

# The Shenango Formation (Mississippian) in Northwestern Pennsylvania

By GRANT E. KIMMEL and GEORGE R. SCHINER

CONTRIBUTIONS TO STRATIGRAPHY

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# THE SHENANGO FORMATION (MISSISSIPPIAN) IN NORTHWESTERN PENNSYLVANIA

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By GRANT E. KIMMEL and GEORGE R. SCHINER

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### ABSTRACT

The top two units of Mississippian rocks are herein defined as upper and lower members of the Shenango Formation. The upper member is mostly shale, and the lower member is principally sandstone and subordinate interbedded shales. A type section is established for the Shenango Formation which is about 150 feet thick in the Shenango River valley. Measured sections and gamma-ray logs of wells show that the individual sandstones of the lower member of the Shenango Formation are not mappable units. The upper member of the Shenango Formation has been correlated by previous workers with the Hempfield Shale, but detailed geologic mapping by the authors indicates that the name Hempfield Shale was applied to a nonmappable shale within the Shenango Formation. The Hempfield Shale is herein abandoned.

### INTRODUCTION

The Shenango Formation and the overlying Hempfield Shale of Mississippian age have been mapped and correlated widely over northwestern Pennsylvania without benefit of established type sections. Rapid lateral and vertical lithologic changes in these rocks have led to some confusion in their mapping, and have created nomenclatural and correlation problems involving the two rock units. Detailed geologic mapping of the Mississippian section in the Shenango and Stoneboro quadrangles (fig. 1) has resulted in better definition of the Shenango Formation.

The purpose of this report is to establish a type section for the Shenango Formation, divide it into two members, show its lithologic variability, clarify the stratigraphic relationship between the Shenango Formation and the various units called Hempfield Shale, and abandon the name Hempfield Shale.

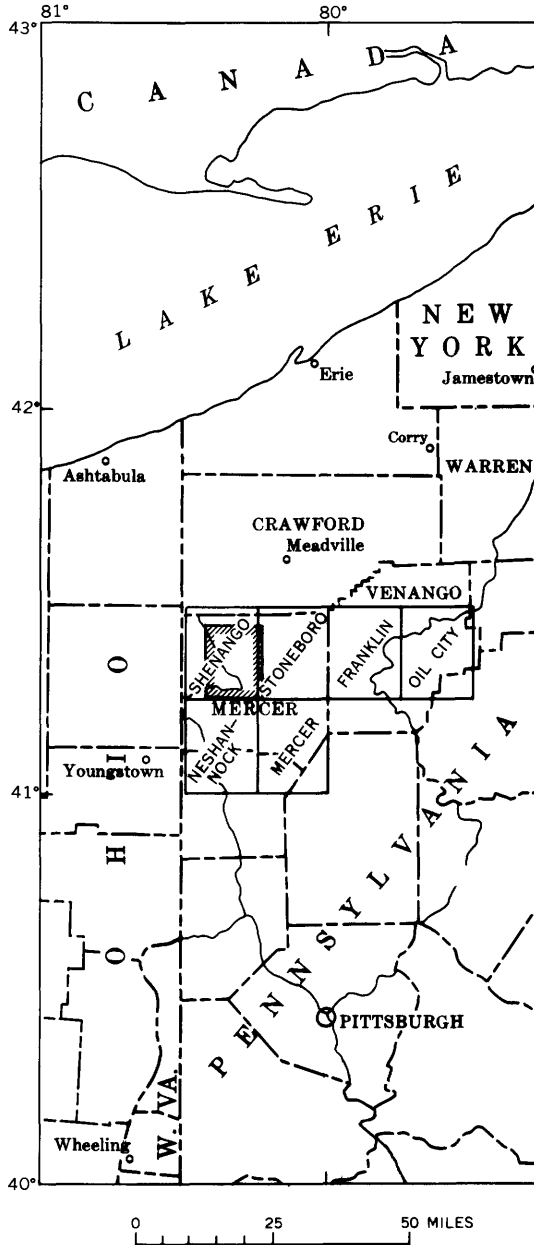


FIGURE 1.—Map of northwestern Pennsylvania, showing principal geographic features, names of counties and quadrangles mentioned in report, and location of area shown in figure 2 (stippled area).

The upper and lower members of the Shenango Formation crop out in a wide belt in Warren, Crawford, Venango, and Mercer Counties, Pa., and in eastern Ohio (fig. 1). They comprise the two upper units of the Mississippian rocks in northwestern Pennsylvania. The lower member of the Shenango Formation overlies the Meadville Shale of the Cuyahoga Group (Cushing and others, 1931, p. 48-54), and represents a distinct change in the sedimentation of the Appalachian basin. The Cuyahoga Group consists mainly of shale and siltstone with subordinate variable-sized lenses and large discontinuous sheet-like bodies of flaggy very fine grained sandstone. The lower member of the Shenango Formation, on the other hand, is principally sandstone. It is commonly coarser grained than the sandstone of the Cuyahoga and contains subordinate interbedded shales. The basal sandstone of the lower member is usually separated from the underlying Meadville Shale of the Cuyahoga Group by a distinct erosional contact.

Beds of shale and siltstone and scattered lenses of fine-grained sandstone of the upper member of the Shenango Formation overlie the lower member and grade into it. In northwestern Pennsylvania, the topmost Mississippian shales are unconformably overlain by the Pottsville Group of Pennsylvanian age. A geologic map of the upper and lower members of the Shenango Formation in parts of the Shenango and Stoneboro 15-minute quadrangles is shown in figure 2.

### PREVIOUS INVESTIGATIONS

The stratigraphic nomenclature for the Mississippian rocks in northwestern Pennsylvania was first introduced by I. C. White in reports of reconnaissance investigations in Mercer (1880) and Crawford (1881) Counties. White named a 3- to 35-foot-thick sandstone and about 45 feet of overlying shale exposed in the Shenango River valley the Shenango Sandstone and the Shenango Shale, respectively (White, 1880, p. 59). Caster (1934, p. 138-142) agreed with White regarding the separation of these rock units, but changed the name of White's Shenango Shale to Hempfield Shale to avoid using the same geographic name for more than one formation.

Reports on the geology of the Oil City quadrangle (Dickey and others, 1943), the Mercer quadrangle (Poth, 1963), and the Neshannock quadrangle (Carswell and Bennett, 1963) used the name Shenango Formation for a much thicker, more complex unit than White's Shenango Sandstone. Dickey and others (1943, p. 15-18) divided the formation into three units of sandstone and two units of shale. They correlated the shale overlying the Shenango Formation with the Patton Formation. Carswell and Bennett (1963, p. 22) mapped the She-

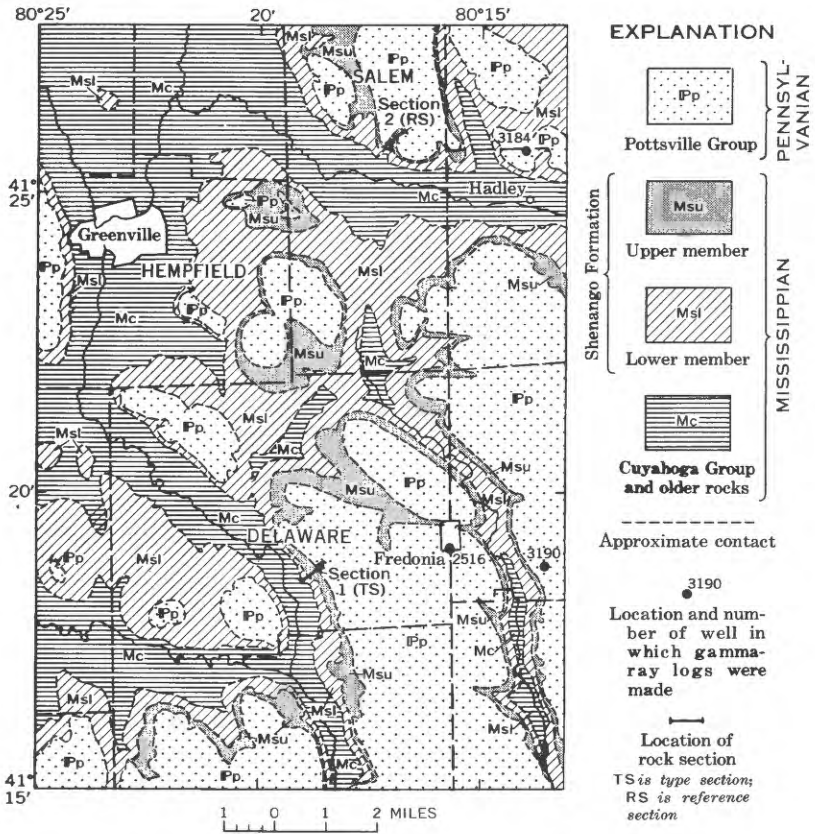


FIGURE 2.—Generalized geologic map of parts of the Shenango and Stoneboro quadrangles, Mercer County, Pa., showing location of sections and wells, and township names mentioned in report. For location of area see figure 1. Geologic sections and gamma-ray logs are shown in figure 4.

nango Formation as a unit that increased in thickness from 10 feet in the northwestern part of the Neshannock quadrangle to 80 feet in the southeastern part of the quadrangle. They mapped the shale overlying the Shenango as the Hempfield Shale. Figure 3 shows how the stratigraphic nomenclature pertinent to this report was applied by the various workers.

### SHENANGO FORMATION

White (1880, p. 163) described a section about 2 miles north of Big Bend, Mercer County, Pa., but he did not designate a type section of the Shenango Sandstone. Although the top of the formation is covered at this locality, it is one of the best exposures of the Shenango Forma-





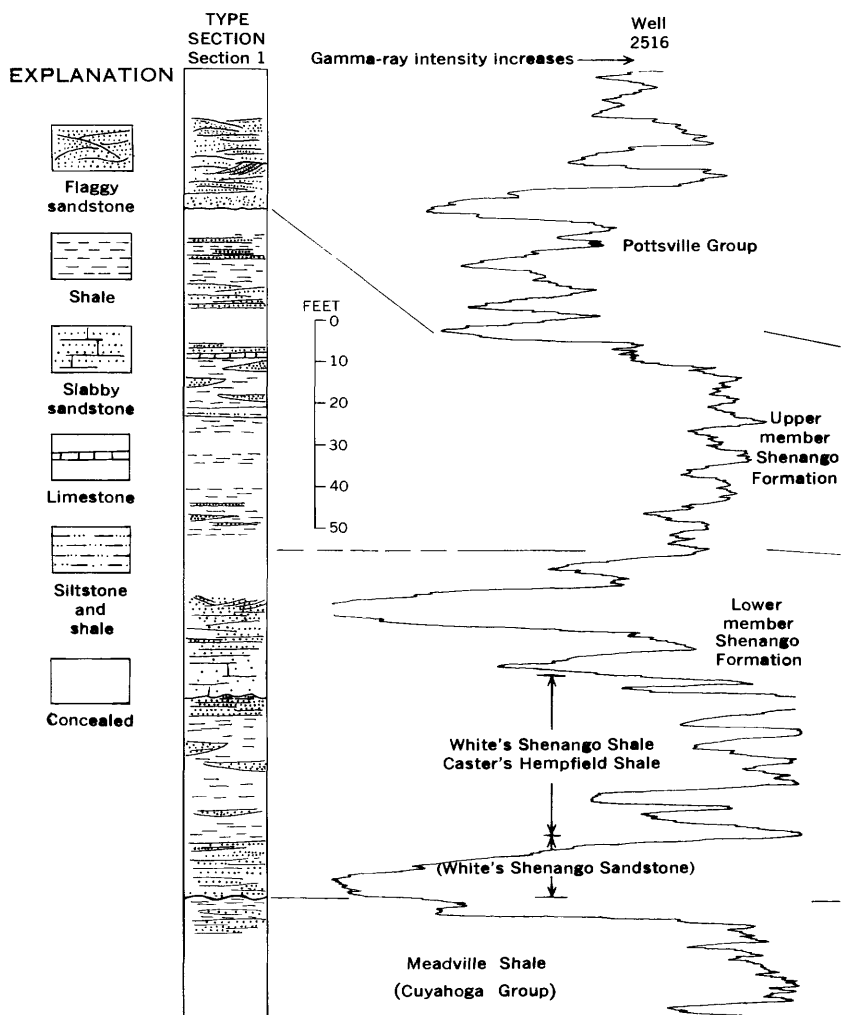
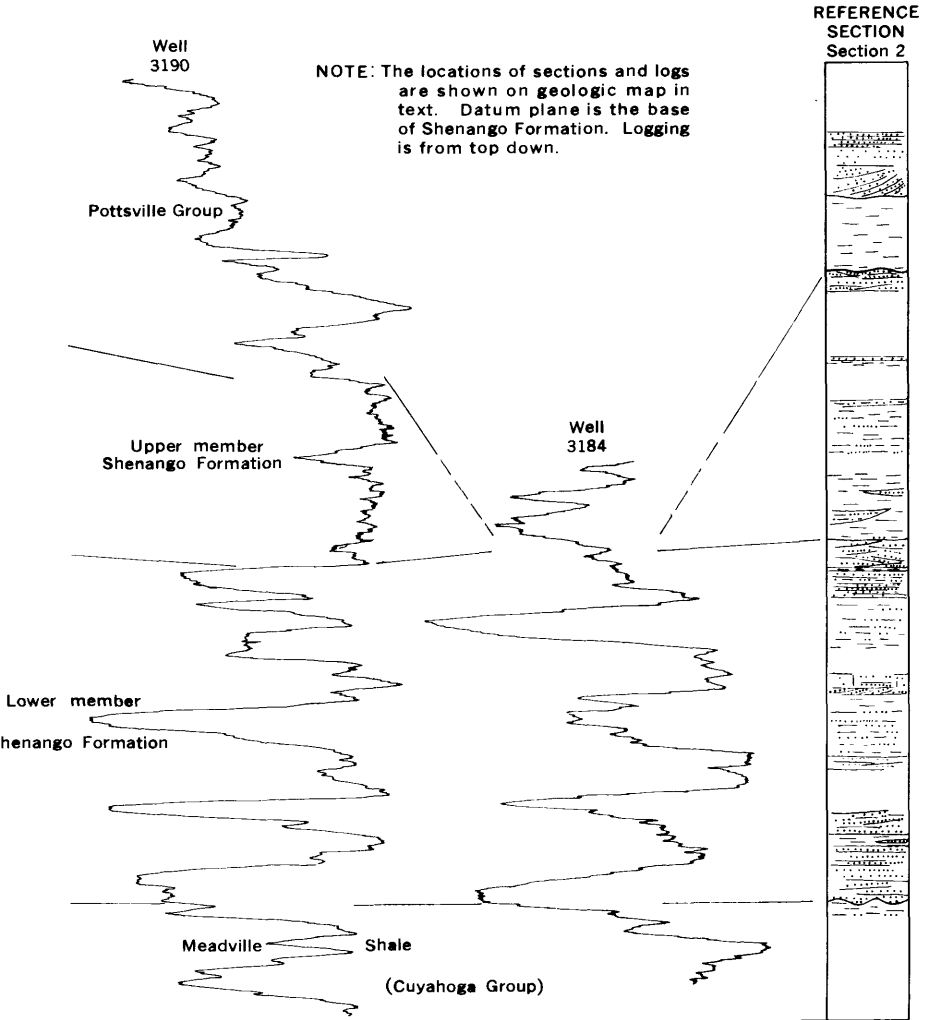


FIGURE 4.—Lithologic variation of the lower member of the Shenango Formation, Group in the Shenango and Stoneboro quadrangles, Pennsylvania. Loca-

veals that he believed the Shenango to consist of a single sandstone unit not more than about 35 feet thick overlying the Meadville Shale. White's Shenango Sandstone is, therefore, correlative in most places to the basal sandstone unit of the much thicker Shenango Formation as defined in this report.

White designated the shale overlying the basal sandstone of the type section as the Shenango shale; however, the correlations in figure 4 show that it is only the first shale unit above the basal sandstone of



and the relation of the upper member to the lower member and the Pottsville formations of the geologic sections and gamma-ray logs are shown in figure 2.

the Shenango Formation. This shale becomes sandy eastward and is not a mappable unit. Further confusion exists because Caster (1934) renamed the Shenango Shale the Hempfield Shale and designated the type locality as Hempfield Township, Mercer County, Pa. (fig. 2). He did not locate a type section but stated that the Hempfield Shale was well exposed there. Geologic mapping in Hempfield Township by the present authors shows that these exposed shales underlie the Shenango Formation and are part of the Cuyahoga Group. The Shenango For-

mation underlies the uplands in Hempfield Township, but only the basal sandstone of the formation crops out to any great degree. The upper member of the Shenango Formation is not exposed, owing to the cover of glacial drift, and therefore could not be the well-exposed shale referred to by Caster as the Hempfield.

Because the name Hempfield was applied to shales that are not considered mappable by the present authors and that are included in the lower member of the Shenango Formation as defined in this report, the name Hempfield Shale is herein abandoned.

#### LOWER MEMBER

Detailed mapping by the present authors shows that the lower member of the Shenango Formation in Mercer and Crawford Counties consists of several beds of fine- to medium-grained sandstone. Some beds are as much as 50 feet thick and have flaggy to blocky partings (McKee and Weir, 1953). Low-angle crossbedding is present locally. Shale and siltstone occur between the sandstone beds, and in some localities may comprise as much as one-half of the formation. The siltstones contain brachiopods, pelecypods, worm borings and trails, and fucoids; ripple marks are present locally. The measured thickness of the formation, where not eroded, ranges from about 80 feet to 120 feet in the Shenango and Stoneboro quadrangles.

The type section consists mainly of a basal sandstone 14 feet thick; an interval of shale, containing sandstone lenses, 34 feet thick; and a top sandstone at least 24 feet but not more than 39 feet thick. The same sandstone units are present in the gamma-ray log of well 2516, but part of the top sandstone unit is replaced by beds of shale. The logs of wells 3190 and 3184 show that east and northeast of the type section prominent sandstones are present in the same interval that includes shale at the type section. The reference section contains about 5 feet of medium-grained crossbedded slabby sandstone in the middle part of the lower member, but the sandstones of the section do not correlate completely with the log of well 3184. Logs of wells west and south of those shown in figure 4 indicate that the member grades laterally into sandstone beds of various thicknesses, and individual sandstones are difficult (if not impossible) to correlate over the distance of a quadrangle.

#### UPPER MEMBER

Beds of shale and siltstone containing lenses of siltstone and fine-grained sandstone overlie the lower member of the Shenango Formation and grade into it. These beds are similar to parts of the lower

member and can only be distinguished from it where sufficient section is present to recognize the top of the lower member. Worm borings, fucoids, and current-striation marks are present on some of the siltstones. Partial exposures of these beds are described in the measured sections at the end of this report. The maximum thickness of these beds, in the area mapped, is 78 feet at the type section for the Shenango Formation described in section 1; however, the thickness may be greater elsewhere, as the exposures are poor in the area. Where overlain by sandstone of the Connoquenessing Formation (Pennsylvanian) of the Pottsville Group, the beds comprise a unit that is readily identified in geophysical logs and that can be traced across the Stoneboro quadrangle and into the adjacent quadrangles. Where the unit is overlain by shale of the Connoquenessing, the formation boundary in the subsurface is arbitrary. (See well 3190 in fig. 4.)

The unit is separated from the Pennsylvanian rocks by an unconformity which cuts across successively younger formations to the southeast. At the Allegheny Front all of the Mississippian section may be exposed. Somewhere between the Stoneboro quadrangle and the Allegheny Front, the relation of the upper member of the Shenango Formation and the Mississippian rocks overlying the units could be established.

Dickey and others (1943, p. 14) correlated these rocks with shale of the Patton Formation in west-central Pennsylvania; however, this formation is poorly defined, and its stratigraphic position is not clearly understood. The authors do not believe that this correlation is accurate. The name Hempfield was applied to the upper member of the Shenango Formation of this report by Poth (1963) in the Mercer quadrangle, and by Carswell and Bennett (1963) in the southeast part of the Neshannock quadrangle; however, because the name Hempfield was given to rocks identified as part of the Guyahoga Group by Caster and to units within the lower member of the Shenango Formation of White, the present authors do not recognize Hempfield as a valid formation.

#### MEASURED SECTIONS

The sections were measured with an altimeter, hand level, and tape. Rock-color names are those given in the "Rock-Color Chart" of the Geological Society of America (Goddard, and others, 1963).

## Section 1

[Type section of the Shenango Formation along an unnamed stream on the east side of the Shenango River valley, Delaware Township, Mercer County, Pa. Base of section is at lat. 41°18'36" N., long. 80°18'52" E. Section extends 0.5 mile upstream from the base]

## Pennsylvanian System.

## Pottsville Group.

Thickness  
(feet)

## Connoquenessing Formation :

Sandstone, white to very light gray, fine- to coarse-grained,  
blocky to flaggy----- 22.0

Total thickness of exposed Connoquenessing Formation - 22.0

## Mississippian System.

## Shenango Formation.

## Upper member :

Covered ----- 7.0

Sandstone, light-olive-gray, very fine-grained, silty, flaggy ;  
greenish-gray siltstone and shale ; worm borings, worm  
trails, and fucoid marks in siltstone ----- 5.0

Shale, dark-brownish-gray to medium-gray ; tabular ; silty  
concretions ----- 6.0

Sandstone, light-gray, very fine-grained to fine-grained, platy  
to flaggy ; mostly planar bedded ; crossbedded in part ;  
finely broken plant material on some parting surfaces---- 6.0

Covered ----- 10.0

Sandstone, medium-light-gray, very fine grained, micaceous,  
platy to flaggy ----- 1.0

Limestone, brownish-gray, silty ----- .7

Shale, brownish-gray ; lenses of medium-light-gray very fine  
grained sandstone ----- 12.0

Siltstone, medium-gray, sandy, well-indurated, shaly ; planar  
top with current striations and groove casts ; irregular bot-  
tom ; concretions at base ----- 1.6

Shale, medium-dark-gray to brownish-gray, fissile----- 4.0

Covered ----- 6.0

Shale, medium-dark-gray, silty, micaceous----- 1.0

Covered ; has a few shale outcrops----- 7.0

Shale, dark-greenish-gray, silty, micaceous ; a few thin sand-  
stones and siltstones----- 11.0

Total thickness of exposed upper member----- 78.3

## Lower member :

Covered ; probably made up mostly of lower member----- 15.0

Sandstone, very light gray, fine-grained ; flaggy at top ; slabby  
at bottom ; parting surfaces generally irregular ; some cross-  
bedding ----- 11.0

Standstone, very light gray, fine-grained, blocky ; clay galls  
and cavities at bottom ; about 1 foot of erosional relief at  
base ----- 13.0

Section 1—Continued

Mississippian System—Continued

Shenango Formation—Continued

Lower member—Continued	<i>Thickness (feet)</i>
Sandstone, medium-light-gray, very fine grained, silty, micaceous, platy, flaggy; crossbedded and planar bedded; finely broken plant material on some parting surfaces-----	4.2
Shale, olive-gray to medium-dark-gray, fissile; concretions; few platy siltstones-----	3.7
Shale, medium-dark-gray; lenses of very fine grained platy, planar-bedded, micaceous medium-gray siltstone-----	27.3
Sandstone, medium-light-gray, very fine grained, micaceous, platy, planar-bedded; scattered crinoid-stem and brachiopod fragments; finely broken plant material-----	2.0
Sandstone, medium-light-gray to light-gray, fine-grained, platy to flaggy; clay galls at base; about 1.5 feet of erosional relief at contact with underlying unit-----	12.0
<hr/>	
Total thickness of exposed lower member-----	73.2
<hr/>	
Total thickness of exposed Shenango Formation-----	151.5
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Meadville Shale:

Shale, medium-dark-gray, fissile; lenses of silty fine-grained sandstone containing shale interbeds-----	4.9
Sandstone, light-olive-gray, fine-grained, flaggy; lenselike crossbeds -----	2.6
<hr/>	
Total thickness of exposed Meadville Shale-----	7.5

Section 2

[Reference section along an unnamed stream on north valley wall of Little Shenango River 4.5 miles northeast of Greenville, Pa., in Salem Township, Mercer County. Base of section is at lat. 41°25'40" N., long. 80°17'15" E. Section extends 0.5 mile upstream from the base]

Pennsylvanian System.

Pottsville Group:

	<i>Thickness (feet)</i>
Sandstone; weathers yellowish orange to very pale orange; white on leached surfaces; fine grained at top to medium grained near base; few pebbles; thin bedded to laminated; crossbedded----	15.0
Shale, dark-gray, silty, micaceous, fissile; contains organic material -----	18.7
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Total thickness of exposed Pottsville Group-----	33.7
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## Section 2—Continued

## Mississippian System.

## Shenango Formation.

## Upper member :

	<i>Thickness (feet)</i>
Sandstone, medium-dark-gray, very fine grained, silty, micaceous, flaggy to platy; top flags have rough surfaces and worm bores; some planar flags have current-striation marks -----	5.0
Covered -----	15.0
Sandstone, medium-light-gray, silty, hard, micaceous; laminated planar-bedded slab, 0.4 to 0.7 foot thick, underlain by shale -----	1.0
Covered -----	9.0
Shale, dark-gray; very thin interbeds of micaceous medium-gray siltstone containing casts of current striations; brachiopods; unit capped by 0.9 foot laminated hard sandy siltstone -----	12.0
Covered -----	6.0
Shale, dark-gray, fissile; concretions; lenses of flaggy to platy siltstone and interbedded shale as much as 3 feet thick; current-striation casts; brachiopods-----	15.0
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Total thickness of upper member-----	63.0
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## Lower member :

Sandstone, light-gray, very fine grained to fine-grained; flaggy irregular parting surfaces; worm borings-----	7.0
Shale, dark-gray, fissile; persistent break in sandstone-----	.3
Sandstone, medium-light-gray, very fine grained, silty, micaceous, platy; a few thin shale partings; 0.2 foot discontinuous calcareous sandstone near base-----	7.0
Shale, dark-gray, fissile; interbeds of shale and flaggy laminated siltstone; some ripple-marked siltstones-----	11.6
Covered -----	6.0
Sandstone, light-gray, fine- to medium-grained, blocky to flaggy; crossbedded in part-----	5.0
Shale, medium-dark-gray, silty, micaceous; interbeds of flaggy siltstone; worm borings-----	14.8
Sandstone, light-gray, fine- to medium-grained; flaggy irregular surfaces-----	3.3
Covered -----	10.0
Sandstone, light-gray, fine- to medium-grained; flaggy irregular surfaces-----	5.5
Shale, dark-gray, fissile; lenses of platy, micaceous very fine grained sandstone-----	2.7



## Section 2—Continued

## Mississippian System—Continued

## Shenango Formation—Continued

## Lower member—Continued

	<i>Thickness (feet)</i>
Sandstone, light-gray, fine-grained; flaggy irregular surfaces; top 1 foot platy, micaceous very fine grained; about 0.5 foot of erosional relief at contact with underlying unit----	13.0

Total thickness of lower member-----	86.2
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Total thickness of Shenango Formation-----	149.2
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## Meadville Shale:

Shale, dark-gray; shaly, sandy, siltstone-----	3.5
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Total thickness of exposed Meadville Shale-----	3.5
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