the Liberty Bridge and the Liberty Tunnel. At the south end of the Liberty Tunnel, turn east (left) on Saw Mill Run Blvd. (State Routes 51 and 88). At 2.4 miles south turn south (right) on Library Rd (State Route 88) and follow State Route 88 south through Castle Shannon, Mollenour, Library, and Finleyville, to Stop I. See figure 5, general index map.

9:15 a.m.	22.1	STOP I - FROMAN RUN (time allotted: 50 minutes) See index map 1, Monongahela quadrangle; figure 7, sketch map of Stop I; and figure 8, columnar sections.
--------------	------	--

Buses will unload and park near the general store on the west side of State Route 88. The stratigraphic position is at the Sewickley Member of the Pittsburgh Formation and we are now in the middle part of a 45-foot limestone unit known as the Benwood Limestone Bed (see fig. 75-2, the generalized geologic section; fig. 8, section 2). We will walk up the hill west of the stop along a dirt road that joins State Route 88 just south of the general store to locality A where a zone of platy, thin-bedded, carbonaceous limestone marks the top of the Benwood Limestone Bed and the top of the Sewickley Member.

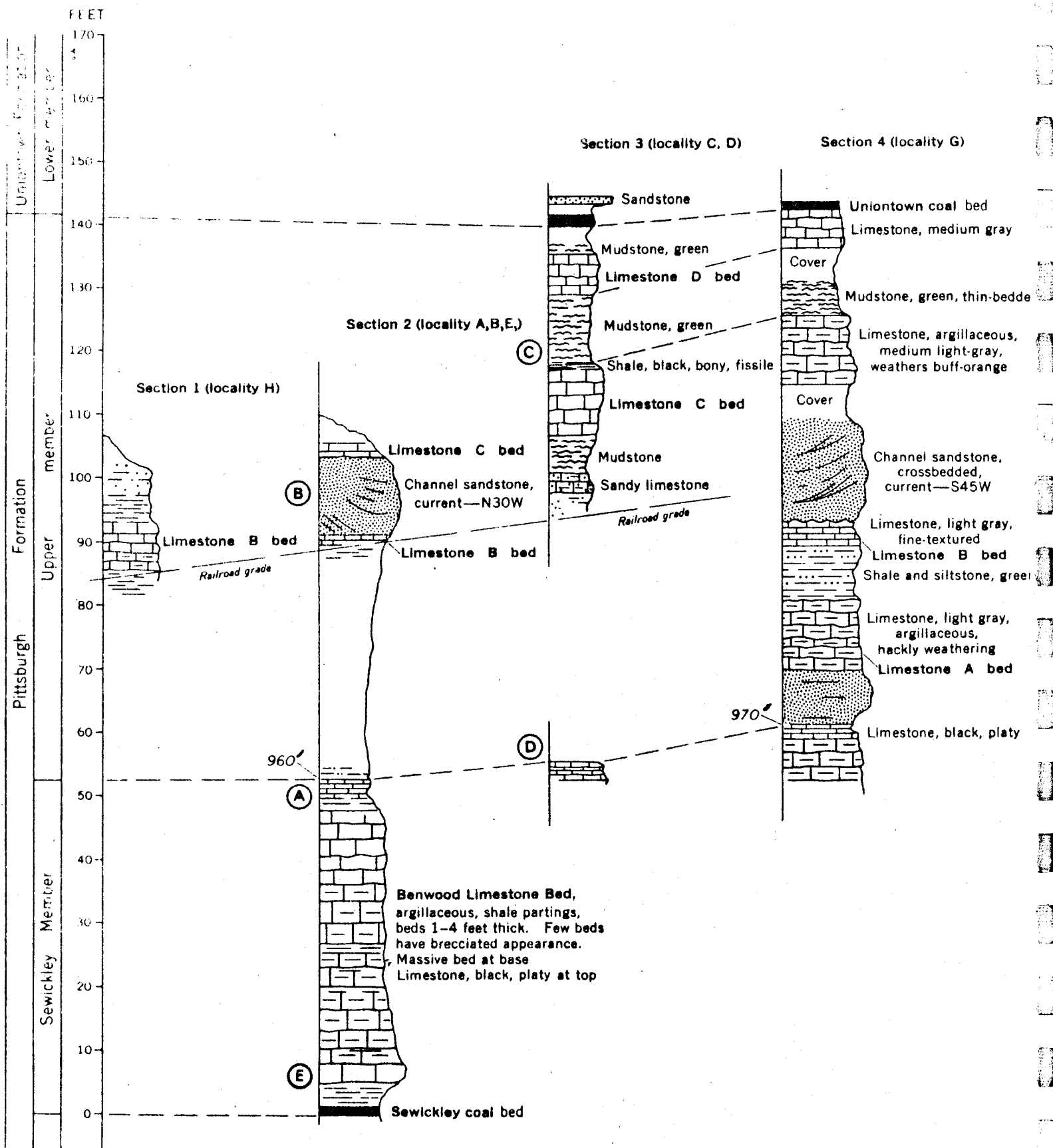


Figure 8.--Stop I. Columnar sections of the Sewickley Member and the upper member of the Pittsburgh Formation. Sections are keyed to localities A, B, C, D, E, and G, Stop I, on sketch map (Figure 6).

From locality A up the road to the railroad crossing, we pass through a covered interval, about 40 feet thick, that has scattered float blocks of sandstone and limestone. A typical section for this interval is exposed at locality G (see section 4, fig. 8). Locality B is the west wall of the railroad cut just north of the railroad crossing. Here, several thin limestone layers of the limestone B bed are at track level near the base of the cut. Above are cross-stratified or foreset-type layers of sandstone which terminate abruptly along the level top of the underlying limestone. Toward the middle of the cut the sandstone layers thicken and occupy a channel which has been cut down through limestone B bed. Unfortunately, time does not permit a formal visit to locality H, which is the next railroad cut south of the railroad crossing at locality B. At locality H a more normal thickness of limestone B--about 7 feet--would be noted, as well as an absence of sandstone layers in the clastic interval between the limestone B and limestone C beds. Before leaving locality B note the greenish color of the sandstone, siltstone, and mudstone; the green color is a distinguishing feature of the sandstone, siltstone, and mudstone in the upper member of the Pittsburgh Formation. From locality B walk north along the railroad to locality C in the next railroad cut (see section 3, fig. 8). The green, limy clastic layers in the base of this cut correlate with the upper part of the channel sandstone zone at locality B. Above, and in ascending order, limestone C, greenish mudstone, limestone D, greenish mudstone, and a layer of coaly material 2 feet thick (equivalent to the Uniontown coal bed), are exposed. Just above the layer of coaly material, and near the top of the cut, a thin bed of sandstone marks the

base of a sandstone in the lower part of the lower member of the Uniontown Formation (see fig. 75-2). Please note that this sandstone does not have the same greenish color as do the clastic rocks in the underlying upper member of the Pittsburgh Formation. From locality C walk north to the next railroad crossing and walk back down the hill to State Route 88 again. At locality D we again cross the contact between the upper member of the Pittsburgh Formation and the underlying Sewickley Member. Along State Route 88, just south of the Stop I parking area, the lower part of the Sewickley Member is well exposed on the west side of the road. Locality E marks the base of the Benwood Limestone Bed (see section 2, fig. 8).

The Benwood Limestone Bed is an excellent index stratigraphic unit in the Pittsburgh Formation because of its remarkable persistence. Wherever this bed has been found in southwest Pennsylvania, it looks about the same and can be traced in the subsurface westward into West Virginia; it is also at the same stratigraphic position in Belmont County, Ohio (Berryhill, 1963, Prof. Paper 380). The limestone beds A, B, C, and D and the interbedded, greenish colored, clastic rocks of the upper member of the Pittsburgh Formation have the same regional distribution as the Benwood.

The sandstone bed in the lower part of the lower member of the Uniontown Formation is unusually thin at locality C. Regionally, a massive phase of the sandstone forms a pattern of anastomosing channels (see also fig. 14). For example, in the first railroad cut northeast of the railroad overpass to State Route 88 (north of Stop I), the equivalent to this sandstone bed is a massive elongate sandstone body more than 15 feet thick at the center.

* * * * *

Time Mileage

10:05 22.1 Buses leave Stop I via State Route 88 through Crookham,
a.m. past the Mathies Mine, to River View:

Point (1): Just south of Crookham, top of Pittsburgh coal bed to west (right) side of State Route 88, at elev. 800 ft.

Point (2): Opposite Mathies Mine, on big bend in road, Pittsburgh coal bed on north (left) side of road.

Point (3): Behind gas station on south (right) side of road junction at River View, lower member of Pittsburgh Formation exposed in quarry wall.

At River View (junction of State Routes 88 and 837) turn north (left) on State Route 837, through Courtney, past the powerhouse substation, Huston Run, Coal Bluff, and Shire Oaks, to Elrama (Stop II):

Point (4): Road bank opposite powerhouse substation, top of Pittsburgh coal bed at elev. 780 ft.

From Courtney to Huston Run, cross axis of small syncline; Pittsburgh coal bed below road level.

Point (5): Huston Run - top of Pittsburgh coal bed, at elev. 780 ft.

Point (6): Coal Bluff - top of Pittsburgh coal bed, at elev. 780 ft.

From River View to Coal Bluff, no massive sandstone in lower member of Pittsburgh Formation.

Point (7): Shire Oaks - top of Pittsburgh coal bed, at elev. 826 ft; massive sandstone above the coal.

10:17 29.0
a.m.

STOP II - ELRAMA (time allotted: 50 minutes)

See index map 1, Monongahela quadrangle; and figures 9 and 9a, columnar sections.

Buses will park and unload inside entrance to strip mine.

Here strip mining of the Pittsburgh and Redstone coal beds has exposed the lower member, Redstone Member, Fishpot Member, and the basal beds of the Sewickley Member, all of the Pittsburgh Formation. Columnar sections illustrating the exposed sequence are shown on Figures 9 and 9a.

The significant feature at this locality is the abrupt facies change which takes place within a short distance in the lower member of the Pittsburgh Formation. On the west side of the locality the lower member contains a massive medium- to fine-grained, thin- to thick-bedded sandstone containing approximately 60 percent quartz grains. On the east side of the valley the member is represented by even-bedded relatively fine-grained shaly rocks. The sandstone facies is present only locally in Washington County and probably represents one of many sinuous channels filled with sandstone (compare also with Stop IV). The crossbedding dips, on an average, northwest, indicating a northwest direction for sediment transport and a southeast source for the sand in this immediate area.

At this stop rapid lithologic changes are not evident in the exposed sequence of the Redstone and Fishpot Members; in other areas abrupt facies changes do occur in these members. For instance, here the limestone bed below the Fishpot coal bed (fig. 9a) is about 2 feet thick, whereas to the south and west the limestone may be as much as two times thicker; 2 miles east of Stop II, across the Monongahela River, the limestone is absent and it is represented by nodular limy shale and claystone. A similar situation exists for the sandstone bed above the Fishpot coal bed; here the sandstone is about 4 feet thick; 2 miles eastward only 2 feet of sandstone occupies this interval. A notable characteristic of this sandstone in most outcrops is the distinct right-angle saw-tooth pattern formed by the intersection of two vertical joint sets.

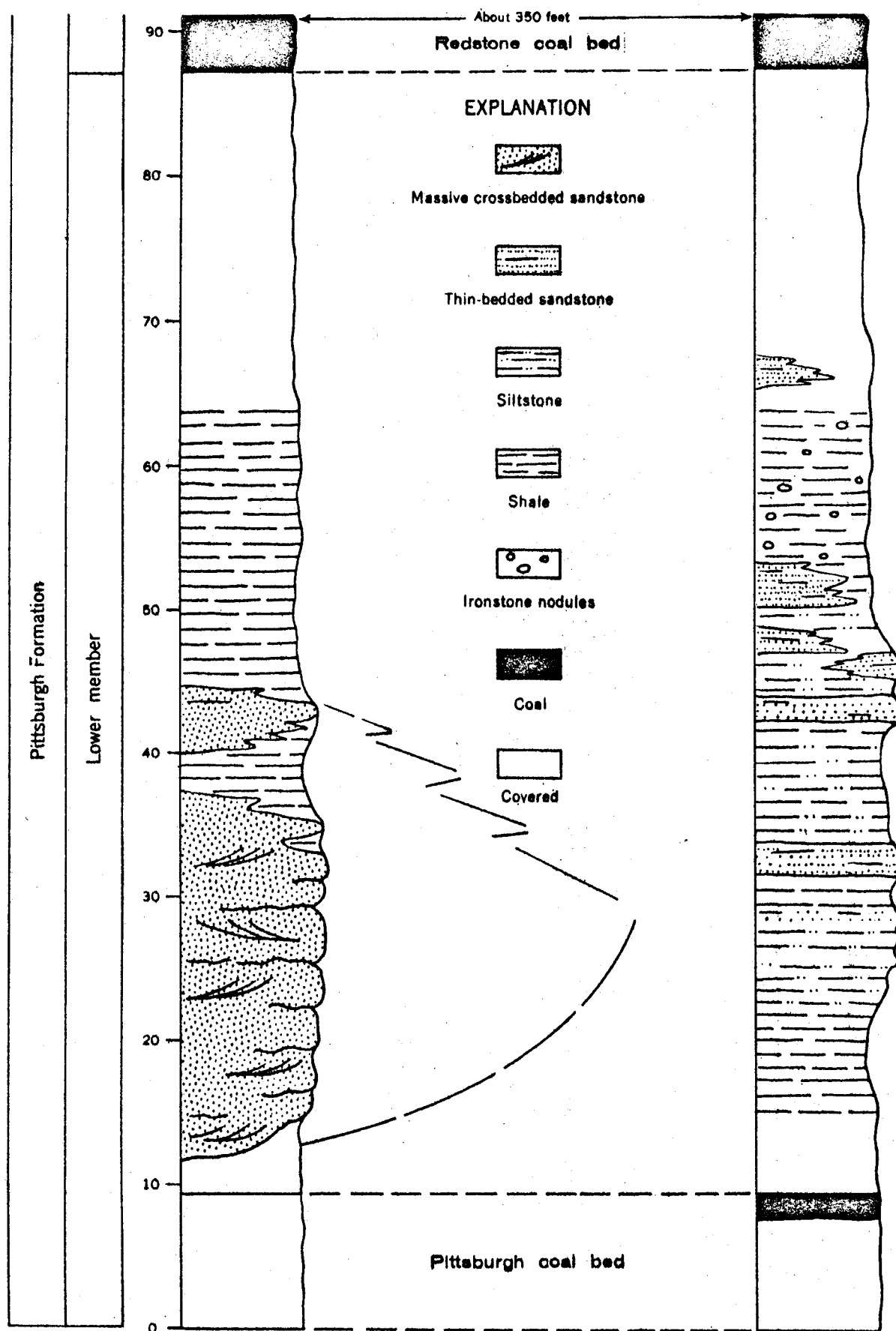


Figure 9.--Stop II, Elrama strip mine. Columnar sections of the lower member of the Pittsburgh Formation showing the massive cross-bedded sandstone facies in contrast to the relatively nonsandy facies. Exposures of the massive sandstone facies are on the west side of the hollow; of the nonsandy facies on the east side. (See Figure 9a for continuation of these sections.)

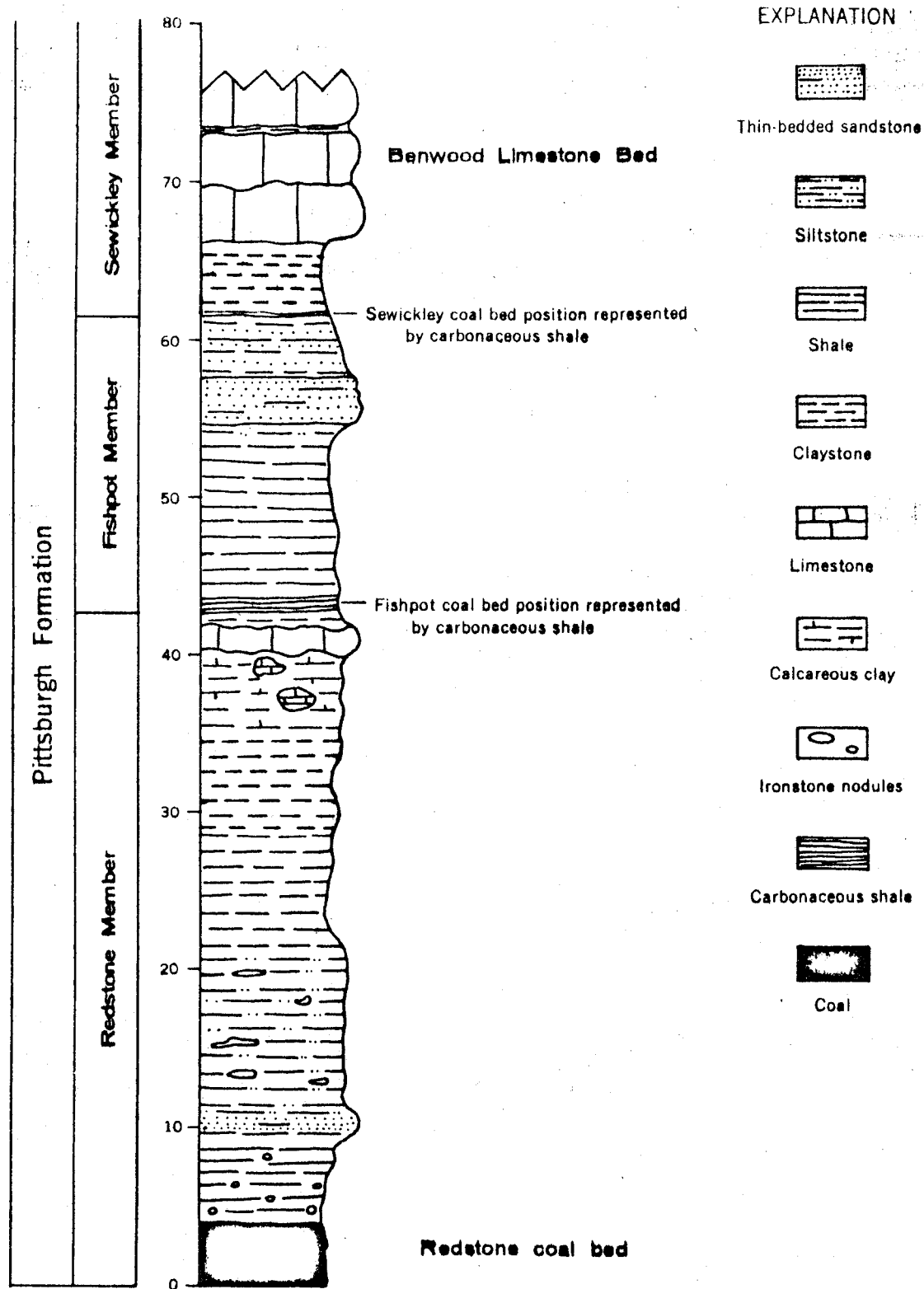


Figure 9a.--Stop II, Elrama strip mine. Columnar section of the Redstone, Fishpot, and Sewickley Members of the Pittsburgh Formation. (See Figure 9 for lower part of this section.)

In contrast to the lithologic variations just described are the consistent thickness and lithology of the Benwood Limestone Bed of the Sewickley Member. Here at Stop II only the basal beds of the Benwood can be seen.

Economically only the Pittsburgh and Redstone coal beds are important, the Fishpot and Sewickley coals being represented by a bed of carbonaceous shale. The Pittsburgh coal bed, only partially exposed here, occupies a 10-foot zone, according to measurements taken at an entry about 1 mile west of Stop II, and is made up of several layers--a lower layer or main bench of coal about 7 feet thick; a middle layer or parting of claystone about 1 foot thick; and an upper layer or roof coal about 2 feet thick. The Redstone coal is a solid, blocky coal about 4 feet thick having a face cleat that strikes about N. 64° W. (this face cleat direction applies as well to the Pittsburgh coal bed and is the same, with only a few degrees variation, throughout the area). The Redstone coal is well developed and is of commercial importance over a large part of the Monongahela quadrangle; in the quadrangles south and west of the Monongahela quadrangle the Redstone coal is thin or absent and is of little economic importance.

<u>Time</u>	<u>Mileage</u>	
11:07 a.m.	29.0	Buses leave Stop II. Return to River View via State Route 837; continue on State Route 837 through Monongahela, cross Pigeon Creek and turn south (right) on State Route 88. Follow State Route 88 south past the Monongahela Valley Country Club, through Lockview, North Charleroi, and Charleroi, to junction of State Route 88 and Interstate 70; turn west (right) onto Interstate 70, then west to Speers (Stop III). Point (8): Maple Creek mine (U.S. Steel) - Pittsburgh coal bed. Point (9): Monongahela - cross Murrys ville anticline; Pittsburgh coal bed up at the level of the Monongahela High School at elev. 810 ft. Point (10): Monongahela Valley Country Club area - cross Pigeon Creek syncline; base of Waynesburg Formation at elev. 1110 ft; section rises to southeast. Point (11): State Route 88 and road intersection near Oldsmobile dealership, elev. 1216 ft. (Waynesburg "A" coal bed at elev. 1200 ft); massive sandstone above the Waynesburg coal below in east (left) bank of State Route 88. Point (12): Powerline crosses State Route 88 just north of Lockview; strip mine in north (left) side of road, of Redstone coal bed at elev. 930 ft. Point (13): South edge of Charleroi near junction of State Route 71 - cross Bellevernon anticline; base of Pittsburgh coal at elev. 1000 ft. *****
11:45 a.m.	42.4	STOP III - SPEERS (Lunch stop--time allotted: 90 minutes) See index map 1; figure 10, sketch map of Stop III area; and figure 11, sketch map of distribution of Carmichaels Formation.

Buses will turn off Interstate 70 at the Speers-Twilight exit, travel northeast (right) to the new Charleroi industrial park, and unload and park along the access road to the industrial buildings. The chief item of interest here is the Carmichaels Formation.

The Carmichaels Formation (Piper, 1933) was originally named the Carmichaels Clay (Campbell, 1902) for the type area near the town of Carmichaels. The formation consists of poorly sorted, generally unconsolidated alluvium that was laid down by aggrading rivers in high valleys during the Pleistocene. The present courses of the Monongahela (fig. 11) and Youghiogheny Rivers approximately follow the courses of those ancestral rivers. Along the Monongahela River the Carmichaels may be found from Morgantown, W. Va., to Pittsburgh, Pa.

The Carmichaels Formation was deposited, according to Piper (1933, p. 125), during the Illinoian Glaciation in Pleistocene time when "the aggradation of the Allegheny Valley by glacial gravels blocked the mouths of the tributary streams from the nonglaciated terrane to the south, and caused them to deposit much of their loads of silt." Actually, the Carmichaels Formation consists of material that ranges in size from clay to boulders as much as 3-4 feet in diameter. The material, from boulders down to coarse sand, is fairly well rounded. The material of largest size is concentrated mainly at the base; however, numerous cobbles and a few boulders are scattered throughout the deposit. Fairly pure sand and clay occur in lenses scattered throughout the deposit, but the main constituent is a mixture of clay, sand, and silt.

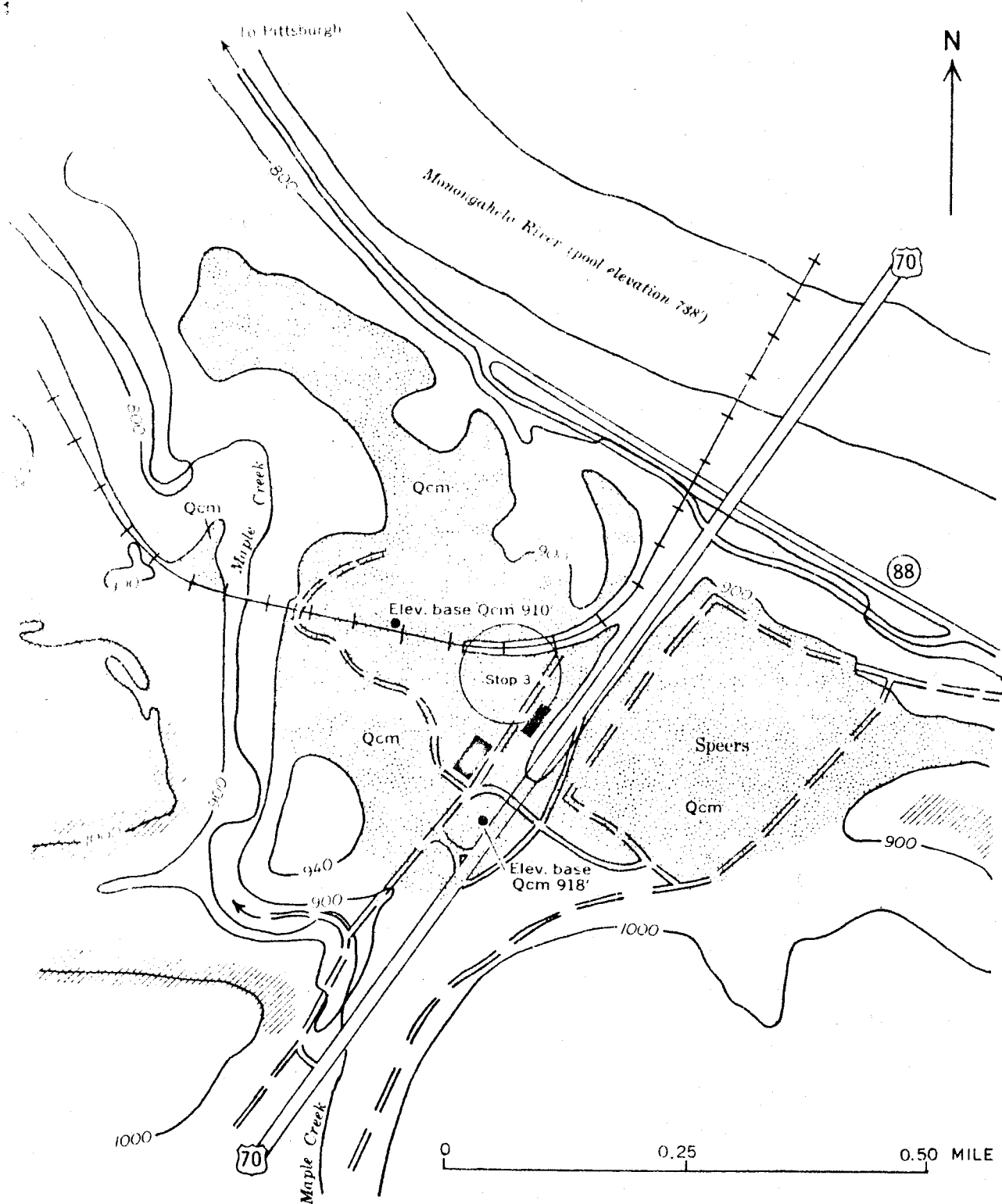


Figure 10.--Stop III. Sketch map of Speers area showing distribution of Pleistocene Carmichaels Formation (Qcm, stippled) in abandoned bend of ancestral Monongahela River. Elevation of base is approximately 910 feet. Maximum remaining thickness of Carmichaels is approximately 30 feet. Here Carmichaels lies mainly on rocks of the upper part of the Conemaugh Formation. None of the formation remains on the northeast side of the present Monongahela River. Bedrock dip is to S. 72° E., $1\frac{1}{2}^{\circ}$. Diagonal lines indicate strip mine in Pittsburgh coal.

The boulders and cobbles of the Carmichaels Formation are composed of micaceous sandstone, some of which may have been derived locally, and small pebble-sized white quartz conglomerate which must have been derived from lands far to the south. The sand fraction is mostly quartz, pure enough in some localities to have been used for making glass. Small rounded pebbles of white quartz and tan chert are scattered through the deposit and locally small limonite nodules are common.

The Carmichaels Formation, at least megascopically, resembles the flood-plain deposits of the present Monongahela River; the only difference between them is the topographic position relative to the present river. The Carmichaels was deposited in a valley whose floor is now about 170 feet above the water level of the present Monongahela River. The base of the Carmichaels at Speers (fig. 10) is at an elevation of about 910 feet and rises slowly to the south and drops slowly to the north; the elevation of normal water level of the present Monongahela at Speers is 735 feet.

The Carmichaels sediments slump relatively easily when wet and locally are much lower than the base of the original deposit along the bluffs of the present Monongahela River valley. The original thickness of the deposit may have been as much as 150 feet, but the remaining thickness of Speers is about 30 feet (fig. 10).

The base of the Carmichaels can be seen very well along the railroad cut at Stop III where boulders lie on mudstone beds of the upper part of the Conemaugh Formation. A fairly clean sand was dug out on the north side

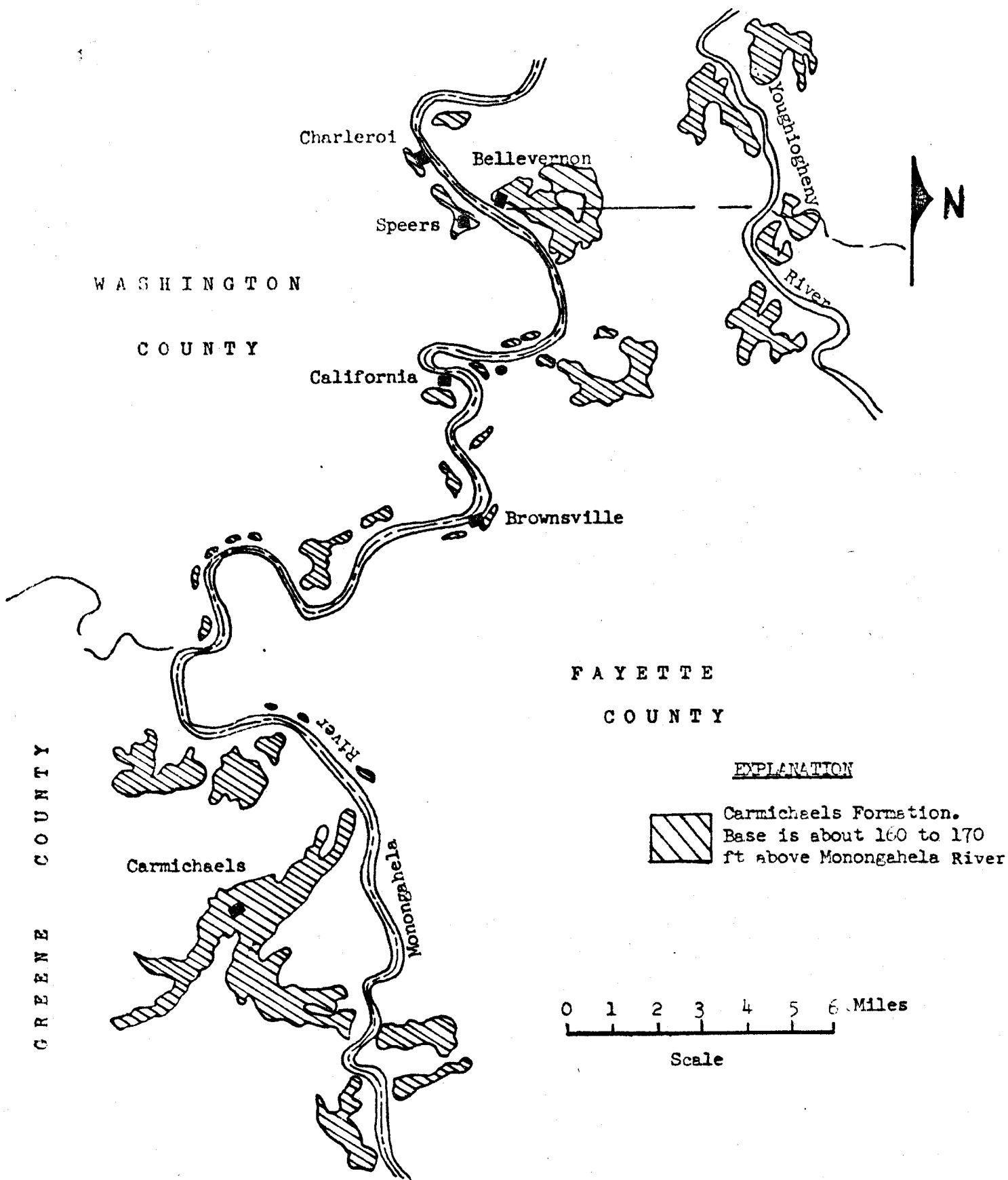


Figure 11.--Distribution of the Carmichaels Formation along the Monongahela River from the town of Carmichaels to Speers.

of the new road of the industrial park just east of the large building. Weathered Pittsburgh coal is in the low hill just west of the same building, indicating that the contact between the Carmichaels and bedrock rises abruptly on this side of the old valley. Along the valley bluffs, as here at Speers, the typical Carmichaels is intermixed with local colluvium and tributary stream deposits and usually cannot be traced up the local tributaries. Probably the Carmichaels was deposited in the valleys of local tributaries, but as the tributaries seem to follow closely their pre-Illinoian courses, they probably have removed all or most of the Carmichaels deposited in them.

References

- Campbell, M. R., 1902, Description of the Masontown-Uniontown quadrangles [Pennsylvania]: U.S. Geol. Survey Geol. Atlas, Folio 82. See page 9.
- Piper, A. M., 1933, Ground water in southwestern Pennsylvania: Pennsylvania Geol. Survey, 4th, Bull. W 1, 401 p. See p. 125-126.

<u>Time</u>	<u>Mileage</u>	
1:15 p.m.	42.4	Leave Stop III via Interstate 70 west (not shown on index map - see sketch map of Stop III, fig. 10). Continue west on Interstate 70 (reenter index map 1 area at exit to State Route 481) past the Bentleyville interchange at Gibson; take next exit north (right) to Ginger Hill Road. Go north on Ginger Hill Road, to Ginger Hill (see index map 2 - Hackett quadrangle). At Ginger Hill turn west (left) on old State Route 31 (the new route no. is 136). Follow State Routes 31 and 136 west past Edwards Chapel. See sketch map of Stop IV (fig. 12) for route to Stop IV from Edwards Chapel.

Point (14): Interstate 70 crosses the crest of the Bellevernon anticline about 2 miles southwest of Speers. The Pittsburgh coal bed is just below road level for about a mile southwest of Speers, then above the road to just west of the mined-out Crescent No. 2 mine of Republic Steel Co. The section above the Pittsburgh coal bed to the base of the Fishpot Member between Speers and Point (15) has no massive sandstone, but does contain a relatively large amount of carbonaceous shale, "slate" of the miner. Some exposures of bedrock and abandoned strip mines are on the north (right) side of the road.

Point (15): Northwest side of State Route 481 exit - hill north (right) of road shows complete section of lower member of Waynesburg Formation: coal bed at top is Waynesburg "A"; Waynesburg coal bed at base of hill. No sandstone present here, but massive sandstone is present above the Waynesburg coal bed just one-half mile west of point (15).

Point (16): Interstate 70 overpass at Bentleyville interchange - upper part of the Benwood Limestone Bed on west bank of creek. Enter index map 2, Hackett quadrangle.

Point (17): Exit road north to Ginger Hill Road - through upper member of Pittsburgh Formation.

Point (18): Waynesburg coal bed in strip pit on west (left) side of road, at elev. 1090 ft.

Point (19): Cross Sawmill Creek. Base of Benwood at creek level (index map 1).

Point (20): Waynesburg coal bed, east (right) side of road at elev. 1100 ft (index map 2).

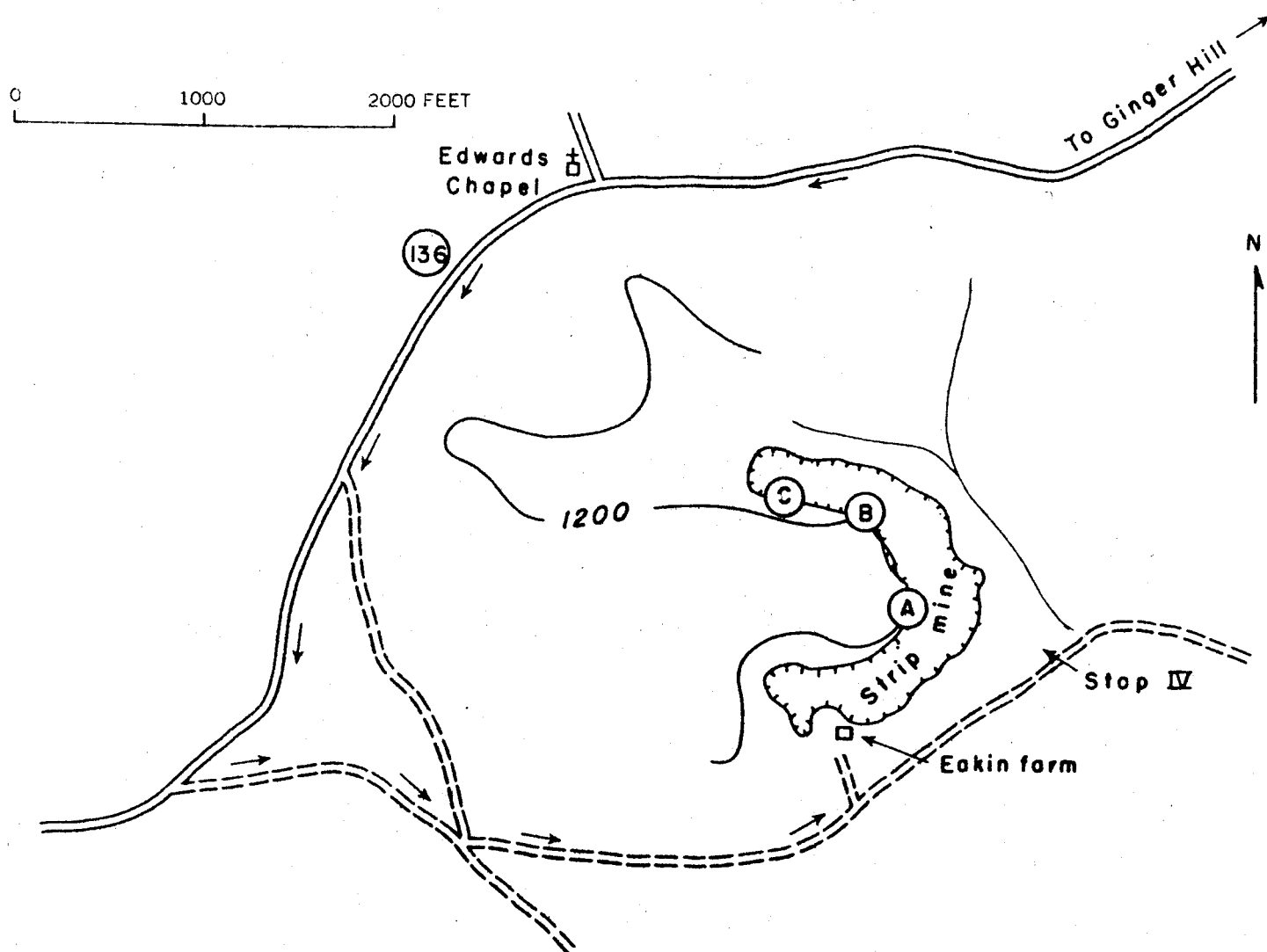


Figure 12.--Sketch map of Stop IV area. Localities A, B, and C are keyed to columnar sections shown on Figure 13.

Time Mileage

Point (21): Base of hill on south (left side of road, just west of Edwards Chapel; Little Washington coal bed (base, upper member of Waynesburg Formation) at elev. 1270 ft.

Point (22): See sketch map of Stop IV area (fig. 12). Waynesburg "A" coal bed at elev. 1205 ft on south (right) side of road.

* * * * *

1:45 58.9 STOP IV - strip mine near Ginger Hill (time allotted: P.m. 55 minutes). (See index map 2, Hackett quadrangle; figure 12, sketch map of Stop IV area; fig. 13, columnar sections; fig. 14, sandstone distribution patterns.

Buses will unload and park near the Eakin Farm. We will visit a strip mine on the Waynesburg coal bed in the hill just north of the road. The Waynesburg coal bed marks the base of the lower member of the Waynesburg Formation (see fig. 75-1, the generalized geologic section; and fig. 13, columnar sections). At locality A (fig. 13), a nearly complete section of the lower member is exposed. The Waynesburg coal bed is covered by backfill about 8 feet thick. The Waynesburg "A" coal bed (the base of the middle member of the Waynesburg Formation) is exposed near the top of the high wall. Note the even-bedded, 3-foot-thick, sheet-like sandstone about 25 feet above the floor of the strip mine. This sandstone layer is all that remains of a sandstone bed that occurs locally in the lower member of the Waynesburg Formation; the lower member is well exposed and consists mainly of mudstone with scattered layers of siltstone. Follow this 3-foot bed of sandstone northward, to locality B. Near locality B, other sandstone beds suddenly appear in the mudstone and siltstone between the Waynesburg coal bed and the 3-foot bed; these

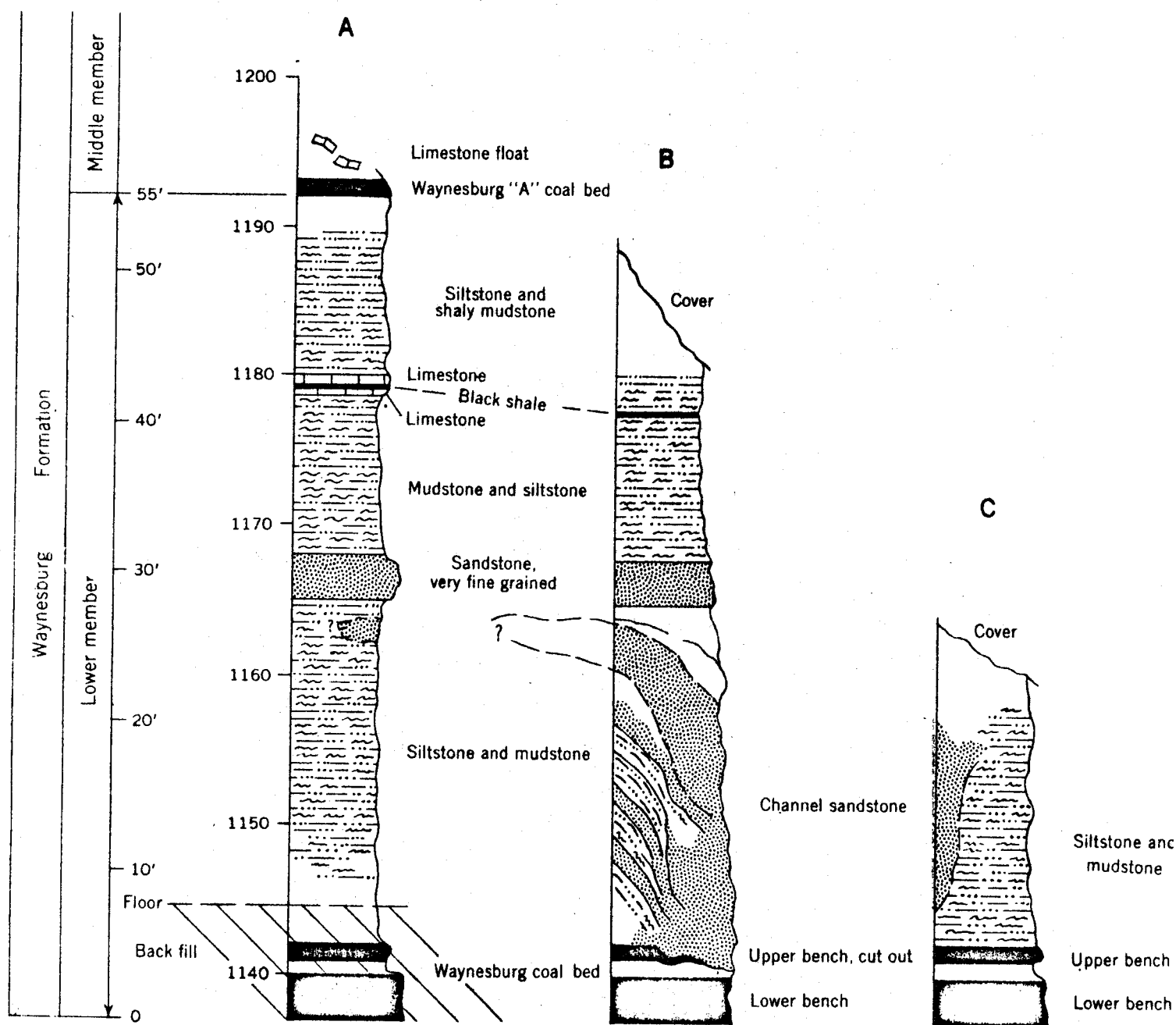
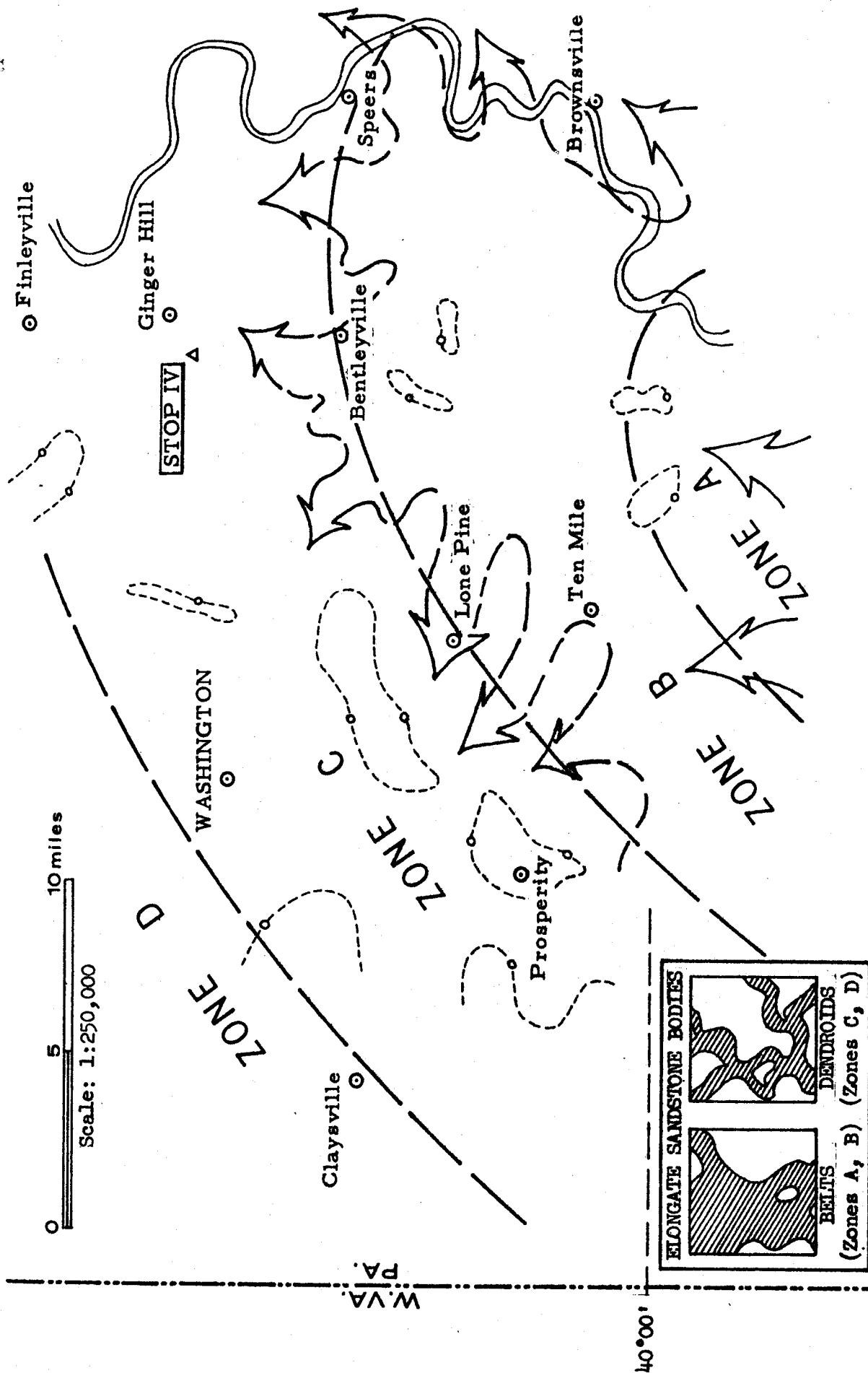


Figure 13.--Stop IV. Columnar sections of the lower member of the Waynesburg Formation. Sections are keyed to localities A, B, and C on the sketch map of Stop IV (Figure 12).

sandstone beds bend sharply downward, thicken, and coalesce to form a massive channel-fill sandstone. Farther along toward locality C, and along the contact between the channel-fill sandstone and the underlying Waynesburg coal bed, several unusual sandstone-coal relationships are exposed. At locality C, the lower part of the lower member is again similar to the section at locality A.

The regional distribution of massive sandstone in the lower member of the Waynesburg Formation follows a pattern of sand-filled anastomosing channels similar to the other massive sandstone, seen so far. Figure 14 shows the characteristic pattern of massive sand distribution, as illustrated by the sandstone in the lower member of the Waynesburg Formation. Over much of Washington County, the massive sands are too discontinuous and too variable to be of use as regional mapping units.

<u>Time</u>	<u>Mileage</u>	
2.40 p.m.	58.9	Leave Stop IV. Return west to State Route 136; follow State Route 136 west (index map 2) through Kammerer, Dunningsville and Eightyfour. Continue west on State Route 136 (across index map 3 - Washington East quadrangle) to the interchange with Interstate 70. Take the access road to the east (left), just this side of Interstate 70 (do not cross Interstate 70). Go east on the access road 2 miles to Vance Quarry, Stop V. Point (23): Just west of Kammerer, cross Amity anticline; Waynesburg "A" coal bed at elev. 1210 ft about 20 ft above road level. Section begins to dip west.



Waynesburg

Figure 14.-- Characteristic sandstone distribution patterns, as illustrated here by the sandstone above the Waynesburg coal. In zone A the belt sand bodies are thicker than 60' and in zone B they range from 30' to 60' in thickness. In zone C the dendroid sand bodies are less than 30' thick, and in zone D they are less than 20' thick. (Classification of sand bodies after Potter, P.E. (1962), Shape and distribution patterns of Pennsylvanian sand bodies in Illinois: Illinois State Geol. Survey, Circular No. 339, p. 20.

<u>Time</u>	<u>Mileage</u>	
		Point (24): Just east of Dunningsville - Little Washington coal bed (base of upper member of Waynesburg Formation) at road level in north (right) bank of road, elev. 1200 ft.
		Point (25): Top of hill west of Dunningsville - limestone in the middle member of the Washington Formation in south (left) bank of road at elev. 1200-1215 ft.
		Point (26): Hill back of Lake 84 - north (right) side of road; Washington coal bed (elev. 1085 ft) and overlying limestone beds of the lower limestone member of Washington Formation represent "normal" section. Contrast with Point (27).
		Point (27): Roadcut just west of Eightyfour - index map 3. Same stratigraphic interval as at point (26), occupied here by a sand tongue - no local absence of limestone beds from the lower limestone member of the Washington Formation.
		Point (28): See also index map 3A - geologic map; cross Nineveh syncline.
		Point (29): Enter Greene Formation - Greene Formation continues to turnoff on access road to Vance Quarry.
		* * * * *
3:10 P.m.	72.5	STOP V - VANCE QUARRY (time allotted: 45 minutes) See index map 3 Washington East quadrangle, and fig. 15, columnar section.

Buses will enter the Washington Stone Co. quarry and park near the office trailer. The best exposure of the upper limestone member of the Washington Formation is above and to the right of the rock crushing plant east of the office.

The section exposed includes the upper part of the Washington Formation and the lower part of the Greene Formation (see fig. 15). In terms of lithology and thickness, this is a typical section for the upper limestone member of the Washington. The member contains the purest limestone in the entire sequence from the Pittsburgh coal bed through the Greene Formation. The top three or four beds are usually the purest and have been mined from many small quarries for agricultural lime and building stone.

The upper limestone member occurs over all of the northern part of the Dunkard basin wherever the upper part of the Washington Formation has not been eroded. The member is about 20-45 feet thick and is mostly beds of limestone with thin interbeds of gray calcareous clay. However, in the southern and western parts of Washington County, the member is split by a wedge of clastic material consisting of claystone, siltstone, and fine-grained sandstone. Where the clastic wedge is present, the member consists of, in ascending order: limestone, 5-15 feet thick; clastic material of variable thickness, locally as much as 15 feet thick; and limestone, 10-20 feet thick.

The limestone of the upper limestone member generally weathers into distinctive float blocks in contrast to most of the other limestones in the section; consequently it is relatively easy to map.

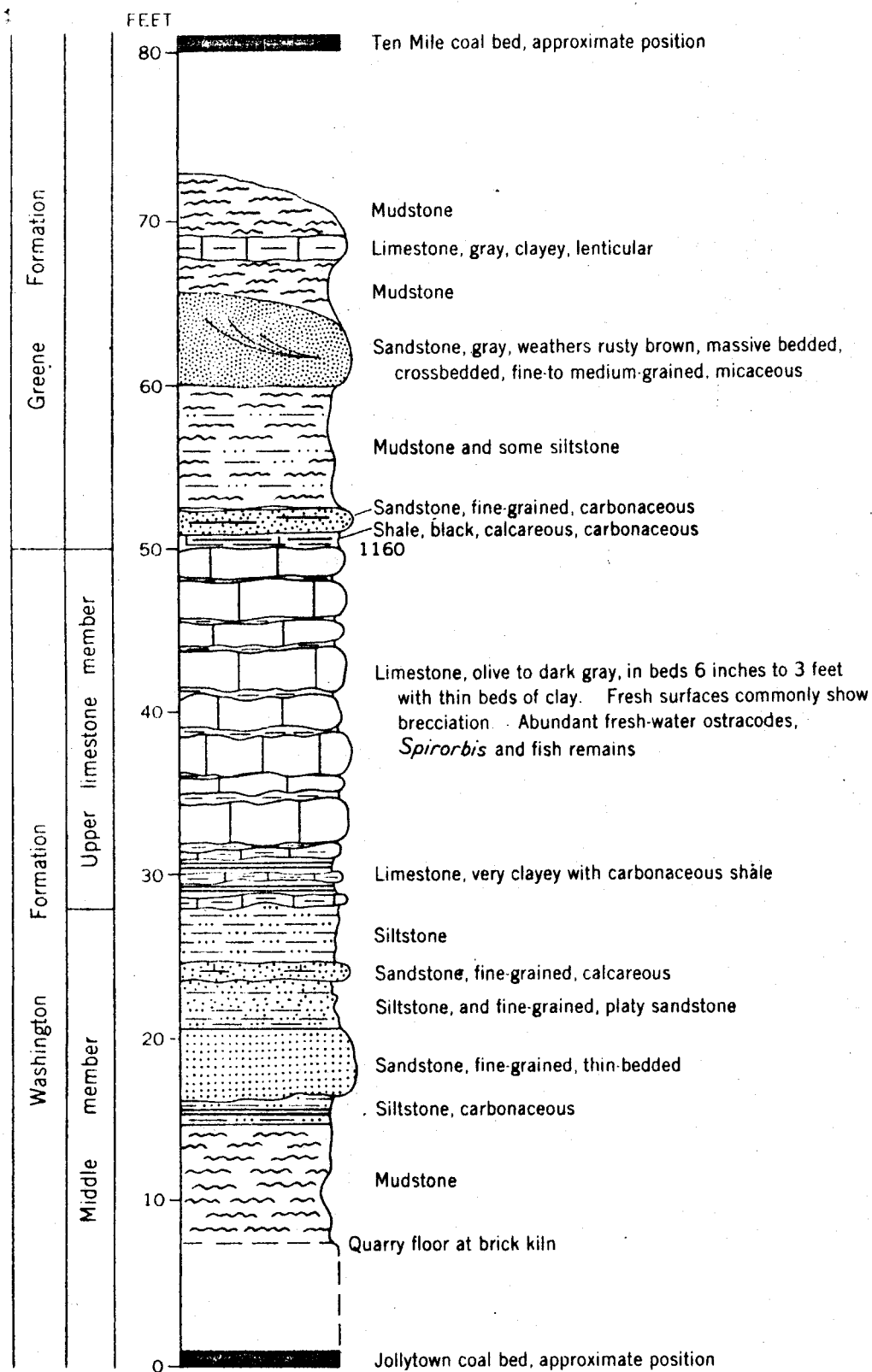


Figure 15.--Stop V. Columnar section of the upper part of the Washington Formation and lower part of the Greene Formation at the Washington Stone Co. quarry, Vance, Pa.

The middle member of the Washington Formation is not as well exposed here as at Stop VI. It is worth noting that the sediments within it vary considerably from place to place, both in type and in thickness, and that the overall thickness of the member reflects locally the presence or absence of thick sandstone bodies. In general, the middle member thickens regionally to the southeast, and ranges in thickness from about 110 feet to about 150 feet.

The Jollytown coal bed, which is just below this section (fig. 15), is persistent regionally, although it is commonly represented by a carbonaceous shale as much as 10 feet thick having either no coal or only a very thin coal bed within it.

The Greene Formation has not yet been subdivided on the basis of the basic mapping unit shown on figure 4, because work to date has failed to demonstrate sufficient lateral persistence of coal beds or other marker beds within it. In general, the rock types seem to be the same as those in underlying formations. Part of the present mapping program is in the area south and west of Washington, Pa., where thick sections of the Greene Formation are exposed. Work there should provide a good opportunity to determine the feasibility of subdividing the Greene Formation.

Time Mileage

3:55 72.5
p.m.

Leave Stop V. Return west on access road, 2.0 miles to Beau St. - State Routes 31 and 136 interchange; enter Interstate 70 west bound. Follow Interstate 70 west (on index map 4) past Washington to Exit 3 (State Route 221). Exit to north (right) to State Route 221 north; follow State Route 221 north to Stop VI.

Point (30): From Vance westward the route travels over the southeast flank of the Washington anticline. Note here in the roadcut the relatively steep southeast dip on the lower limestone member of the Washington Formation.

Point (31): At the intersection of Interstates 70 and 79, the Waynesburg coal bed is exposed at the base of the roadcuts. Here a wedge of fine sandstone and siltstone extending from the east separates the Waynesburg coal bed into two benches, as much as 6 ft apart; at the west end of the cut the wedge pinches out and the two benches of coal are separated by only 1 ft of clay. A massive sandstone overlies the Waynesburg coal bed just northwest of this intersection.

Point (32): Route crosses the crest of the Washington anticline and then parallels it for about 2 miles.

Point (33): From here on the route crosses very low-dipping strata of the Washington Formation and the lower part of the Greene Formation. The light-gray to white limestone exposed prominently in several roadcuts is the upper limestone member of the Washington Formation.

* * * * *

<u>Time</u>	<u>Mileage</u>	
4:10 p.m.	83.4	STOP VI - Sandstone quarry (time allotted: 55 minutes) (See index map 4, Washington West quadrangle; figure 16, columnar section.)

The purpose of this stop is to examine the lower limestone member and the middle member of the Washington Formation. Figure 16 is a columnar section of the sequence exposed by quarry operations in a prominent sandstone in the base of the middle member. The top of the lower limestone member of the Washington Formation is approximately at the floor of the quarry. The basal beds of the middle member consist of 4-5 feet of shale which is overlain by the massive sandstone that forms most of the quarry wall.

Regional mapping to date indicates that this sandstone is part of a much larger sandstone body which covers the southwest quarter of the Washington West quadrangle and extends to the west, southwest, and south. Tongues of the sandstone similar to zones C and D of figure 13 extend northward. Sediment-transport direction as indicated by cross-bedding and channel pattern suggest a source area to the south. The massive sandstone in the lower part of the middle member is very similar in mineralogy and texture to the other sandstones seen on this trip.

The first economic use of the sandstone at this quarry was for building stone; the quarry was first operated about the time of the Civil War. The railroad station in Washington, Pa., is made of sandstone from this quarry. Recently the quarry was reactivated to supply base course material for Interstate 70.

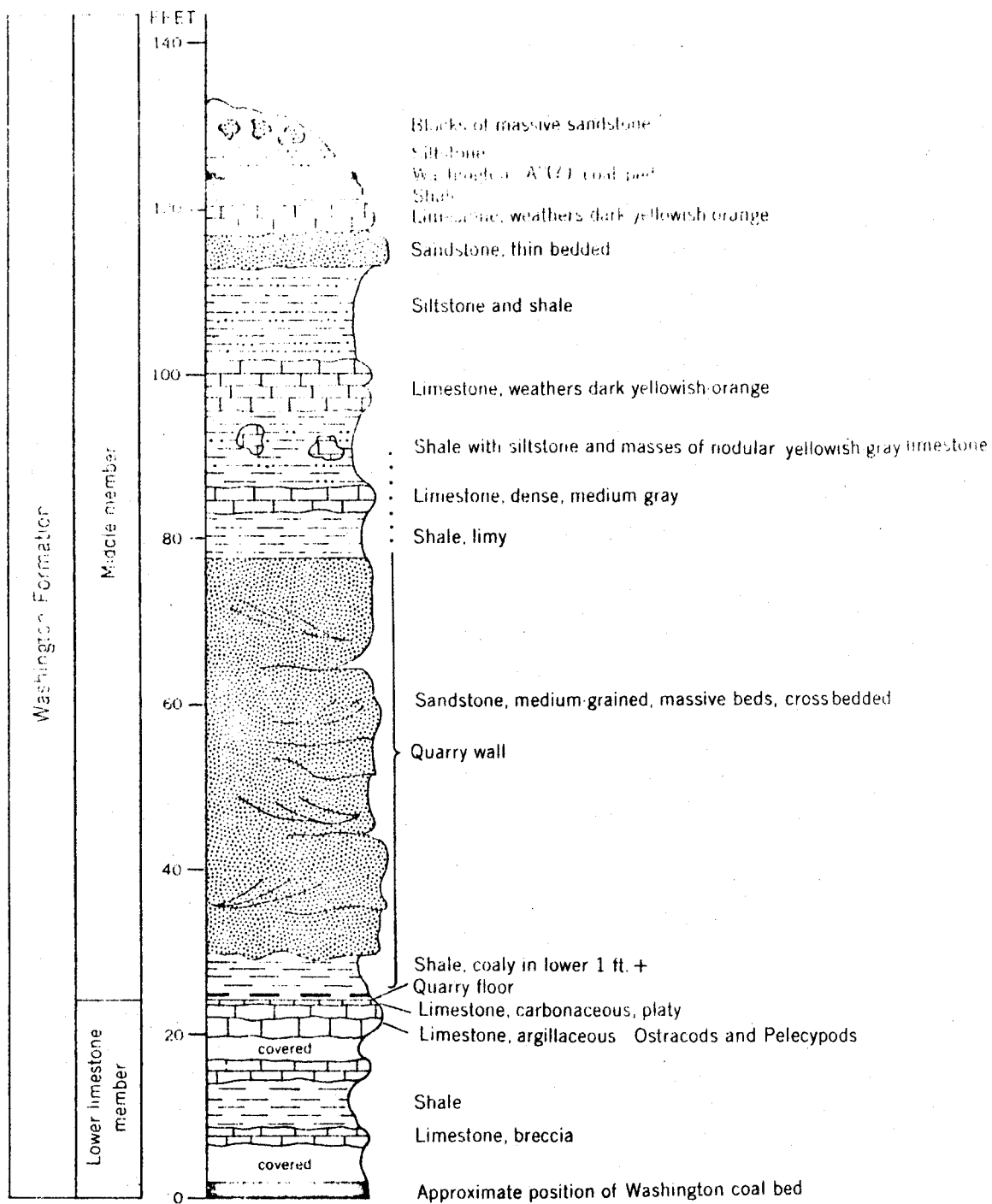


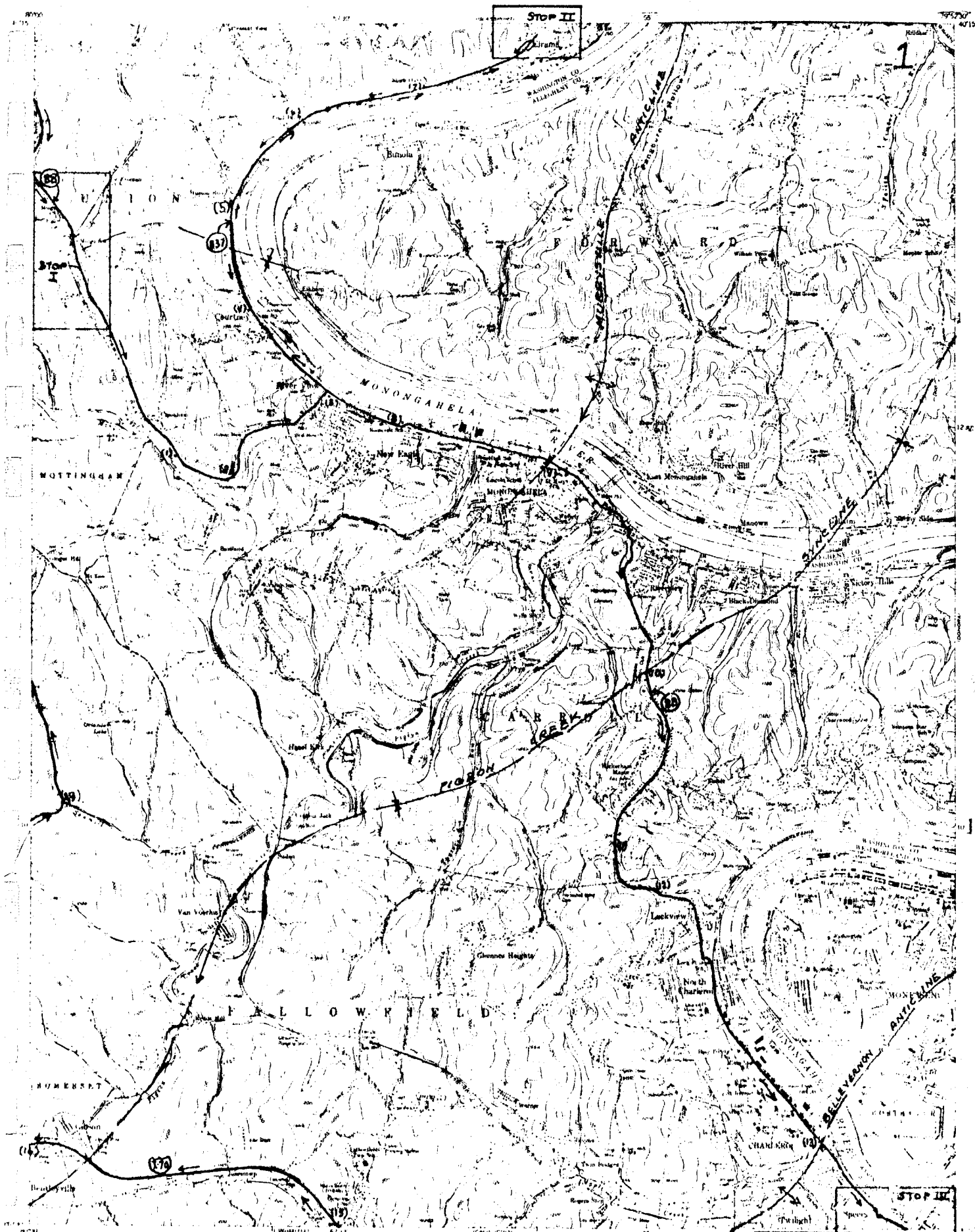
Figure 16.--Stop VI, sandstone quarry. Columnar section showing portions of the lower limestone member and the middle member of the Washington Formation.

Overlying the thick sandstone and extending upward to the base of the Washington "A"(?) coal bed is a sequence of three limestone beds separated by beds of sandstone, siltstone, and shale (fig. 16). These beds are within the middle member of the Washington Formation. (See Fig. 75-2). Here at Stop VI, the limestone sequence is not well developed, as it includes beds of clastic sediments. However, some 8 miles to the north and northwest the clastic beds are absent and the limestone attains thicknesses of as much as 50 feet. Limestone of the middle member is commonly clayey and breaks down rapidly to a light-orange clay soil.

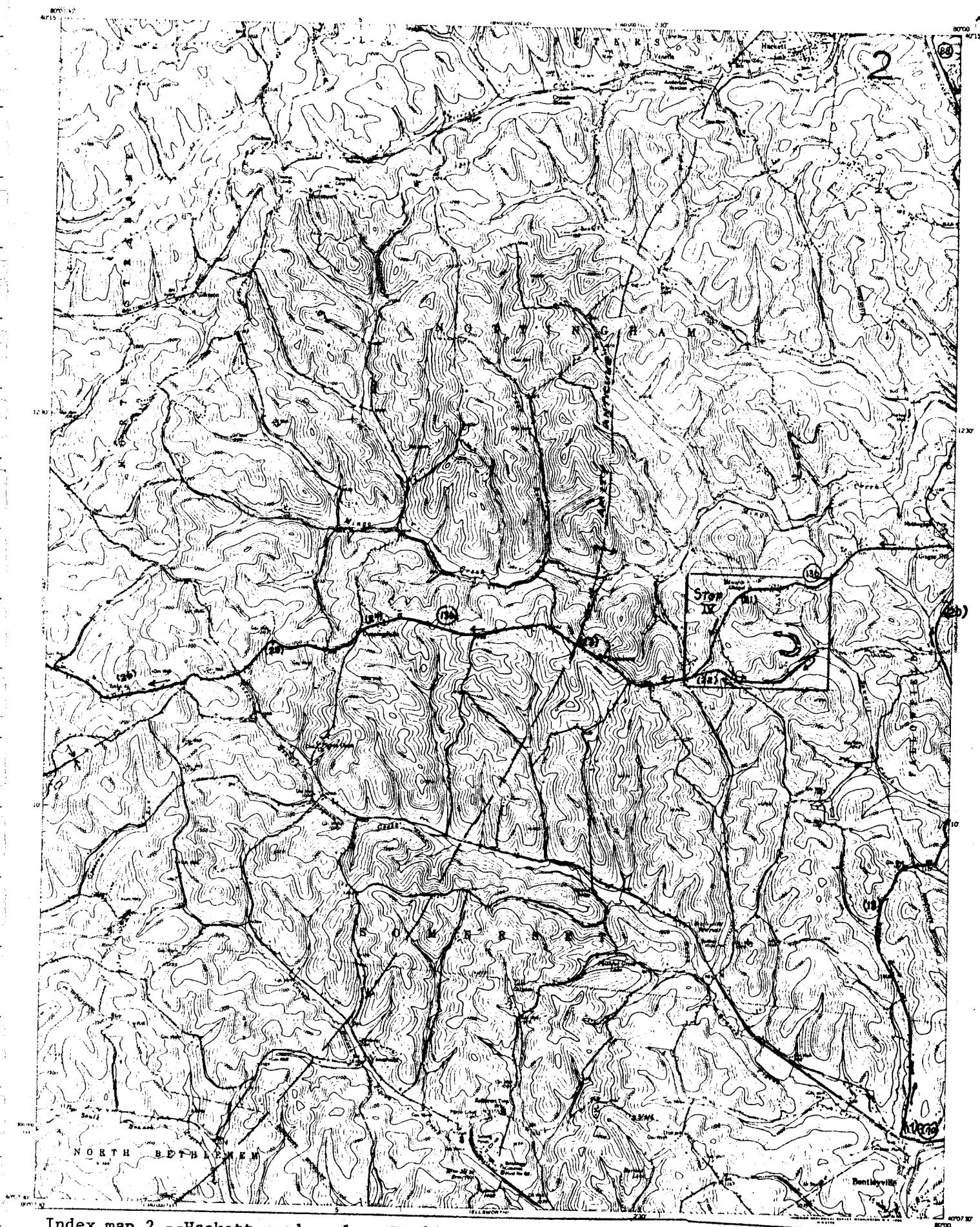
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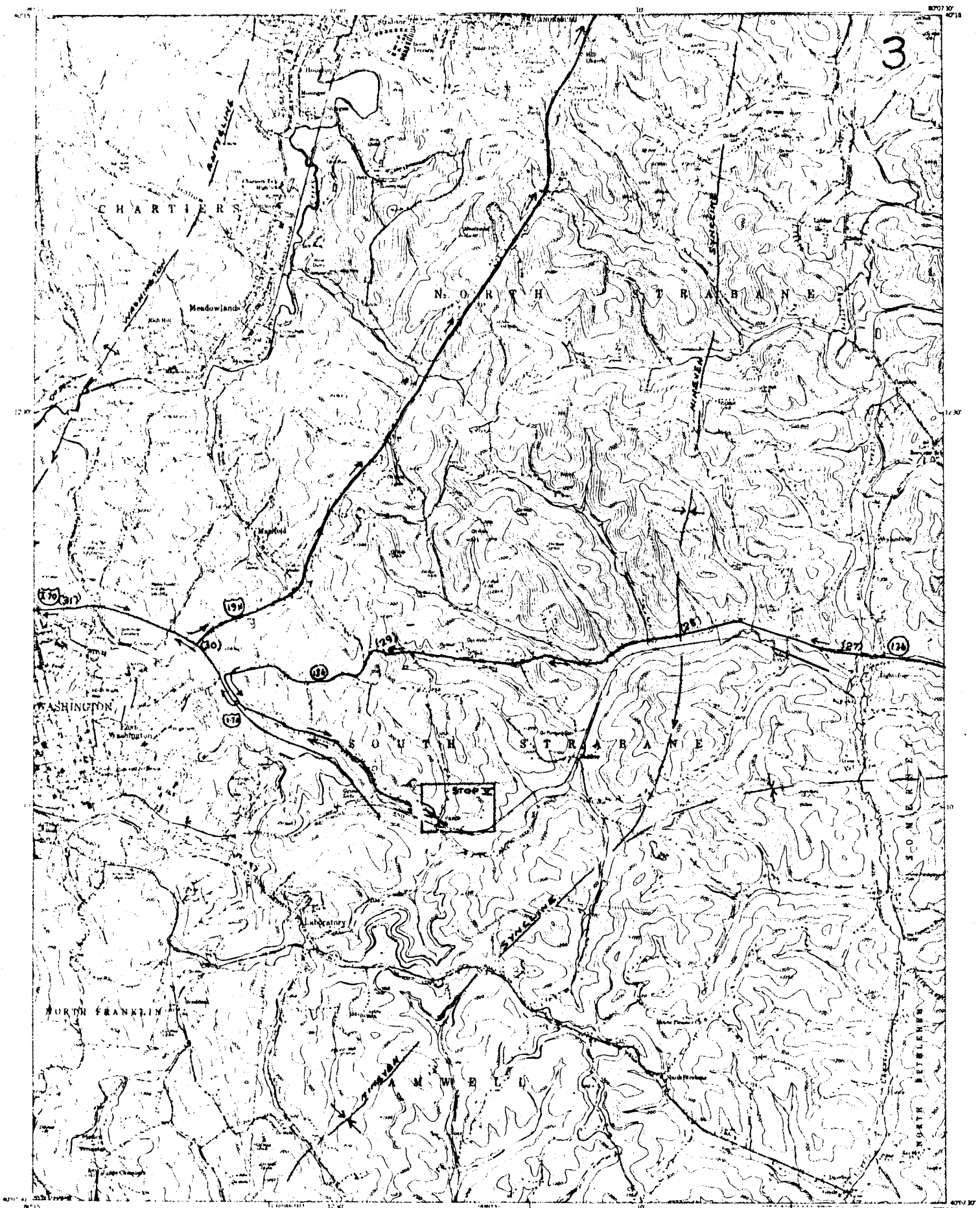
<u>Time</u>	<u>Mileage</u>	
5.05 p.m.	83.4	Leave Stop VI. Return to Interstate 70. Take Interstate east (left) back toward Washington. At exit to State Route 19 north, take State Route 19 north to Pittsburgh. Points of interest along State Route 19 north are on index map 3A.
6:30 p.m.	122.6	Webster Hall Hotel.



Index map 1.--Monongahela quadrangle. Field trip route to Stops I (Froman Run), II (Elrama) and III (Speers), and points of interest along the route. See road log for points (1) 44 through (16) See figure 3, the general index map, for location of this map.



Index map 2.--Hackett quadrangle. Field trip route to Stop IV (strip mine near Ginger Hill), and points of interest along the route. See road log of points (17) through (26).



Index map 3.--Washington East quadrangle. Field trip route to Stop V (quarry at Vance) and points of interest along the route. See road log of points (27) through (31).



Index map 4.--Washington West quadrangle. Field trip route to Stop VI (sandstone quarry near "S-Bridge") and points of interest along the route. See road log of points (32) and (33).

FIELD TRIP 2

**Stratigraphy of the Pottsville and Allegheny
Groups of Mercer and Lawrence Counties, Pa.**

Louis D. Carswell

Host: United States Geological Survey

**Prepared in cooperation with
The Commonwealth of Pennsylvania
Department of Internal Affairs
Bureau of Topographic and Geologic Survey**

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STRATIGRAPHY OF THE POTTSVILLE AND ALLEGHENY GROUPS OF MERCER
AND LAWRENCE COUNTIES, PENNSYLVANIA¹

Louia D. Carswell

INTRODUCTION

This field trip traverses an area having a long history of geologic exploration for oil, gas, coal, fire clay, limestone, sandstone for building and refractory purposes, and in the mid-19th century for siderite and bog iron for use in the charcoal furnaces of that day.

The type exposures of the stratigraphic subdivisions of the Pottsville Group in western Pennsylvania and localities from which the included economic beds have been named are within or near the area, and a major emphasis of the trip is on lateral changes which take place within these stratigraphic units. Unfortunately, outcrops are few, because the area is veneered by glacial deposits, and conclusions based in part on the synthesis of drilling data are difficult to demonstrate in the field.

The road log for this field trip is largely restricted to the area included in the Neshannock quadrangle, which lies in parts of southern Mercer and northern Lawrence Counties, where outcrops of the Allegheny and Pottsville Groups of Pennsylvanian age will be visited.

¹ Publication authorized by the Director, U. S. Geological Survey.

The bus trip from Pittsburgh to Harlansburg, which is just east of the Neshannock quadrangle, is on the Conemaugh Formation from the hotel in downtown Pittsburgh to Zelienople. Near Pittsburgh the higher hills are capped by the lower part of the Monongahela Formation. Between Zelienople and Portersville, or roughly that part of the trip on Interstate Route 79, the valleys and lower elevations are in the Allegheny Group, and the ridges are capped by the Conemaugh Formation. North of Portersville, the Allegheny underlies the land surface to the gorge of Slippery Rock Creek, where the upper part of the Pottsville is exposed. The southern limit of Pleistocene glaciation is crossed between Portersville and U.S. Route 422, where till and erratics of Illinoian age are found. A short distance north of U. S. Route 422 is the southern limit of Wisconsin drift.

The Neshannock area lies entirely within the glaciated part of the Allegheny Plateau physiographic province. The topographic setting is that of a hilly upland broken by the valleys of the Mahoning and Shenango Rivers and the Neshannock and Lackawannock Creeks, which typically flow upon glacial deposits that are more than 200 feet thick in places and occupy valleys of preglacial and interglacial origin. The flanks of the valleys contain kames, kame terraces, and valley train deposits. Many of the valleys aligned parallel to the direction of ice movement are filled with silts and clays believed to have been deposited in lakes that formed as the ice retreated. Valleys aligned at a high angle to the direction of ice movement often are filled with till--which also covers the upland area.

The bedrock consists of Mississippian and Pennsylvanian rocks composed of alternating units of sandstone and shale that dip to the south and southeast at approximately 15 feet per mile.

Mississippian rocks, poorly exposed in the lower reaches of the small valleys entering the Shenango and Mahoning Rivers, include the following formations: Sharpsville Sandstone, Meadville Shale, Shenango Formation, and Hempfield Shale. Because of the poor exposures of these units within the Neshannock quadrangle, no stops have been scheduled where they may be seen.

The sandstone units of the Pennsylvanian System do not extend continuously throughout the quadrangle but occur in poorly defined, overlapping, elongate belts. The sandstone units intertongue laterally with shale. Locally, the sandstone units fill ancient channels that were cut completely through the next underlying shale unit, coalescing with sandstones lower in the section.

The shale units of Pennsylvanian age intertongue laterally with sandstone and are cut by sandstone-filled channels. Shale locally fills ancient streamcut channels. The extensive shale units contain coal and fire clay. The Mercer Formation, which is predominantly shale, contains two thin beds of limestone. The coals and particularly the limestone beds (those in the Mercer and the Vanport Limestone) are the key stratigraphic marker beds, and their bases or tops are the horizons used to define the structure of the area. In general, the shale units tend to thin and drape over the thicker channel-fill sandstones where they are not cut out by younger channel-fill sandstone. In between the areas of

prominent channel-fill sandstone the sandstone units intertongue laterally with shale.

The nomenclature for the rock units within the area is a curious mixture of traditional names. Some of these were applied to rock units, and some were applied to coal beds. Most of them were later extended to include the associated rocks. Most of the stratigraphic nomenclature originated in the reports of the Second Pennsylvania Geological Survey (White, 1879 and 1880). However, the term "Mercer" was used by Rogers (1858, p. 474-477) in reference to the lower limestone bed of the Mercer Formation of current usage. The nomenclature used for the Pottsville Group and the lower part of the Allegheny Group is shown on figure 1.

The nomenclature used by Van Lieu and Patterson (1964) in their report on Lawrence County, shown on figure 2, covers beds higher in the Allegheny Group than are present in the Neshannock quadrangle, as well as units in the lower part of the Conemaugh Group.

STRATIGRAPHY

In the Neshannock quadrangle, Pennsylvanian rocks include the lower part of the Allegheny and the Pottsville Groups. Rocks of Mississippian age are exposed in the lower reaches of the minor tributaries to the Mahoning and Shenango Rivers, but are not to be seen in the course of this field trip.

SYSTEM	FORMATION	THICKNESS (feet)	MEMBER, BED, AND LITHOLOGY
CARBONIFEROUS PENNSYLVANIAN	Conemaugh	100	Mahoning Sandstone Member Mahoning(?) coal Upper Freeport coal Upper Freeport Limestone Member of Platt (1877) Shale Butler Sandstone Member Lower Freeport coal Lower Freeport Limestone Member of Platt (1877) Shale Freeport Sandstone Member Upper Kittanning coal Shale, locally sandstone Middle Kittanning coal Shale, locally sandstone Lower Kittanning coal Shale Kittanning Sandstone Member Vanport Limestone Member Shale Scrubgrass coal Clarion Sandstone Member (locally shale) Clarion coal Shale Brookville(?) coal Shale
	Allegheny	300	
	Pottsville	250	Homewood Sandstone Member Homewood coal Shale Upper Mercer Limestone of White (1879) Upper Mercer coal Shale Lower Mercer Limestone of White (1879) Shale Middle Mercer coal Shale Lower Mercer coal Shale Upper Connoquenessing Sandstone of White (1878) Shale Quakertown coal Shale Lower Connoquenessing Sandstone of White (1878) Shale (position of Sharon coal)
			Sharon Shale Member Connoquenessing Sandstone Member Mercer Shale Member

Figure 2.-- Stratigraphic Section from Van Lieu and Patterson (1964, p.5).

PENNSYLVANIAN SYSTEM

Pottsville Group

Sharon Formation

Rocks included in the Sharon Formation were called the Sharon conglomerate and Sharon shales by I. C. White (1879, 1880). The shale member of the Sharon includes the Sharon coal bed, which was of great economic importance in the area during the latter half of the 19th century. The Sharon is poorly exposed in the Neshannock area. Much of the information concerning it comes from the reports of the Second Pennsylvania Geological Survey augmented by logs of water-well drillers. The Sharon is moderately to well developed only in the northwest quarter of the Neshannock quadrangle, where the conglomerate member attains a thickness of 50 feet and the shale member is locally as much as 50 feet thick. Throughout almost the entire rest of the quadrangle the Sharon cannot be recognized.

Connoquenessing Formation

The Connoquenessing was named by I. C. White (1878) from exposures along a creek of that name which enters the Beaver River 9 miles south of New Castle. White (1879, p. 63-64) recognized an "Upper Connoquenessing Sandstone," a shale interval referred to as the Quakertown coal and shales, and a lower massive unit, the "Lower Connoquenessing Sandstone," which form respectively the upper sandstone member, the middle shale member,

and the lower sandstone member of the Connoquenessing Formation. The aggregate thickness of the three members of the Connoquenessing is 100 to 180 feet. The thickness of the individual members of the Connoquenessing is highly variable. The Quakertown coal was named by I. C. White (1879, p. 65) for exposures in Quakertown River, which enters the Mahoning River just west of the Neshannock quadrangle. The coal has been mined only locally and on a small scale, mostly during the late 19th century.

Mercer Formation

The name "Mercer" was used as a stratigraphic term by Rogers (1858, p. 474-77) for the lower limestone bed of the Mercer Formation of current use. The name Mercer was redefined by White (1879) and extended to include the shale unit lying between the Homewood and the Connoquenessing Formations. The formation is variable in thickness, reaching a maximum of 90 feet in the Neshannock quadrangle, and contains three coals and two thin limestone beds--the upper and lower Mercer limestone and coal beds and the Tionesta or Homewood coal. The limestone beds form two of the most useful stratigraphic marker beds in the area. The upper and lower Mercer coal beds lie at various intervals of as much as 15 feet below each of the two limestone beds, and locally a sandstone unit occurs between the limestone beds. In many areas, the Mercer is thinned and locally replaced by channel-filling sandstone beds of the overlying Homewood Formation. The upper and lower Mercer coals were mined for local use during the 19th century, and the Tionesta coal is currently being mined in Mahoning and Pulaski Townships, Lawrence County.

Homewood Formation

The name "Homewood" was first used as a stratigraphic term by White (1878, p. 67) as a replacement for the names "Piedmont" and "Tionesta" which had previously been used for the upper sandstone unit of the conglomerate measures (Pottsville Group) of earlier reports. The type locality of the Homewood was designated by White (1878, p. 67) as Homewood Station, Beaver County, Pa., which is about 13 miles south of New Castle. At Homewood, a great thickness (155 feet) of sandstone is exposed. White considered this abnormal thickness to result from the extension of the Homewood upward into the Allegheny Group. DeWolf (1929, p. 49) considered the exposure at Homewood Station to represent the combined Homewood and Connoquenessing Formations. In any event, the type locality serves as an example of an often-faced dilemma when an attempt is made to map Pottsville rocks, namely, the separation and recognition of the sandstone units when they overlap.

As mapped in the Neshannock quadrangle, the Homewood Formation consists of a lower sandstone member, ranging in thickness from 0 to 60 feet, and a shale member from 0 to 40 feet thick, commonly 6 to 15 feet thick. The upper boundary of the Homewood is drawn at the base of the "Brookville" underclay.

Allegheny Group

Clarion Formation

The term "Clarion coal group" was applied by geologists of the First and Second Pennsylvania Geological Surveys to a predominantly

shale interval containing several coal beds which extends from the top of the Homewood to the top of the Vanport Limestone. This same interval was referred to as the Clarion Formation by Ashley (1926, p. 29).

There has long been a certain amount of confusion in the literature as to whether this formation contains two or three coals in Lawrence and Mercer Counties, and as to whether the lowermost coal found in the formation is the lower Clarion coal or the Brookville coal.

In mapping the Neshannock quadrangle, only two coals were seen in the Clarion Formation--one immediately below the Vanport, called the Scrub Grass coal, and another just above the base of the formation, which was called Brookville in deference to the past usage of the term in the area. The middle coal in the formation referred to as the Clarion in adjacent areas was not recognized in the Neshannock quadrangle but appeared in one section given by White (1880, p. 27) which had been compiled from several exposures. Williams (1960, p. 914) correlated the Brookville coal of Lawrence and Mercer Counties with the lower Clarion coal at Clarion.

The Clarion Formation is typically 50 feet thick in the Neshannock quadrangle and is composed of gray shale containing nodules of siderite; however, locally the unit is largely sandstone and was referred to as Clarion sandstone in older reports. The Vanport Limestone was excluded from the Clarion in mapping the Neshannock quadrangle because it is a distinct, mappable, lithologic unit.

Vanport Limestone

The Vanport Limestone was named by White (1878, p. 60) for exposures of limestone at Vanport, Beaver County, Pa. This unit was referred to in many of the reports of the Second Pennsylvania Geological Survey as the Ferriferous Limestone. The Vanport ranges in thickness from 0 to 22 feet in the Neshannock quadrangle. It is fossiliferous, and where typically developed it consists of an upper light-gray unit and a lower more siliceous bluish unit 3 to 4 feet thick. An irregular bed of siderite caps the Vanport locally and was referred to as the Buhrstone ore. The siderite was mined in the mid-19th century as a source of iron ore for local charcoal furnaces. The Vanport is cut locally by channel-fill sandstone of the lower member of the Kittanning Formation.

Kittanning Formation

Rogers (1858, p. 467) first applied the name Kittanning to a thin coal bed at Kittanning, Pa. In the reports of the Second Pennsylvania Geological Survey the term Kittanning coal group was applied by White (1878, 1879, 1880) to a variable sequence of shale, sandy shale, sandstone, and three beds of coal, the unit extending from the top of the Vanport or of the Buhrstone ore to the top of the uppermost three coal beds. Subsequently, the three coal beds have been referred to as the Lower, Middle, and Upper Kittanning coals. In the report on the Neshannock quadrangle, the Kittanning was subdivided into lower, middle, and upper members with the line separating the members drawn at the top of the

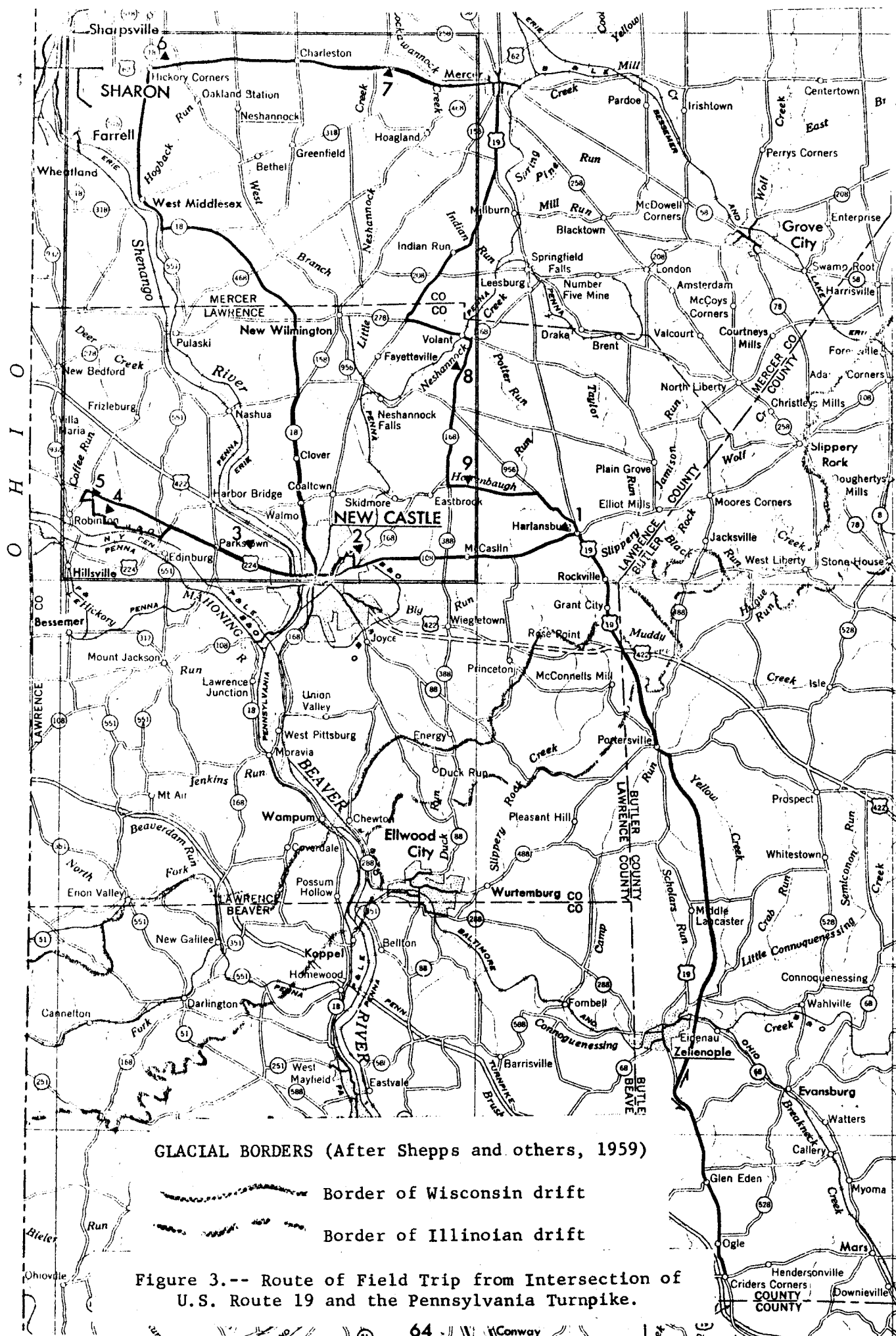
lower and middle coals, approximately 20 feet and 80 feet above the Vanport. In the Neshannock quadrangle, exposures of the Kittanning, with the exception of a sandstone unit of the lower member, are rare. The upper member of the Kittanning Formation occurs in only two small areas in the Neshannock quadrangle, both 2 miles east of New Castle. The middle member of the Kittanning caps a hill in Union Township, two hills in Neshannock Township, and one in Washington Township, Lawrence County. The lower member of the Kittanning caps most of the hills in the southern and eastern parts of the quadrangle. However, the Kittanning in the northeastern part of the quadrangle is largely represented by the channel-fill sandstone unit of the lower member of the Kittanning.

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ROAD LOG

SECOND DAY

Mileage

- 0.0 At northern exit of the Pennsylvania Turnpike on U.S. Route 19. On Route 19 from the Pennsylvania Turnpike to Harlansburg, the route traverses the lower part of the Conemaugh to Portersville, all the Allegheny Group, and, near Harlansburg, the upper part of the Pottsville Group. North of Portersville may be seen a large number of strip pits where coals in the Allegheny have been mined. The route crosses the southern limits of glaciation a short distance south of Harlansburg, providing an opportunity to contrast the topography both north and south of the extreme southern limit of glaciation. (See fig. 3.)
- 5.8 Turn right and north on Interstate Route 79. Note coalbed in cut to the right of the road immediately after turning onto Interstate Route 79.
- 17.2 Leaving Interstate Route 79 at Portersville, turn left on Route 19, in Portersville.
- 18.0 Stop-sign intersection; turn right on Route 19, proceed north on Route 19.
- 18.8 Leaving Portersville. From here on northward for the next few miles the route crosses the Allegheny Group.

Mileage

- 20.5 Passing the entrance to McConnells Mills State Park at left of road. This state park contains good exposures of the Pottsville Group and is one of the localities in which the Pottsville consists of an almost continuous sequence of sandstone.
- 21.0 Approximate location of glacial border. Evidence of glaciation consists of erratics in the soil and thin patches of till of Illinoian age.
- 21.7 Crossing U.S. Route 422.
- 21.9 Approximate boundary of the Wisconsin glaciation.
- 22.0 Gravel pits to right of road.
- 24.0 Kittanning Formation is exposed to left of road in woods.
- 24.5 Bridge over Slippery Rock Creek. On the left and northwest side of the bridge there is a flowing water well. Well is reported to be 1,300 feet deep and is partially plugged. The water is fresh and probably from the Connoquenessing Formation.
- 25.3 Entering Harlansburg. Intersection of Pa. Route 108 and U.S. Route 19. Turn left on Route 108 and proceed west.
- 25.7 On the west edge of Harlansburg. Entering a road cut with Vanport Limestone at the base, overlain by sandstone of the lower member of the Kittanning Formation.

Mileage

26.0

STOP I - HARLANSBURG. Right of the road opposite sign for

Scott Township Volunteer Fire Department grounds. Leave the bus and walk eastward down the hill into the cut where the Vanport Limestone and the sandstone unit of the Kittanning Formation are exposed. Please stay on the side of the road because this route is heavily traveled.

Near bottom of the hill on south side of road can be seen the contact between the Vanport Limestone and the underlying Clarion Formation. At the top of the Clarion is the Scrubgrass coal. Many solution features are seen on surfaces of the Vanport. Locally, the overlying sandstone unit of the lower member of the Kittanning Formation has collapsed into solution openings in the Vanport. There are several caves in the Vanport here; openings to the caves are mostly on the south side of the road.

Cross bedding in the Kittanning is predominantly to the west. Return to bus, and continue west on Route 108. For the next few miles Pleistocene deposits completely mask the bedrock.

The Pleistocene deposits are locally more than 100 feet thick.

29.7

Laurel High School on the right of road shown on the map of the southeast corner of the Neshannock quadrangle (fig. 4).

A water well drilled for this high school is shown on figure 5 as La-616; this well penetrated 65 feet of unconsolidated deposits. The total depth of the well is 389 feet; it is

Includes a lower conglomeratic member and an upper shale member which mostly contains a sand. The Formation can be recognized only in the northernmost part of the quadrangle where the conglomeratic member is present. Yields water for domestic use.

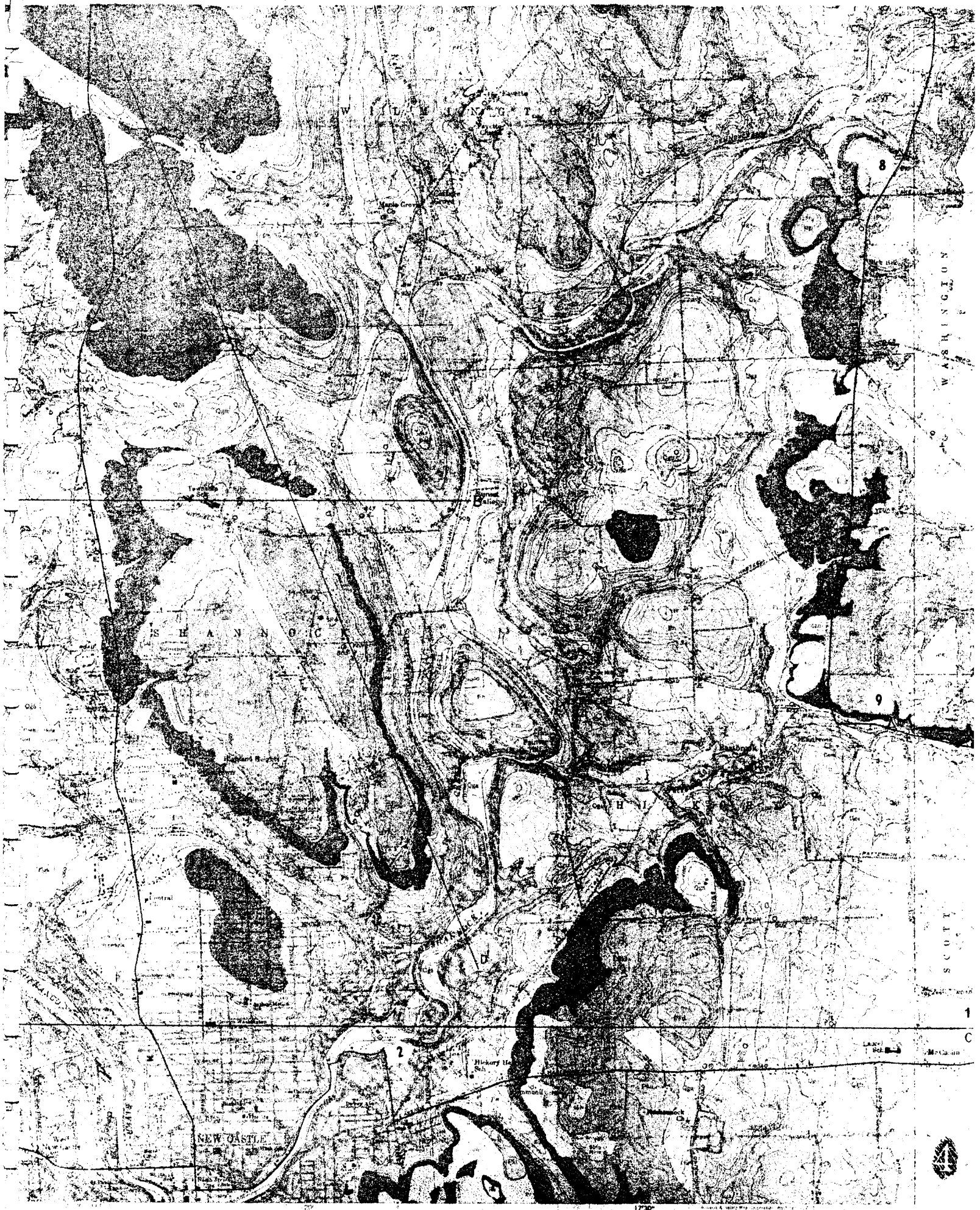
PENNsylvania

MISSISSIPPI

Fine-grained, light-gray, typically planar-bedded sandstone, locally interbedded with shale and siltstone. Yields better for domestic use.

WELLS

Numbers refer to those wells appearing in Table 1. Figures underlined show depth to bedrock.



WASHINGTON

SCOTT

1

C

McLean

1730

1730

1730

1730

1730

1730

1730

1730

1730

1730

1730

1730

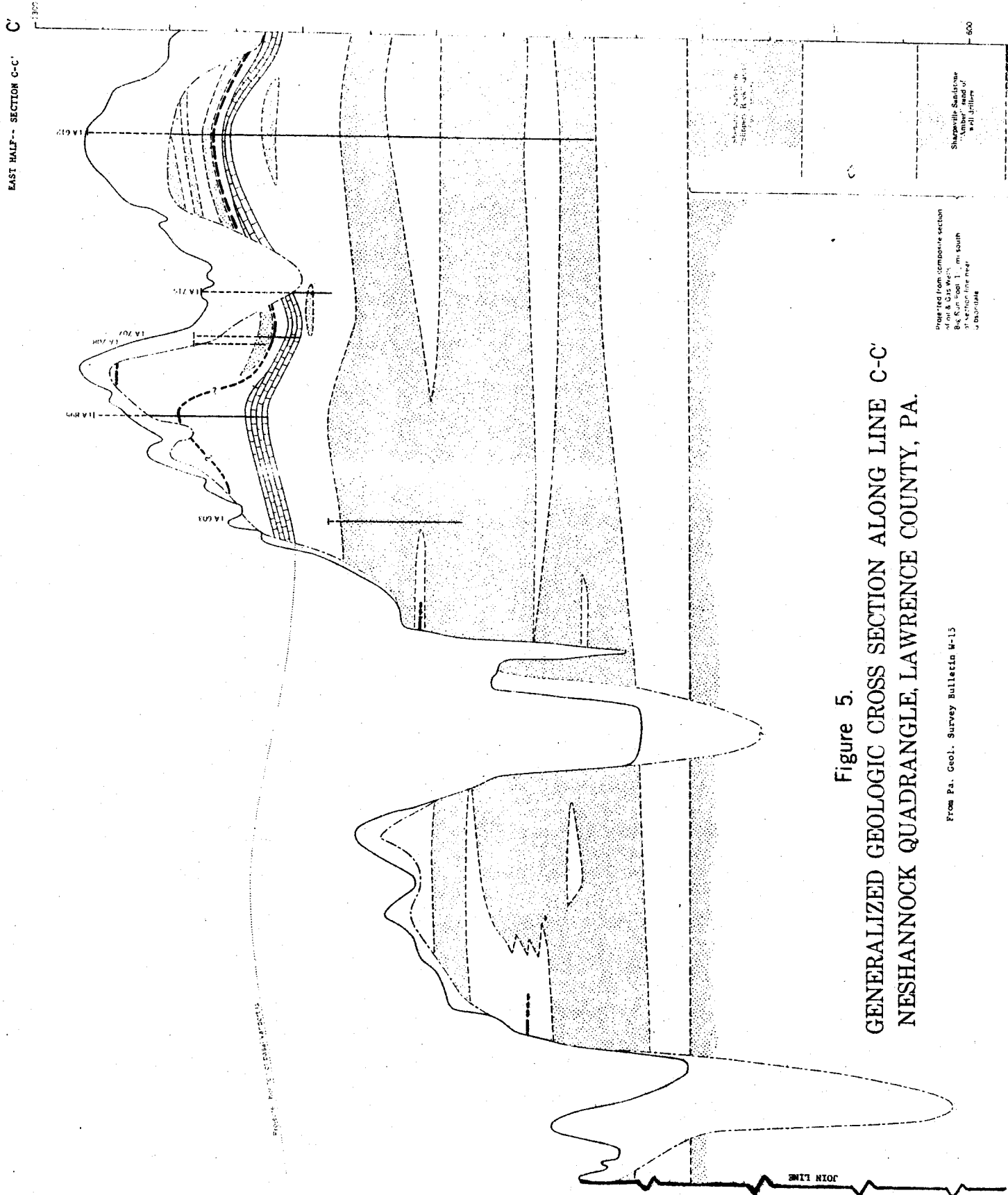


Figure 5.
GENERALIZED GEOLOGIC CROSS SECTION ALONG LINE C-C'
NESHANNOCK QUADRANGLE, LAWRENCE COUNTY, PA.

Projected from composite section
of oil & gas wells
Be Run Pool 1, 1 mi. south
of center line near
of 1900-1905

From Pa. Geol. Survey Bulletin W-13

JOHN LINE

Mileage

finished in the Connoquenessing Formation.

- 30.1 Intersection of Pa. Routes 108 and 388. Continue west on Route 108.
- 30.5 "Sportland" sign on right of road. This valley is filled with glacial deposits more than 100 feet thick. A well about 1 mile to the north penetrated 84 feet of glacial deposits without hitting bedrock. Additional control on the depth to bedrock was provided by hearsay evidence from local well drillers.
- 31.6 Strip pits to the left and south of Route 108. These strip pits are mainly those of the Fenati Brick Co., which is mining clay below the lower Kittanning coal.
- 32.1 Entrance to Fenati Brick Co. To the left up the valley can be seen the stack of the abandoned Lehigh Portland Cement Co., plant. The Vanport Limestone in this southeastern corner of the quadrangle is practically mined out.
- 32.7 Entering New Castle - blinking caution light.
- 33.0 Turn right a quarter of a block before light signal, and proceed north across stop street, which is Pa. Route 108.
- 33.2 Gravel road crosses a bench on top of the upper sandstone member of the Connoquenessing.
- 33.3 Sharp left and proceed down the hill.
- 33.6 At base of hill. Small quarry on left shows crossbedding in the Connoquenessing.

Mileage

33.6+ Turn right and proceed east.

33.8 STOP II - NEW CASTLE. Leave bus, walk up road to the east, parallel to railroad, to quarry. The upper member of the Connoquenessing forms the upper wall of the quarry. The thin dark-black shale represents the Quakertown coal. The sandstone and shale below constitute the lower member of the Connoquenessing. Note shale-filled channels. These deposits are interpreted as having been formed in a fluvial environment--the lenses of shale seem to represent channel filling--perhaps sloughs or oxbows. Return to bus.

34.0 Intersection; continue west.

34.2 Bridge over Neshannock Creek. Turn left at far side of bridge. Outcrops of the lower sandstone of the Connoquenessing.

34.7 Stop-street intersection; continue west into New Castle.

35.1 Stop light; bear right and proceed west 4 blocks to North Jefferson Street. Turn right for 2 blocks.

35.6 Turn left on U.S. Route 422 and 224. Continue west on Route 224.

36.2 Intersection of 422; continue west on 224.

37.1 Stop light. Belmar Park shown on the geologic map of the southwest corner of the Neshannock quadrangle (fig. 6). Continue west.

38.2 Castle outdoor theater on side of road. 100 yards beyond theater turn down farm lane toward barn.

Mileage

38.3 Turn right down farm lane to north.

* * * * *

STOP III - PARKSTOWN. Exposures here are in the valley to the right or east of the barn and consist of an almost continuous section from the Brookville coal to the Connoquenessing sandstone. To the south, beyond the theater, Vanport Limestone has been encountered in drilling wells. The fence may be entered by a gate at the west end of the barn. The Brookville coal is exposed in the small gulley below the barn. On down the valley there is an adit where coal was mined as late as 1960. The coalbed can be seen just north of the entry in a deep streamcut. Continue north down the stream valley. There are many caved adits on either side of the valley where coal has been mined in the past. Exposures of the Homewood sandstone may be seen where the stream makes an abrupt turn to the north. Continue down valley. Small falls over the sandstone. At the base of the small falls is a thin bed of coal; another thin coalbed is above the falls. Together they represent the Tionesta or Homewood coal. The next water fall is held up by the upper limestone bed of the Mercer Formation, below which is another thin coal bed. Around the corner below the fence is an outcrop of the lower limestone bed of the Mercer.

Mileage

There are caved adits in the lower coal, which lies 12 to 15 feet below the lower limestone bed. Return to bus.

Return to Route 224 and continue west on Route 224.

39.0 Intersection; continue west on U.S. Route 224.

39.3 Proceed down hill to just east of a large valley, which is an abandoned meander perhaps of the preglacial northward-flowing drainage. The valley is now filled with glacial deposits.

41.1 Intersection with Pa. Route 551. Turn right, crossing Route 551, and continue west on East River Road.

41.6 The valley of the Mahoning River to the left of the road has been repeatedly drilled for oil and gas. The first well was drilled in 1861, and by 1864 several wells had been put down to the Berea Sandstone 300 feet below the Mahoning. Concerning these wells White (1879, p. 203) commented: "Salt water was also obtained in nearly every well, and many of them are still throwing up gas and salt water in considerable quantities.

"It is very probable that had this territory been operated skillfully at first, it might have been made a productive district, but the reckless methods which characterized the early oil operations have probably ruined it entirely.

Mileage

"None of the wells were cased, and when abandoned they were all allowed to fill up with water, which would of course, ruin the best oil territory in a short time."

To the south on the hilltop beyond the Mahoning River the Vanport is being mined by the Michigan Limestone Division of U.S. Steel.

- 42.5 Oakland Sportsman's Club of New Castle, Pa., on right. Turn right just past Sportsman's Club and continue up the hill.

- 43.0 STOP IV - 1 MILE EAST OF ROBINSON. At bend in road pull off to right of road. Exposures of the Connoquenessing, Mercer, and Homewood are found up the valley to the north. Walk up the stream valley to north. Note the comparatively fine grained and shaly character of the Connoquenessing. The spoil pile is from a mine into the lower Mercer coal. Just west of the spoil pile is a little draw where the caved entry can be seen. Above the lower coalbed the Mercer Formation, approximately 12 feet of shale is capped by the lower limestone bed of the Mercer Formation. In 1960 this adit was open and the coalbed could be clearly seen. Continue on up the stream valley to where it divides. Slightly different sections are exposed in each of these stream valleys. The Mercer limestone is about 25 feet above the stream at the base of the intersection of the three valleys, and the lower Mercer coal can be seen in the stream going

Mileage

up the center valley. Up the center valley, we pass over the lower limestone member of the Mercer. A short distance above the lower limestone bed a small waterfall over sandstone can be seen. This is the unnamed middle sandstone member of the Mercer Formation. The upper limestone bed of the Mercer is above the sandstone in the east bank.

Walk up hill to the southeast and enter the next valley about where the loer Mercer limestone intersects the valley flow. Proceed from there northward, up the valley. Around the first bend the upper limestone bed of the Mercer crosses the valley. The sandstone unit just seen between the two limestone beds in the main valley is not conspicuous. There is a coalbed immediately below the upper limestone. Continue up the valley, where above the upper limestone the floor of the valley is underlain by fossiliferous shale. At the top of the valley there are two small cliff exposures of the tionesta or Homewood coal. At the top of the exposures is the Homewood. Return to bus.

43.5 Vanport Limestone. The upper layers of the Vanport were quarried here in the 19th century. The lower blue, more siliceous, beds are now being removed.

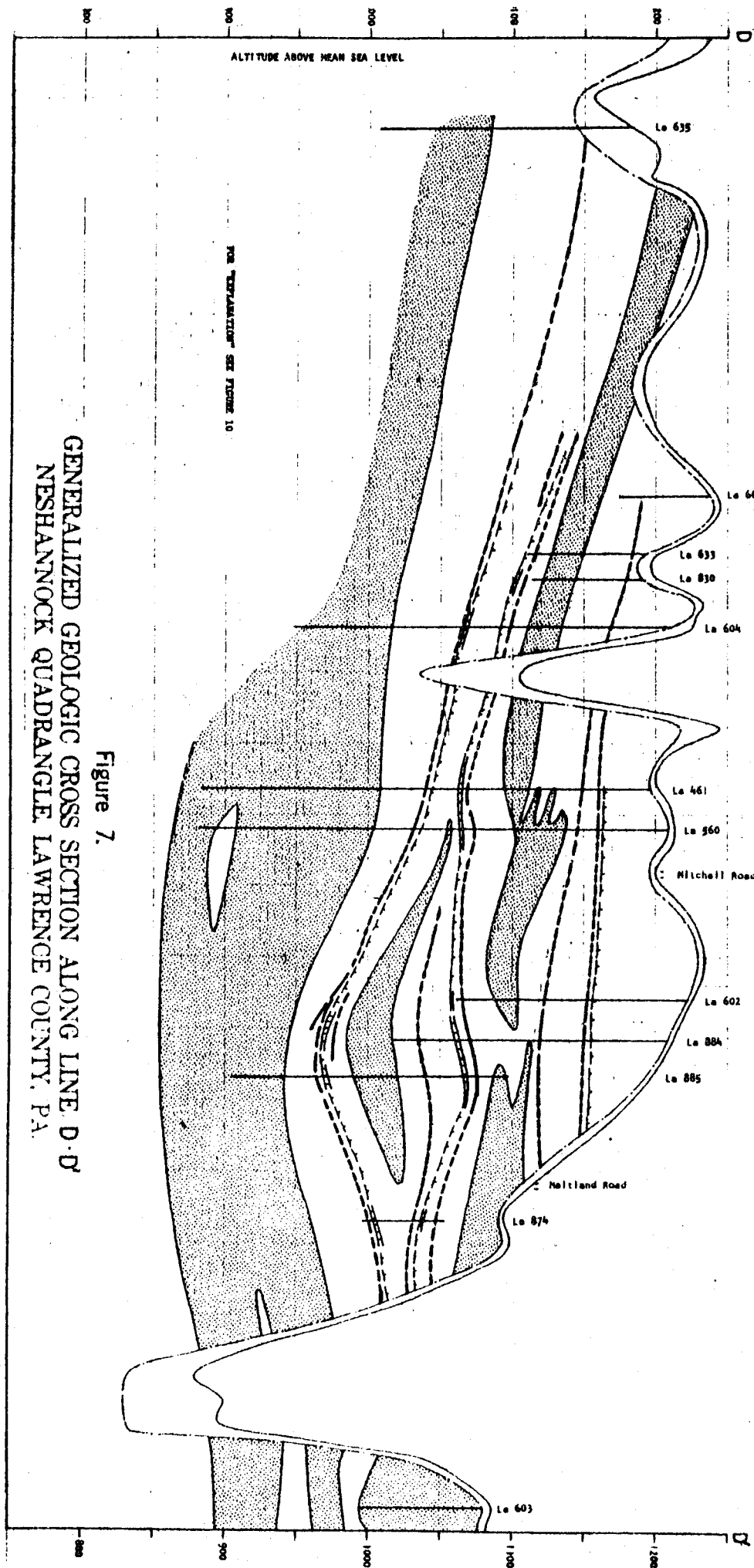
44.0 Tionesta or Homewood coal has been stripped at the right of the road. The coalbed here dips gently to the east and southeast, toward the valley where this coal was seen at Stop IV.

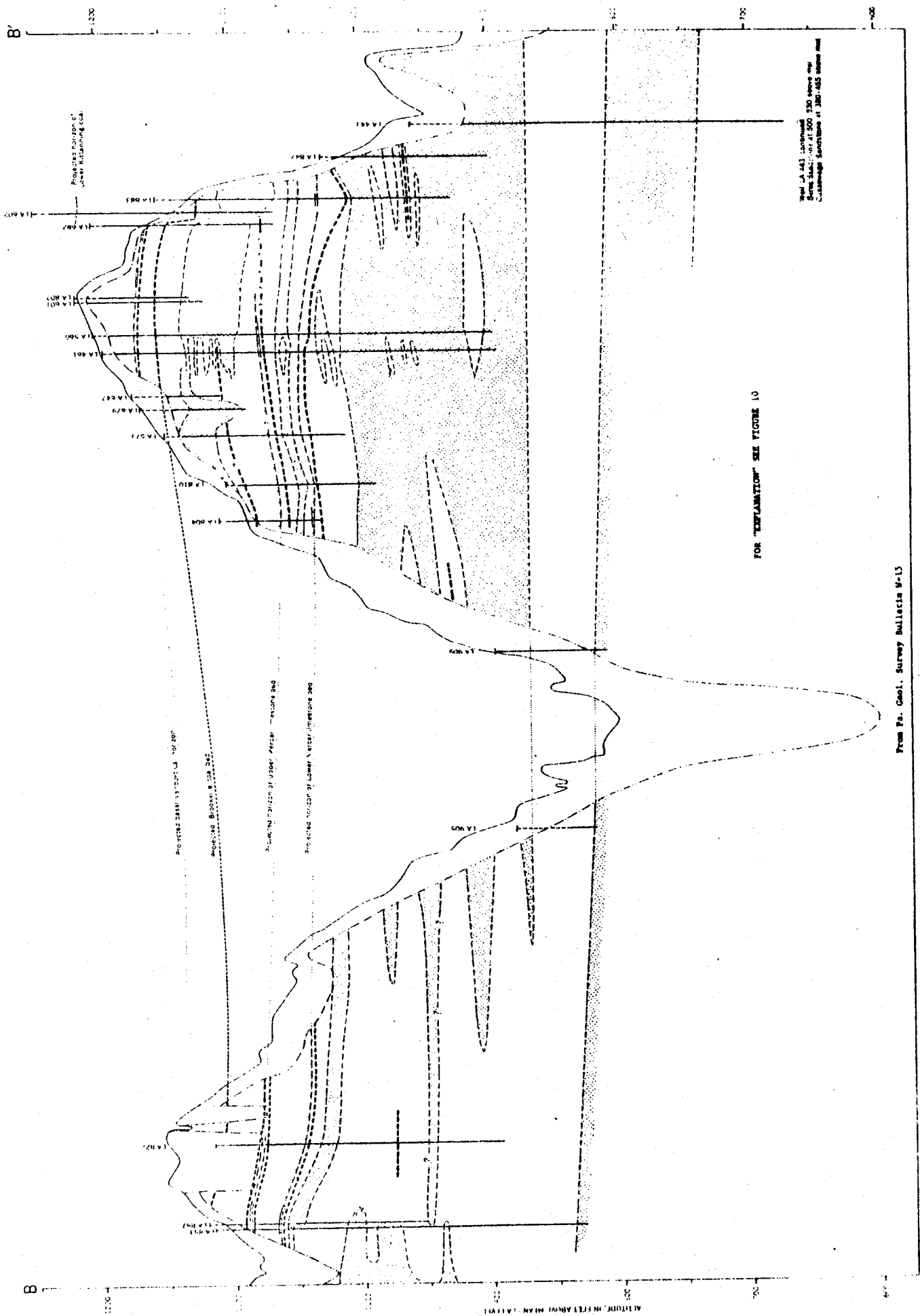
Mileage

- 44.2 STOP V. Brief stop to see upper part of the Mercer, Homewood, and Clarion Formations. The thin sandstone is the Homewood--above it may be seen the Brookville underclay. Return to bus.
- 44.3 Sharp break in slope. Downhill from here, outcrops in gullies on either side of the road are of the upper member of the Connoquenessing and predominantly of sandstone which is coarser grained than stratigraphically equivalent rocks seen in the valley at Stop IV.
- 44.5 At "T" intersection turn right and continue north.
- 44.9 Stop-street intersection; turn right.
- 45.1 Passing the northern end of the strip pit seen at Stop V. To the left, the Tionesta coal is being stripped. Here the Homewood is overlain by fine-grained sandstone and the clay seen at Stop V is not present.
- 45.8 The basal siliceous beds of the Vanport Limestone may be seen to the left of the road. The upper part of the Vanport was mined out many years ago.
- 46.0 Crest of hill. Passing over exposures of the lower beds of the Vanport Limestone. Immediately below the Vanport Limestone can be seen exposures of thin-bedded fine-grained sandstone of the Clarion Formation. Continue east downhill. Strip pits to the right of road were for mining the Tionesta or Homewood coal.

Mileage

- 46.7 Intersection Ambrosia Road; continue east.
- 47.3 Stop-street intersection; continue east.
- 48.0 Intersection U.S. Route 224. Continue east on Route 224 to
New Castle.
- 51.7 Entering New Castle.
- 52.7 Intersection U.S. Route 224 and Pa. Route 18. Turn left
on Route 18 and proceed north toward Sharon. The first
steep hill is formed by the Connoquenessing.
- 54.1 Calls Plaza--Section D-D' (fig. 7), parallels this route but
is drawn through wells a mile or so to the east.
- 54.5 A & P store on right of road.
- 55.3 Stop signal, Maitland Lane.
- 56.0 Castle View Burial Park. Behind this cemetery, and to the
east, the Brookville coal has been mined. The lower
Kittanning coal has been mined higher up on the hill.
- 57.0 Passing over valley. To the west, down this valley, are
exposures of the Mercer Formation.
- 57.5 Mitchell Road. Warehouse sales to left of road. To the left
and west of road the Tionesta or Homewood coal has been
stripped. Section B-B' (fig. 8) crosses route here.
- 58.3 McGary Road.
- 58.6 Strip pits to right of road up valley in the Clarion or
so-called Brookville coal.
- 58.8 Fork in road; continue north on Route 18.





From Pa. Geol. Survey Bulletin M-13

Mileage

60.3 Intersection of Pa. Routes 208 and 18; continue north on 18.
To the left, in the southwest corner of this intersection, is a one-room school that is still being used by the Amish. The well at the school marks the northernmost point of Section D-D'.

67.0 Intersection Pa. Route 551.

67.6 Entering Borough of West Middlesex. Shown on the map of the northwest corner of the Neshannock quadrangle (fig. 9).

68.0 Intersection of Pa. Routes 18 and 318.
On the left is a Sunoco station. Behind it are the Borough of West Middlesex wells, which derive their water supply from the Cussewago Sandstone. This is the southern limit of fresh water in the Cussewago Sandstone; to the south the Cussewago contains salt water and, locally, gas.

69.5 Tamoshanter Country Club.

70.0 Blinking light. Pa. Route 518 turns left. Continue north on Pa. Route 18--now entering the area in which the Sharon coal was extensively mined during the 19th century. This coalbed formed an important resource in the area and was one of the prime reasons for the development of the steel industry in the Shenango Valley.

The importance of the Sharon coal in the economy of the Shenango Valley in the past can be appreciated from the following quotes from Eavenson (1952, p. 225): "Coal was



Mileage

found near Sharon probably as early as 1810 and actual mining began about 1835 * * *. The coal had a different structure from most western Pennsylvania coal, it was laminated, split in flat blocks, very hard to break across the laminations. It was strong enough to stand the weight of the burden in the furnaces of those days and after 1849, for many years, all iron made in this locality, and some furnaces in Ohio, used raw coal for fuel. During the Civil War, the output of the County (Mercer) exceeded 2,500 tons per day, a considerable tonnage then." The following statements from White (1880, p. 55) concern the reserves of the coal: "The quantity of Sharon coal remaining unmined is hard to calculate, because new areas of it are discovered every few years. But the best informed men in the Shenango Valley state that more than half of the known available coal has been extracted; that 25 or 30 years' more mining will practically exhaust the known areas; and that, making a liberal allowance for areas to be discovered, and at the rate of production for the last 20 years, 50 years more will certainly exhaust the whole."

72.0

Hickory. Turn right at light on U.S. Route 62.

Mileage

72.6 Turn left on Snyder road. At end of road turn left on first land and continue to small strip mine. This strip mine represents the only exposure I know of Sharon coal and the Sharon conglomerate.

* * * * *

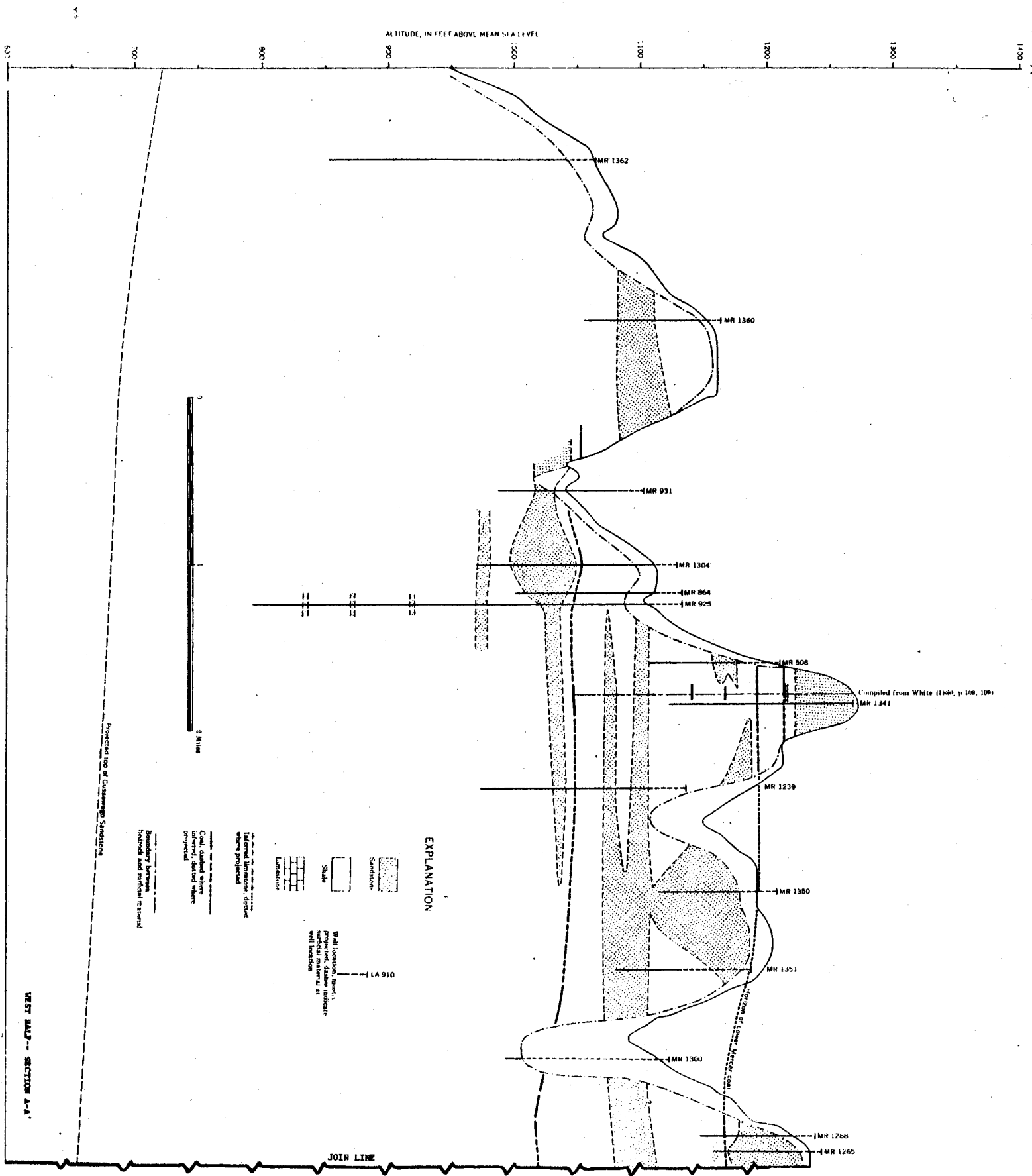
STOP VI - HOLLOW RUN. Of interest here is the relief on the Sharon coalbed and exposures of the underlying conglomerate member of the Sharon Formation. White (1880, p. 104), reporting on the Sharon coal near Bethel, a few miles to the southeast of this strip, stated: "The Sharon coal bed is quite variable in thickness at this locality, the floor being exceedingly uneven, rising and falling in hills and swamps, thinning away to 6 inches or less on the hills and thickening up to 3½ feet in the swamps; and the difference in level between the tops of the hills and the bottoms of the swamps is often as much as 25 feet." Return to bus. Continue east on U.S. Route 62. Section A-A' of figure 10 nearly parallels route from here to Mercer, Pa.

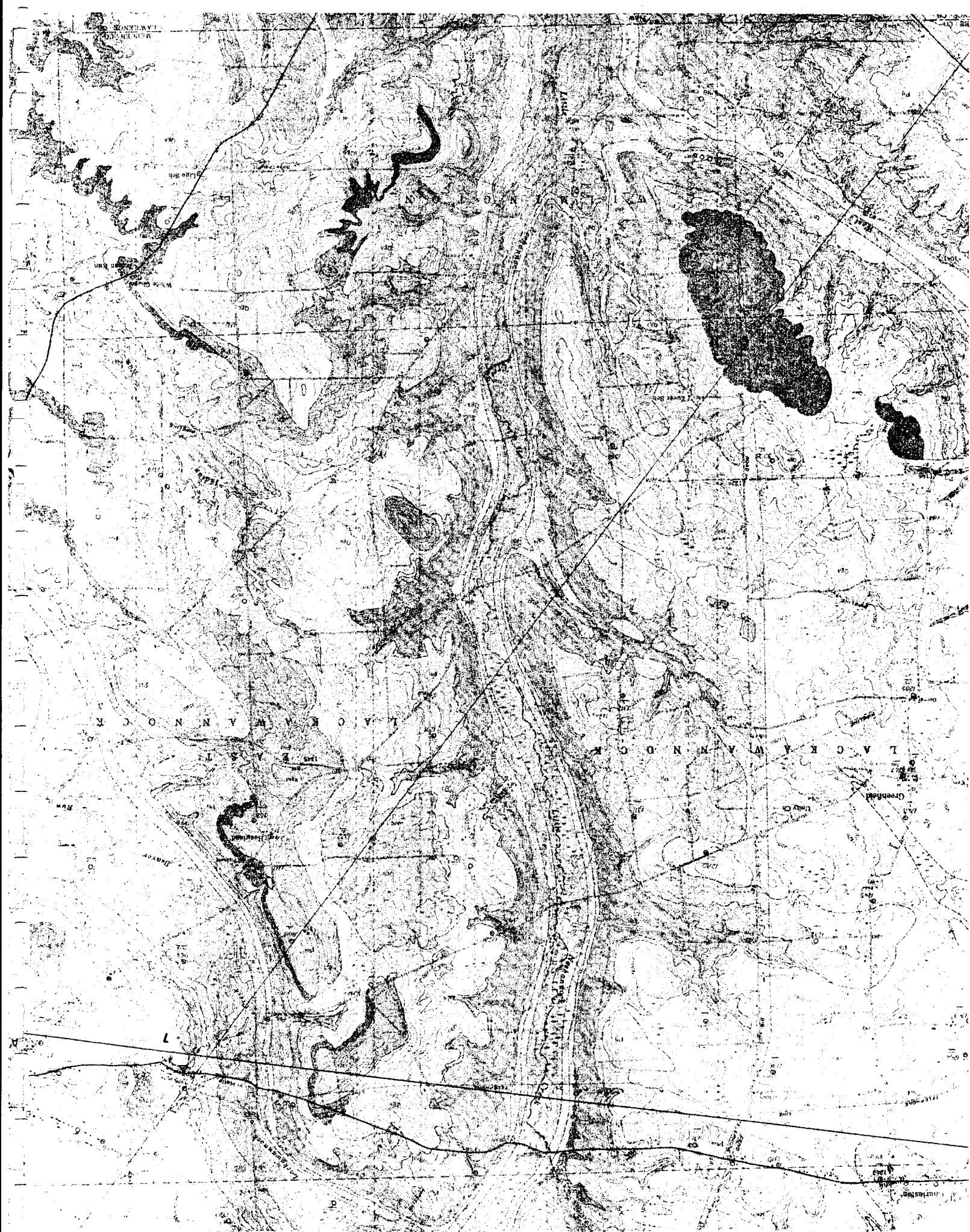
74.1 Top of hill is capped by Homewood Formation. Below the Homewood I. C. White (1880, p. 108) reported the lower limestone and coalbeds of the Mercer Formation.

75.6 Parker Bros., well drillers, to left of road. Mr. Parker, a gentleman 75 years young, had worked in some of the mines in the area and was of great assistance in locating the shafts of mines mentioned by White (1880).

Mileage

- 76.0 Bottom of the valley is filled with glacial deposits more than 100 feet thick. Mr. Parker informs me that down this valley to the south was one of the large centers of mining of the Sharon coal in the mid-19th century, and that at one time there were more than 3,000 coal miners living and working there. The towns of New Virginia, Bethel, and Neshannock are quite small. It is now difficult to find the locations of the old mines. The shafts have been filled with debris and the spoil piles hauled away for fill and road metal.
- 77.9 Perry Ross Coal Co. tipple. The hill is capped by the Homewood. See geologic map of the northeast corner of the Neshannock quadrangle (fig. 11).
- 79.3 Top of hill, west of the broad valley containing Little Neshannock Creek. Hill is capped by the Homewood. The Mercer Formation is not conspicuous on this hillslope and could be found in only a few of the small valleys to the south. The valley of the Little Neshannock is filled with glacial deposits more than 100 feet thick.
- 80.0 Two-thirds of the way across the valley of the Little Neshannock turn right and continue east.
- 80.2 Intersection. Continue straight ahead up hill. Exposures on right of the road are of the upper sandstone member of the Connoquenessing.





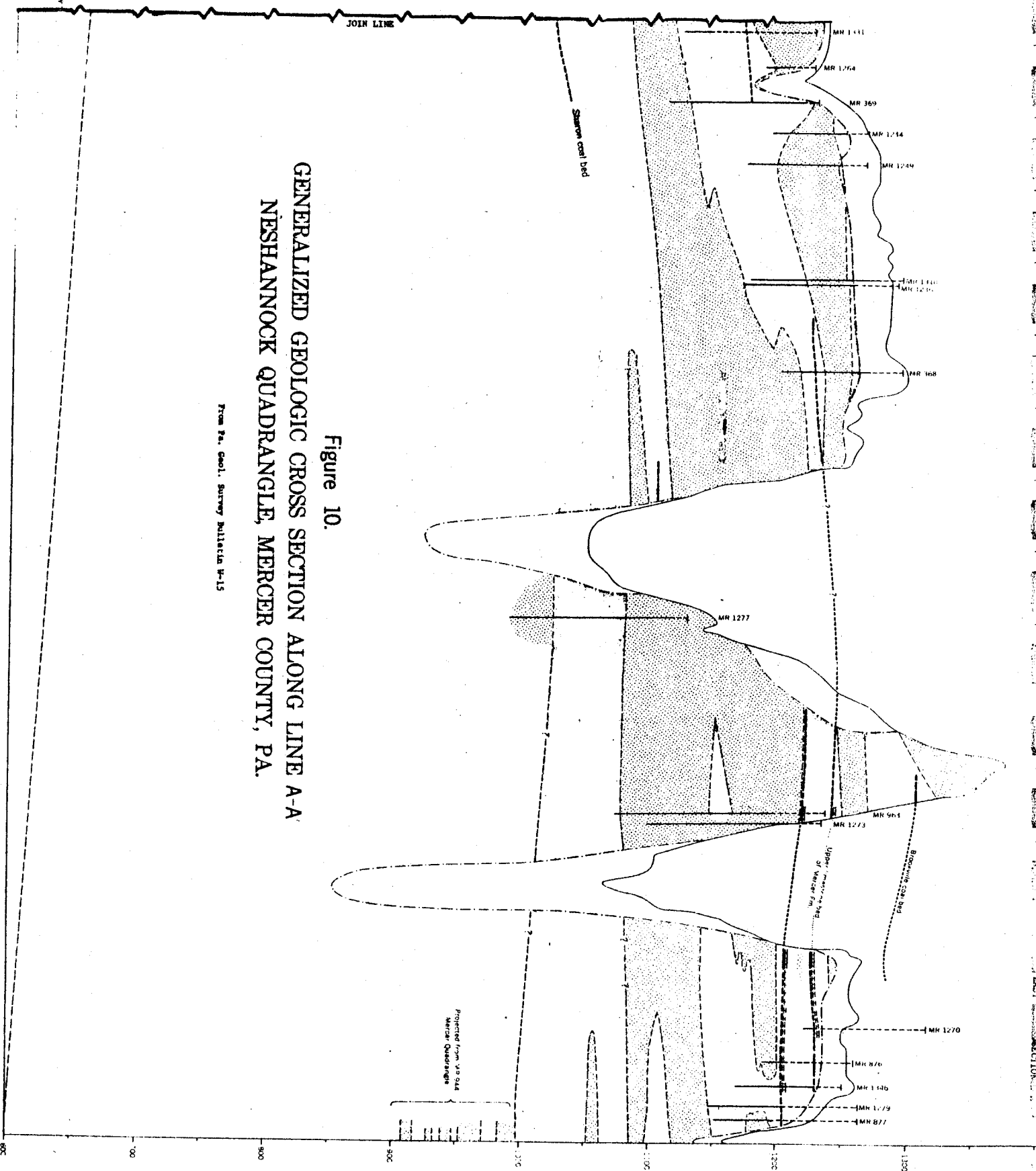


Figure 10.
GENERALIZED GEOLOGIC CROSS SECTION ALONG LINE A-A
NESHANNOCK QUADRANGLE, MERCER COUNTY, PA.

From Pa. Geol. Survey Bulletin 9-15

Mileage

- 80.6 Intersection. Continue east. In the gully to the northwest of the intersection are several caved adits, presumably on the Quakertown coal. One mile south, down the road to the right, is an exposure of the sandstone unit of the lower member of the Kittanning.
- 80.9 Gentle bend in the road to the right. To left of road below barn are small pits where limestone and coal beds of the Mercer were mined many years ago.
- 81.5 At the crest of the hill just before descent to Lackawannock Creek. To the right of the road and to the south are several small caved adits driven years ago to mine the Brookville coal. The property owner reports that the coalbed was cut out to the south by the sandstone unit in the lower member of the Kittanning, which caps the high knob a mile south where it is exposed in a road cut. This sandstone may represent a continuation of the channel seen at Harlansburg and which will be seen at Stop VIII south of Volant. Steep hill; use low gear.
- 81.8 Small caved adits to the right of the road in the Mercer coals.
- 81.9 There are small outcrops of the upper sandstone member of the Connoquenessing Formation to the right of the road.
- 82.3 Road intersection in the valley of Lackawannock Creek. This valley is filled with Pleistocene deposits, which are 200 feet thick locally.

Mileage

82.5

Oil well to right of road is drilled to the Hundred Foot sand. Entering Hells Hollow. The name of Hells Hollow was derived during the early days of settlement and referred to a frontier tragedy involving the murder of several friendly Indians. Their ghosts allegedly lamented here. This valley contains the best exposures of the Mercer Formation in the vicinity of Mercer. The exposures are not as good today as they were when visited by members of the First Pennsylvania Geological Survey more than 130 years ago, and by Leslie and White in the 1870's when many small mines were operating in the vicinity.

STOP VII - HELLS HOLLOW. Mercer Formation overlain by Homewood Formation. The base of the Mercer is not exposed. To the north, on top of hill, the Brookville coal has been mined. Three measured sections are given by I.C. White (1880, p. 134-136) for the exposures at Hells Hollow. The Mercer upper limestone bed is not definitely identified in any of the sections but is to be found in gullies both north and south of Hells Hollow. White's section No. 2 is as follows:

Mileage

1.	Concealed from hilltop-----	25'
2.	Brookville coal-----	4'
3.	Concealed-----	30'
4.	Homewood Sandstone, and concealed--	15'
5.	Shales, darkish-----	5'
6.	Mercer - upper coal-----	2'
7.	Shales and sandstone-----	8'
8.	Shales, darkish, sandy, ball ore---	15'
9.	Mercer lower iron ore-----	1'
10.	Mercer lower limestone-----	2' 6"
11.	Fireclay and coaly shales-----	5'
12.	Shales, blackish; ball ore-----	15'
13.	Iron ore in a solid layer-----	6"
14.	Shales, blackish; visible-----	10'
		<u>138'</u>

After brief stop, continue east.

- 83.0 Intersection with U.S. Route 62. Ahead in woods are strip pits where the Brookville coal has been mined. Right turn on U.S. Route 62.
- 84.3 Traffic light intersection of U.S. Routes 62 and 19. Right turn on Route 19.
- 86.6 Intersection of U.S. Route 19 and Interstate Route 80. A short distance past this intersection turn right on the New Castle road.
- 87.0 Right turn on New Castle Road.
- 88.5 Approaching crest of hill. Vanport Limestone is exposed in a small pit behind farm on the right.
- 89.0 Crest of hill. About three-quarters of the way down the hill are caved adits on both sides of the road to the Mercer coals.
- 89.6 Esker.

Mileage

- 91.0 Ligo School, another 1-room school used by the Amish.
- 91.2 Intersection. Continue straight ahead.
- 92.8 Stop-sign intersection. At Shepard School turn left and east toward Volant.
- 93.0 Passing small pond on right of road. The low hill beyond the pond is capped by the sandstone unit of the lower member of the Kittanning Formation.
- 94.1 Crest of hill; reduce speed.
- 94.4 Cemetery on right of road. Beyond the cemetery, the Mercer Formation is exposed in an abandoned quarry. The Mercer is cut out to the northeast by channel-filling sandstones of the Homewood Formation.
- 94.8 Railroad crossing in Volant.
- 94.9 Neshannock Creek. Small quantities of oil are produced from wells drilled to the to the Hundred Foot sand a mile to the northeast (Volant Pool).
- 95.0 Stop-street intersection of Pa. Routes 208 and 168.
Right turn on Pa. Route 168. Continue to top of hill.
- 95.8 STOP VIII. Pull over to left of road before houses. Down valley to right of road, the sandstone unit of the lower member of the Kittanning cuts out the Brookville coal. On down the valley, the Homewood, Mercer, and Connoquenessing Formations are exposed. Two thousand feet to the southwest, the Vanport Limestone is exposed in a gully to the right of Lake Road.

Mileage

- The sandstone-filled channel here had cut out the Vanport and all the Clarion. Continue south on Route 168.
- 97.3 Intersection of Pa. Route 956.
- 98.0 To left of road in the distance can be seen spoil piles from strip mining of the lower Kittanning coal.
- 98.8 G. R. Riddle Paving Co., to the right of the road.
- 99.0 The Brookville coal has been strip-mined to right of road. Here back-filling has obscured the location and extent of the working. Pits were open about 10 years ago.
- 99.3 Fork in road. Take left fork south down steep hill.
- 99.4 At top of hill are outcrops of the Vanport Limestone on either side of road.
- 99.7 Near bottom of hill at road intersection, turn left.
- 99.8 To left of road are small spoil piles from mining Brookville coal.
- 100.0 STOP IX. Pull off to right of road. Spoil pile to left of road from abandoned underground mine in the Tionesta coal. Section exposed is from the Tionesta coal to the Vanport. Here the Clarion is composed largely of shale. Return to bus.
- 102.7 Stop street. Turn right and continue to Harlansburg.
- 104.3 Intersection of U.S. Route 19. Turn right onto Route 19 and return to Pittsburgh.