

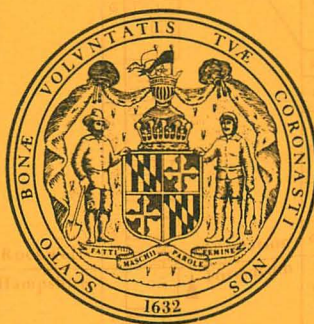
Department of Natural Resources
MARYLAND GEOLOGICAL SURVEY
Kenneth N. Weaver, Director

REPORT OF INVESTIGATIONS NO. 52

THE MISSISSIPPIAN SYSTEM IN MARYLAND

by

David K. Brezinski



1989

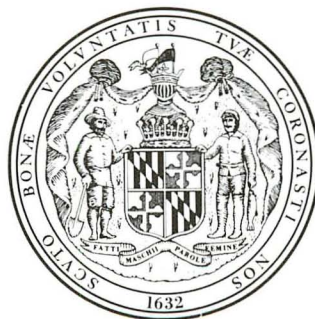
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THE MISSISSIPPIAN SYSTEM IN MARYLAND

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ABSTRACT

The Mississippian System in Maryland comprises the Rockwell, Purslane, Greenbrier, and Mauch Chunk Formations in ascending order. The Rockwell Formation consists of interbedded siltstones, shales, and thin sandstones. The lower part of the formation spans the Devonian-Mississippian boundary and conformably overlies the Hampshire Formation. Intertonguing of marine and nonmarine facies characterizes the Rockwell of Garrett County. The lower marine unit correlates with the Oswayo Formation of northwestern Pennsylvania and the upper unit with the Sunbury Shale of Ohio. At Sideling and Town Hills only one marine unit is present. This marine episode can be correlated with the Riddlesburg Shale of Pennsylvania. Associated with and underlying the Riddlesburg Shale are shoreface sandstones and locally polymictic diamictites. Aggradation into alluvial plain deposition marks the end of Rockwell deposition.

The Purslane Formation consists of thick, cross-bedded, light-colored sandstones and conglomerates with thin intervals of red mudstone, carbonaceous shale and siltstone. An overall coarsening-upward in the Purslane indicates the change from low-gradient stream deposition in the lower part of the formation to high-gradient braided streams in the upper.

Erosion following Purslane deposition produced an unconformity separating it from the overlying Greenbrier Formation. The Greenbrier Formation in Maryland consists of four members. In ascending order they are: Loyalhanna, Deer Valley, Savage Dam, and Wymps Gap. The Loyalhanna consists of cross-bedded, green-gray to red, sandy limestone directly overlain by medium-bedded, purer carbonates of the Deer Valley Member. Interbedded terrigenous red clastics and marine sandstones, shales, and limestones characterize the Savage Dam Member, a tongue of clastic rocks which thicken dramatically to the east. The Savage Dam Member is overlain by a carbonate tongue known as the Wymps Gap Member, which thins both north and east in Garrett and Allegany Counties.

The uppermost Mississippian unit, the Mauch Chunk Formation, is characterized by red claystones, mudstones, and siltstones, and relatively thick, cross-bedded, green-gray and red-brown sandstones. A thin marine unit, correlated with the Reynolds Limestone of West Virginia, is present in southwestern Garrett County. Erosion near the end of Mauch Chunk deposition led to the development of an unconformity between it and overlying Pennsylvanian units.

INTRODUCTION

GENERAL

Mississippian strata represent one of the least studied and least understood stratigraphic intervals in Maryland. Monographic treatments of Cambrian and Ordovician (Bassler, 1919; Sando, 1957), Silurian (Swartz et al., 1923), Devonian (Schuchert et al., 1913; Prosser et al., 1913), Cretaceous (Clark et al., 1911; Clark et al., 1916), Eocene (Clark et al., 1901), Miocene (Clark et al., 1904), and Pliocene-Pleistocene (Shattuck et al., 1906) strata of the State have been comprehensively compiled, whereas Late Paleozoic strata remain poorly known. Moreover, in a recent review of the Carboniferous System in the United States (U.S.G.S. Professional Paper 1110, 1979) the Maryland portion of the compendium was all but omitted (Arkle et al., 1979). It is for these reasons that this investigation was undertaken. The purpose of this report is to describe the Mississippian stratigraphy of Maryland, and to discuss the age, distribution, correlations, facies variations, environments of deposition, and economic utility of these units.

This report is based on 35 measured stratigraphic sections (Appendix I) located in Garrett, Allegany, and Washington Counties in Maryland; Fayette, Somerset, Bedford, and Fulton Counties, Pennsylvania; and Preston, Grant, and Mineral Counties, in West Virginia (Figure 1).

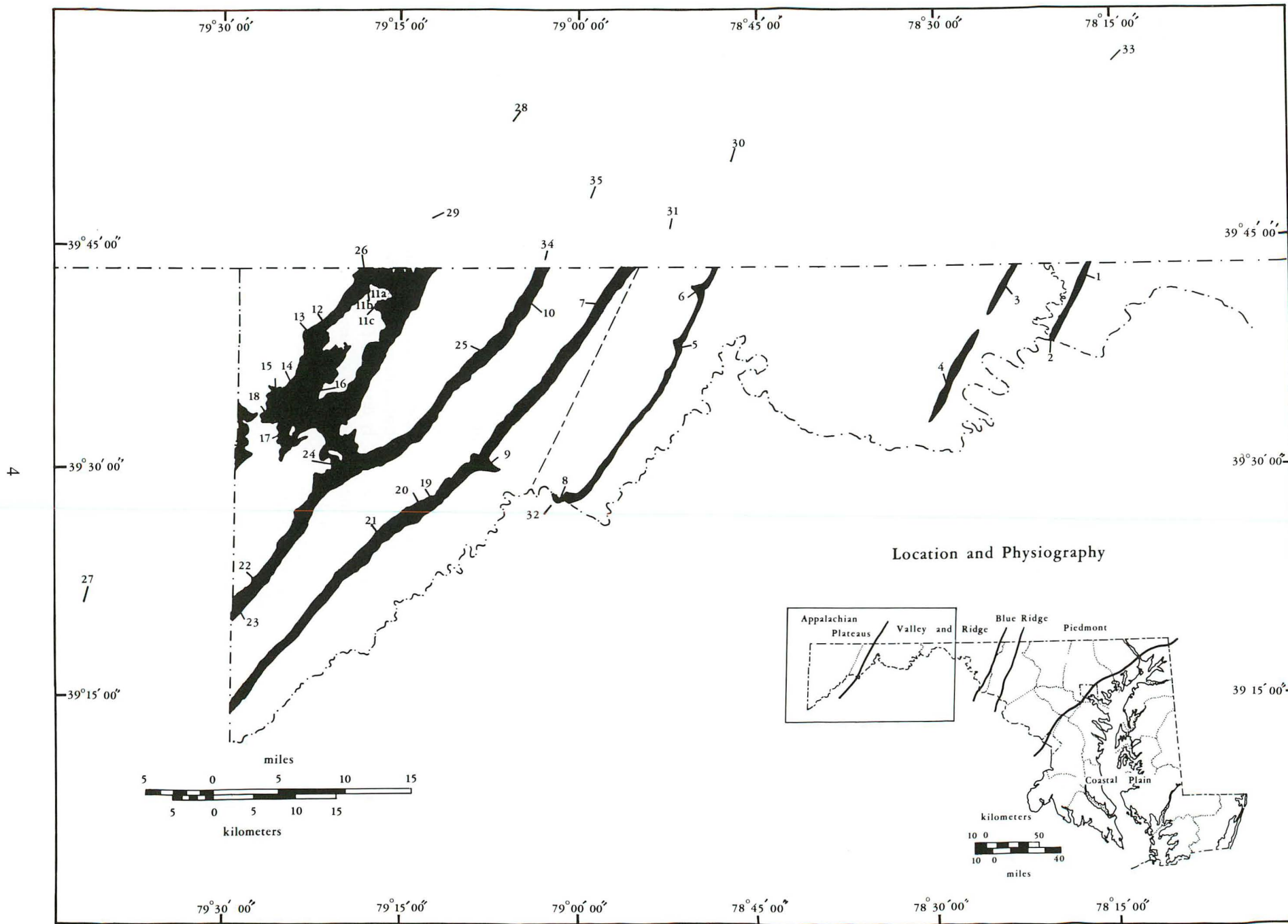
PHYSIOGRAPHIC EXPRESSION

The Mississippian strata of Maryland crop out in two separate physiographic provinces. Within the Valley and Ridge Physiographic Province of Maryland, Mississippian strata are largely restricted to eastern Allegany and western Washington Counties (see Figure 1). Here, the Town Hill and Sideling Hill ridges are composed of Mississippian units. Both ridges are southern extensions of the Broad Top Synclinorium of Pennsylvania. In Maryland, no Mississippian units are present east of Sideling Hill. The next occurrence to the west is along the Allegheny Front near La Vale and Corriganville. Within the Allegheny Mountain Section of the Appalachian Plateaus Province of Maryland, Mississippian units crop out along the flanks of the Deer Park, Accident, and Briery Mountain Anticlines. In these areas Mississippian formations exhibit a distinctive physiographic distribution. Although the Pennsylvanian Pottsville Group is the major ridge-forming unit of the Appalachian Plateaus, sandstones of the Mississippian Purslane Formation commonly form a secondary ridge somewhat lower in altitude than, but parallel to, the Pottsville ridges. Between these twin ridges more easily eroded limestones, shales, siltstones,

and sandstones of the Upper Mississippian formations (Greenbrier and Mauch Chunk Formations) form an intervening valley. At numerous locations throughout the Maryland part of the Appalachian Plateaus Province, the drainage within these intervening valleys has become impeded and as a result bogs have developed. Such bogs support an unusual boreal flora and consequently are somewhat intriguing. Some examples of such swamps are Cranberry Swamp near Finzel, Cranesville Swamp west of Sang Run, Wolf Swamp near Piney Grove, and Pine Swamp west of Barton.

HISTORY OF STUDY

Studies of the Mississippian System of Maryland have ranged from cursory overviews of regional stratigraphy to detailed studies of specific units or outcrops. Martin (1902) briefly discussed the distribution and stratigraphy of Mississippian units in Garrett County, and recognized a three-member subdivision of the Greenbrier Formation. One of the earlier discussions regarding the Maryland Mississippian was by Stose and Swartz (1912) who, in mapping the Hancock and Pawpaw quadrangles of Maryland and West Virginia, were able to recognize a five-fold subdivision of the Pocono Group in that area. Cook (1912) described the fauna from the Greenbrier Formation of western Maryland. A regional overview of the Greenbrier Formation of Maryland and West Virginia was given by Rittenhouse (1949). Study of the macrofloral assemblages of the Pocono Formation and equivalent Price Formation of Pennsylvania, Maryland, West Virginia, and Virginia was conducted by Read (1955). The distribution of paleocurrents and pebble diameters of Pocono sandstones was presented by Pelletier (1958). Amsden (1954), in his study of Garrett County, discussed the distribution of Mississippian units, and noted several of the better exposures of the area. Amsden disagreed with Martin's subdivisions of the Greenbrier Formation and believed that the Loyalhanna Limestone was the only traceable member of the formation. Haney (1963) briefly discussed the paleontology and lateral variations of several exposures of the Greenbrier Limestone of western Maryland and Pennsylvania. Hoque (1968), in his study of Mauch Chunk sandstones, examined several exposures from western Maryland. A detailed study of the paleocurrents, petrography, and provenance of the Loyalhanna Limestone of Maryland, Pennsylvania, and West Virginia was published by Adams (1970). Arkle et al. (1979) gave a very cursory discussion of the Mississippian of Maryland and West Virginia. More recently, Brezinski (1984), through an integration of previous studies and a reexamination of numerous exposures, developed a depositional synthesis for Upper Mississippian units of Pennsylvania, Maryland, and northern West Virginia. Beuthin (1986) studied the



Location and Physiography

lateral extent of a lower Pocono marine unit in Garrett County, Maryland and adjacent West Virginia and Pennsylvania. A detailed discussion regarding the stratigraphy and depositional environments of the Rockwell and Purslane Formations at Sideling Hill road cut was presented by Bjerstedt (1986), and Brezinski (1989).

Although the Mississippian System of both West Virginia and Maryland was intended to be discussed by Arkle et al. (1979), little was said about the Maryland part. A plethora of studies of the Mississippian of adjacent Pennsylvania and West Virginia has been conducted, but only several of the more important discussions will be noted here. A study of the Upper Devonian and Lower Mississippian of southwestern Pennsylvania was conducted by Laird (1942), and represents a useful discussion to which any study of the equivalent intervals in Maryland can be compared. The same might be said of Dalley's (1956) examination of the Pocono Group of West Virginia. A subsurface study of the Greenbrier Series of West Virginia by Flowers (1956) allows correlation of subdivisions of the unit in southern West Virginia with those in the northern part of the state. Kammer and Bjerstedt (1986) reviewed the nomenclatural history of the Pocono Group of West Virginia and proposed that it be replaced by the Price Formation. Bjerstedt (1987) described trace fossils present within the Rockwell and Price Formations of western Maryland, northern West Virginia, and Pennsylvania. Bjerstedt and Kammer (1988) examined the deltaic environments of deposition of the Price and Rockwell Formation of West Virginia and Maryland.

It should be apparent from the preceding discussion that the Mississippian stratigraphy of adjacent states is better understood than it is in Maryland. Consequently, it is the goal of the following discussion to correct this shortcoming in understanding the Mississippian stratigraphy of Maryland.

STRATIGRAPHY

GENERAL

Traditionally, the Mississippian System in Maryland has been subdivided into three formations: a lower unit termed the Pocono Formation (or Group), the middle unit the Greenbrier Formation, and the upper unit named the Mauch Chunk (Figure 2). All three names have been imported into Maryland from somewhat distant areas of adjacent states (Pocono and Mauch Chunk from northeastern Pennsylvania and Greenbrier from

southeastern West Virginia). Invariably, when stratigraphic terms are carried over large geographic areas, the character, diagnosis, and meaning, as defined in the type area, become overextended and confusion commonly results. This is exemplified by the usage of the term Pocono over much of Pennsylvania, Maryland, and West Virginia for the unit which is stratigraphically situated between the Hampshire (Catskill of Pennsylvania) red beds and the marine carbonates of the Greenbrier or Mauch Chunk red clastics. The "Pocono" of the rest of Pennsylvania, Maryland, and West Virginia bears little resemblance to the formation in the type area. For this reason, Kammer and Bjerstedt (1986) proposed the abandonment of the Pocono terminology in West Virginia. Likewise, recent reports by the Pennsylvania Geological Survey (Berg and Edmunds, 1979; Edmunds et al., 1979; Berg et al., 1986) have reserved use of the term Pocono Formation for northeastern Pennsylvania, and have elsewhere subdivided what was previously called Pocono into separate units. It is herein proposed that a similar scheme be utilized for Maryland, with the Rockwell and Purslane Formations superceding the name "Pocono Formation."

A somewhat similar problem surrounds use of the name "Greenbrier." This unit was named for Greenbrier County in southeastern West Virginia where the unit may attain a thickness of up to 1800 feet (Reger, 1926). In the type area the Greenbrier Group consists, in ascending order, of the Hillsdale, Denmar, Taggard, Pickaway, Union, and Alderson Formations. The Greenbrier Group thins rapidly to the north, primarily through the loss of sub-Union limestone units, so that in Randolph County in central West Virginia the group has a maximum thickness of 400 feet (Reger, 1931). This northward thinning continues into Maryland (Amsden, 1954), where the thickness of these strata ranges from 250 to 125 feet. In Pennsylvania, where thinning of individual limestone units continues, the term Greenbrier Formation is applied only in the southwestern portion of the state where red clastics, which elsewhere separate individual carbonate units, are absent and unconformity-bound limestone members are stacked atop one another. Elsewhere in the State, strata equivalent to the Greenbrier of West Virginia are termed the Mauch Chunk Formation, inasmuch as red clastics commonly comprise a greater proportion of the sequence than do carbonates. The only exception to this is in south-central Pennsylvania where the Loyahanna Limestone has maintained a formational rank.

As a consequence of northward thinning and facies changes, the Greenbrier Group of the type area bears little resemblance, aside from being a marine

Figure 1. — Physiographic location and distribution of rocks of Mississippian age at the surface (black) in Maryland. Numbers represent measured sections discussed in text and described in Appendix I.

system	stage	traditional western Maryland Mississippian nomenclature		nomenclature used in this report	
MISSISSIPPIAN	Chesterian	Mauch Chunk Formation		Reynolds Member	Mauch Chunk Formation
	Meramecian	Greenbrier Formation		Greenbrier Formation	Wymps Gap Member
					Savage Dam Member
					Deer Valley Member
	Osagean	Loyalhanna Member		Greenbrier Formation	Loyalhanna Member
	Kinderhookian	Pocono Formation		Purslane Formation	
DEVONIAN		Hampshire Formation		Rockwell Formation	Riddlesburg Member
					Finzel Marine Tongue
					Hampshire Formation

Figure 2. — Nomenclature of Mississippian units of Maryland used in this report compared to traditional Mississippian nomenclature of western Maryland.

carbonate, to the Greenbrier Formation of western Maryland. Indeed, correlation of individual carbonate units is difficult between central West Virginia and western Maryland. Consequently, one must question whether it is truly advisable or proper to apply the name Greenbrier to this sequence in western Maryland. In Pennsylvania, where marine units equivalent to the Greenbrier Formation of Maryland are assigned, based on the predominance of red coloration, as members of the Mauch Chunk Formation, a revised nomenclature hierarchy also seems desirable. One must then consider whether correlation problems and nomenclatural confusion would be better remedied by either: 1) erecting a new stratigraphic name for this interval, thereby redefining its limits (both geographically and stratigraphically), or 2) maintaining the current nomenclature

and attempting to better differentiate its limits and correlations. Insofar as reduction in rank from group to formation (or even member) is not a basis for the abandonment of a stratigraphic name (North American Stratigraphic Code, 1983, p.855), and because the term Greenbrier has become so entrenched in the scientific literature of the State, it seems more appropriate, at present, to maintain the current stratigraphic nomenclature. It is, therefore, necessary to delineate more clearly the limits, and correlations of each unit so that future confusion regarding these units can be minimized.

Nomenclature utilized in this report consists of the Rockwell, Purslane, Greenbrier, and Mauch Chunk Formations. The Pocono as used in previous reports is abandoned and subdivided into the Rockwell and

Purslane Formations. The Greenbrier and Mauch Chunk Formations maintain their meaning as used by earlier workers (e.g., Amsden, 1954); however, the facies relationships and subdivision into members of these units are outlined so as to reduce confusion (Figure 2).

HAMPSHIRE-ROCKWELL CONTACT

Traditionally, the base of the Mississippian in Maryland has been placed at the Pocono Formation-Hampshire Formation contact (Martin, 1902; Amsden, 1954; Flint, 1965). This has generally been the point, in the transition from the typical red bed sequence of the Hampshire to the predominately non-red Pocono, that the latter lithology becomes dominant over the former. The contact, although commonly sharp, as exhibited at the exposure at Finzel Road and U.S. Route 48 (locality 7) (Figure 3), generally lacks evidence to indicate that it is unconformable. In fact, at Keyzers Ridge (localities 11A, 11C) and La Vale (locality 5), relatively thin intervals of red beds occur stratigraphically above what is interpreted to be strata of the Rockwell Formation. This indicates that an intertonguing relationship exists

between these two formations. Figure 4 illustrates this relationship in a west to east cross section. Where such an intertonguing is present, the lower contact of the Rockwell is placed at the base of the lowest thick (usually greater than 10 feet) non-red interval. At Keyzers Ridge the base of this interval coincides with the sharp basal contact of a sandstone unit. The base of this sandstone does appear to be erosional in origin, so in this case the Rockwell-Hampshire contact may be considered unconformable. However, this basal sandstone is only a local deposit and it is highly unlikely that the disconformity at its base represents a hiatus of any significant duration.

ROCKWELL FORMATION

The basal Mississippian unit in Maryland, the Rockwell Formation, was named by Stose and Swartz (1912) for exposures along Rockwell Run as it cuts through Purslane Mountain in Morgan County, West Virginia. As originally described by Stose and Swartz, the Rockwell consists of approximately 500 feet of "coarse arkosic sandstones, fine conglomerates, and buff shales, with some dark shale containing thin coal



Figure 3.— Contact between the Hampshire Formation (Dh) and Rockwell Formation (MDr) along east-bound lanes of U.S. Route 48 at locality 7.

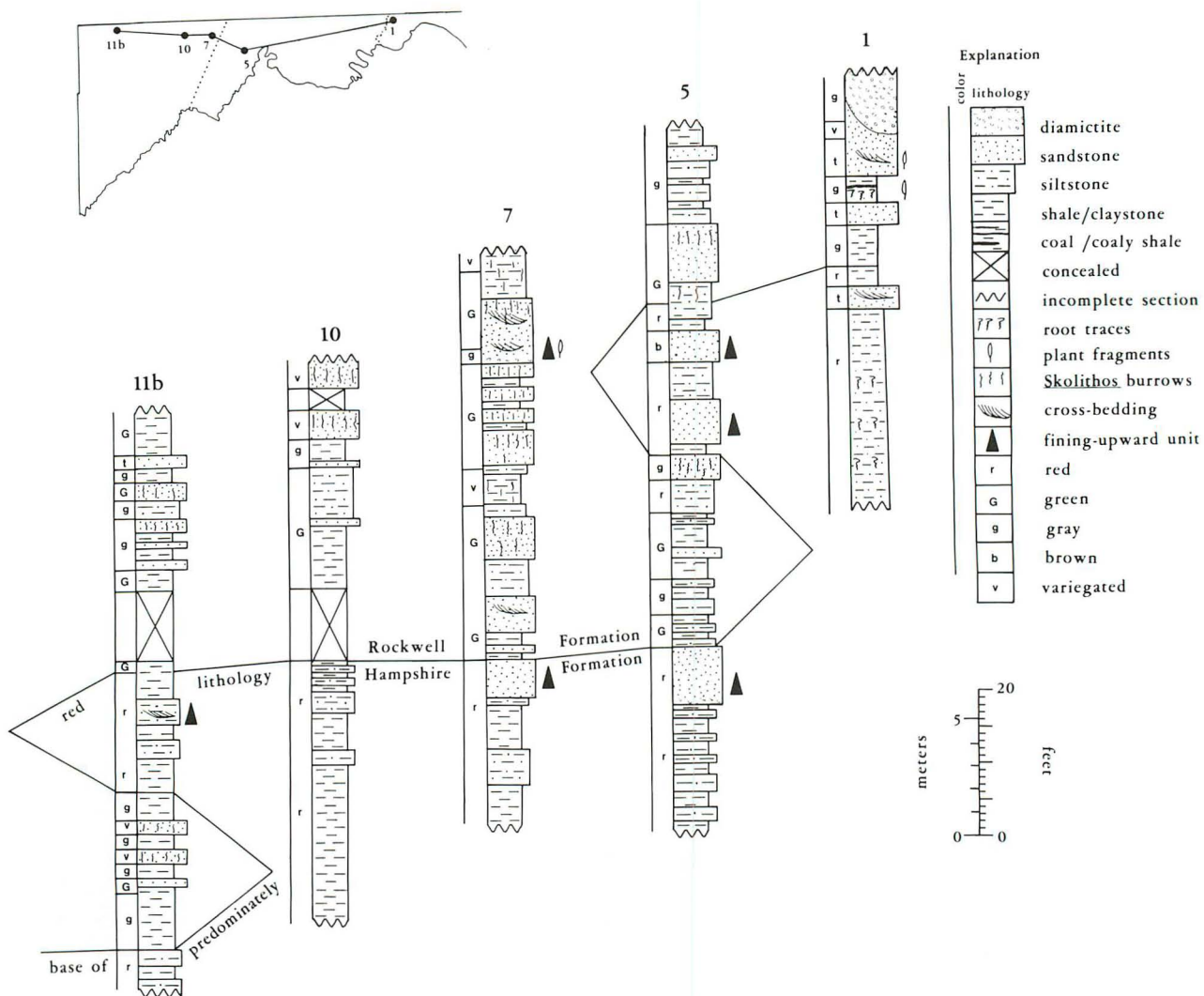


Figure 4.—Intertonguing relationships of transition zone between the Hampshire and Rockwell Formations as illustrated in a west (left) to east (right) cross section of select measured sections in western Maryland. Sections are correlated on the basis of the Riddlesburg Member which is not shown.

beds.” In their description, however, Stose and Swartz noted that this formation typically was not well exposed and that one of the best exposures was in Maryland at the southern end of Sideling Hill at the Potomac River. Remeasurement of the Rockwell strata at this exposure (locality 2) has shown that only about 160 feet of the Rockwell is exposed here, and that these beds comprise only about a third of the formation as currently recognized along U.S. Route 48 at Sideling Hill (locality 1). Study of this new Sideling Hill cut (Bjerstedt, 1986) has shown that the entire formation is exposed there, and that Stose and Swartz actually misrepresented the character of the formation in their original description. Firstly, the Rockwell sandstones have been shown by Bjerstedt (1986, fig. 4) to be sublitharenites and not

arkoses as originally described by Stose and Swartz. A second major difference is that most of the Rockwell comprises siltstone and shale with only subordinate amounts of sandstone, and these are typically not coarse or conglomeratic as proposed by Stose and Swartz. An interval of sandstone near the base of the formation, however, may prove to be an excellent local marker unit.

The lithology of the Rockwell changes markedly to the west in Maryland, so that exposures in the Appalachian Plateaus Province of Allegany and Garrett Counties bear only a superficial resemblance to that of the type area. For this reason it is necessary to discuss separately the character of the Rockwell strata in each area.

Rockwell Formation of the Eastern Outcrop Area

At the Sideling Hill road cut, the basal Rockwell lithology consists of 15 feet of interbedded, gray, locally coaly, claystone with thin beds (3 feet) of argillaceous, fine-grained sandstone. This basal lithology is overlain by approximately 70 feet of a medium-gray to red-brown, unsorted, unbedded, polymictic diamictite. Clast sizes vary from sand to cobbles greater than 6 inches in diameter, all of which are supported in a mud matrix. Composition of the pebbles and cobbles varies from pink granite to graywacke, hornfels, and shale (Figure 6B). Bjerstedt (1986) recognized up to 6 feet of local relief at the base of this diamictite, which suggests significant erosional scouring. This polymictic diamictite lithology is also present in a section along Scenic U.S. Route 40 to the west of Town Hill (locality 3), and at La Vale (locality 5), but varies considerably in thickness. Overlying the diamictite are 28 feet of medium- to fine-grained, well-sorted, herringbone

cross-bedded sandstone (Figure 6A). What is interpreted to be this same sandstone unit is apparently present at the south end of Sideling Hill (locality 2), along Scenic U.S. 40 on Town Hill along Merten's Avenue in Green Ridge State Park (locality 4), and at La Vale (locality 5). If this, indeed, represents the same sandstone unit at all localities, it presents a means by which local correlation and geologic mapping can be facilitated. This sandstone interval fines upsection into 130 feet of dark-gray siltstone and shale containing coal beds near the top and bottom of the interval and marine fossils near the middle. This siltstone and shale interval can probably be correlated with the Riddlesburg Shale, a widespread marker unit of central Pennsylvania. The homotaxial sequence of the herringbone cross-bedded sandstone immediately overlain by the Riddlesburg marine facies suggests that this may represent a significant genetic relationship which may aid in correlation. Consequently, wherever the herringbone cross-bedded sandstone is observed, it may be considered to represent

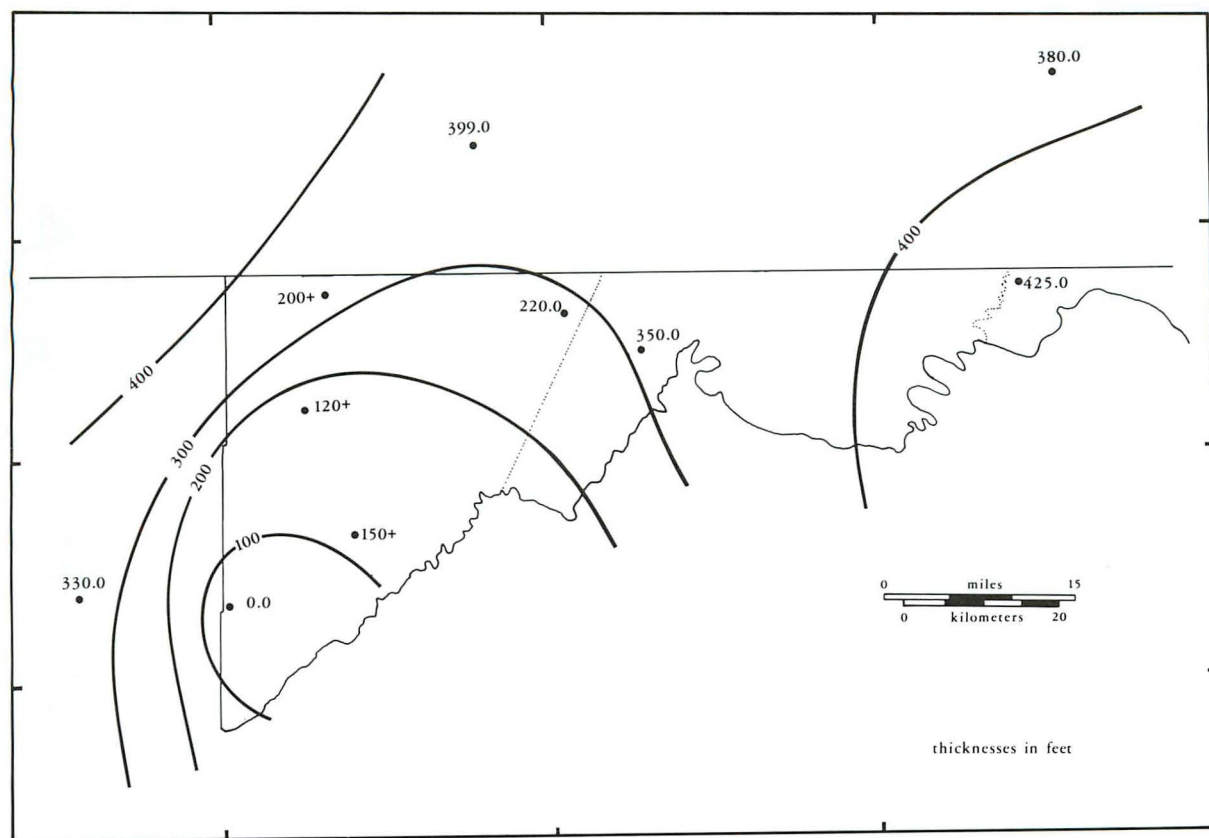
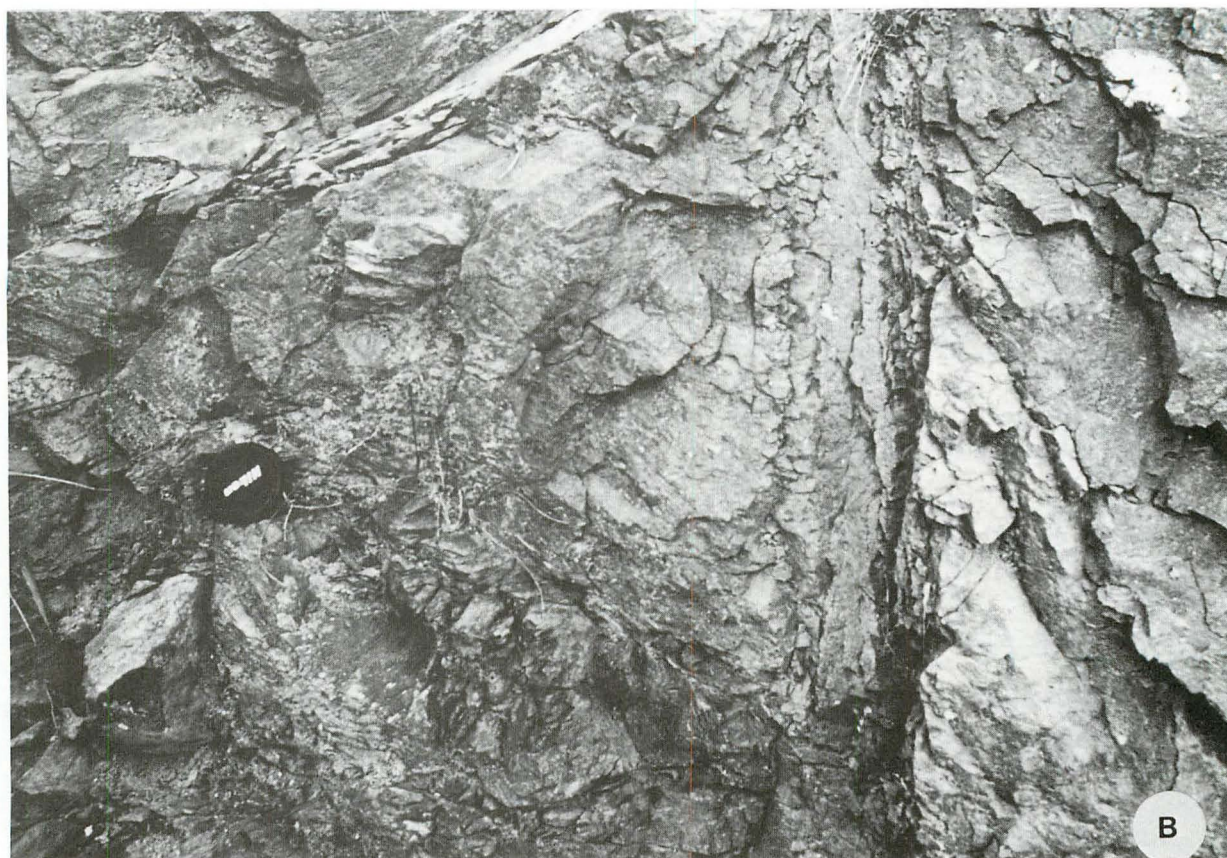
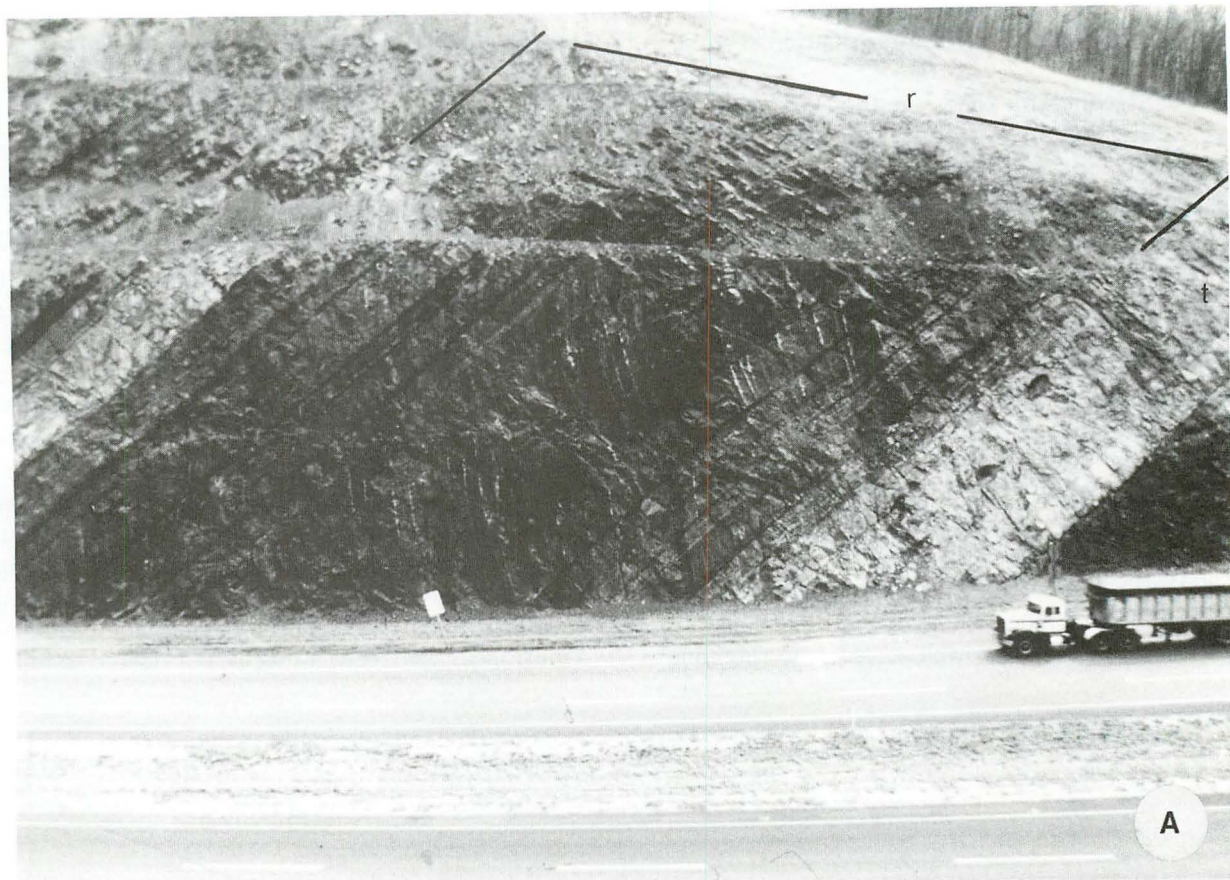


Figure 5.—Generalized isopach map of the Rockwell Formation of western Maryland and adjacent Pennsylvania and West Virginia.



the initial stages of the Riddlesburg transgression, and therefore can be correlated even in the absence of the actual Riddlesburg Shale. Although the Riddlesburg Shale is best exposed at the Sideling Hill road cut, it can also be observed at several other localities in Maryland. It is exposed quite well in borrow pits at the southern end of Sideling Hill, along Scenic U.S. 40 on Town Hill, on Town Hill in Green Ridge State Forest, and along the railroad tracks at Altamont (locality 21). The fauna found at these localities are similar, but are much lower in diversity when compared to the fauna present in the Riddlesburg Shale in the type area (Girty, 1928).

Upsection from the Riddlesburg marine facies, strata of the Rockwell become much lighter in color and consist of interbedded claystones, siltstones, and relatively thin sandstone units. Within this interval claystone and siltstone strata range in color from light-gray-green to red-brown or variegated (predominately red brown near the top of the interval), and contain zones of anastomosing root casts. Very thin carbonaceous beds are locally present. Individual sandstone units ranging in thickness from 2 to 15 feet exhibit sharp, possibly erosional, bases, basal shale-pebble or quartz-pebble conglomerates, and invariably fine upward.

Bjerstedt (1986) placed the upper contact of the Rockwell Formation at the top of what he termed the Patton Shale Member. Although this red mudstone interval, which is approximately 60 feet thick at the Sideling Hill road cut, is present at nearly the same interval in its type area in central Pennsylvania (Campbell, 1904; Butts, 1905), it was not observed in any other outcrop of the Rockwell in Maryland. Campbell (1904) noted that the Patton Shale was commonly absent, yet where it could be found it represented a significant marker horizon. Inasmuch as the Rockwell-Purslane contact was never clearly defined by Stose and Swartz, and that a contact based on a lithology so irregularly present as the Patton red shale (e.g., Bjerstedt, 1986) is impractical, it seems appropriate and germane to the present discussion that a more precise definition of this contact be proposed. Stose and Swartz originally characterized the Purslane Sandstone as "heavy-bedded, coarse, white sandstone with bands of quartz conglomerate and some soft beds containing locally thin coal seams and a little red shale between the harder sandstones." Based on this characterization, one would assign to the Purslane any thick, white, coarse-grained sandstone unit separated from similar strata by either shaly intervals containing coal beds or red shale. At Sideling Hill road cut, the unit believed to be the Patton

Shale by Bjerstedt is present stratigraphically between two thick sandstone units of 87 and 62 feet in thickness. Consequently, one might interpret the inferred Patton Shale to be a subunit of the Purslane Sandstone rather than part of the Rockwell Formation, if the base of the Purslane is placed at the base of the lowest major (typically greater than 30 feet in thickness) sandstone unit. Utilizing this interpretation, the original description is maintained, and yet a more precisely refined definition of the Rockwell-Purslane contact is accomplished. Under this redefinition, the top of the Rockwell Formation (i.e., base of the Purslane Formation) at the Sideling Hill road cut is placed at the base of the 87-foot-thick sandstone that forms the axis of the syncline at highway level (unit 10 of Bjerstedt, 1986) (Figure 7). This viewpoint is more useful than that proposed by Bjerstedt, since it provides greater ease in recognition for field mapping.

Rockwell Formation of the Western Outcrop Area

In western Allegany and Garrett Counties, the Rockwell exhibits a change in character from that of the Sideling Hill-Town Hill area. The Riddlesburg Member, a diagnostic marker interval at Sideling and Town Hills, is no longer characterized by a dark-gray siltstone or shale, but instead at Keyzers Ridge (localities 11A, 11B) is manifested as a pebbly, cross-bedded sandstone containing brachiopods and bivalves. The presence of a herringbone cross-bedded sandstone, overlying the polymictic diamictite at La Vale suggests that the Riddlesburg transgression did not reach full marine conditions at this locality. At Finzel Road (locality 7) the Riddlesburg interval is represented by a white, cross-bedded, fossiliferous sandstone which caps the exposure.

Finzel Marine Tongue

West of La Vale, the thickness of the Rockwell strata underlying the Riddlesburg Member increases to as much as 200 feet (such as at Keyzers Ridge). In western Garrett County this sub-Riddlesburg interval contains deposits of at least one and perhaps two additional marine units. The lowest, and most easily recognized, of these marine units is well displayed at the Finzel Road outcrop (locality 7). At this exposure the basal Rockwell is comprised of 70 feet of interbedded gray-green, sandy, bioturbated, siltstones and shales and light-green, gray to variegated, argillaceous sandstones containing *Skolithos* burrows. Lingulid brachio-

Figure 6. — A, Riddlesburg Shale Member (r) of the Rockwell Formation at Sideling Hill road cut. Diamictite interval located directly over truck's trailer. White unit above truck's cab is cross-bedded marine sandstone. B, Diamictite from Sideling Hill road cut. Note scattered cobbles (such as above lense cap).

pods and molds of indeterminate bivalves are locally present. Dennison et al. (1986) termed this marine unit the Finzel Tongue. Further to the west, at the Piney Grove section (locality 10) *Skolithos*-bearing sandstones 2 to 6 feet thick are interbedded with shaly intervals con-

taining root zones and thin coal beds. The marine lithologies at the bottom of the Rockwell Formation become more poorly developed and thinner to the east, so that at La Vale only about 40 feet of the lower Rockwell can be attributed to this marine episode, and

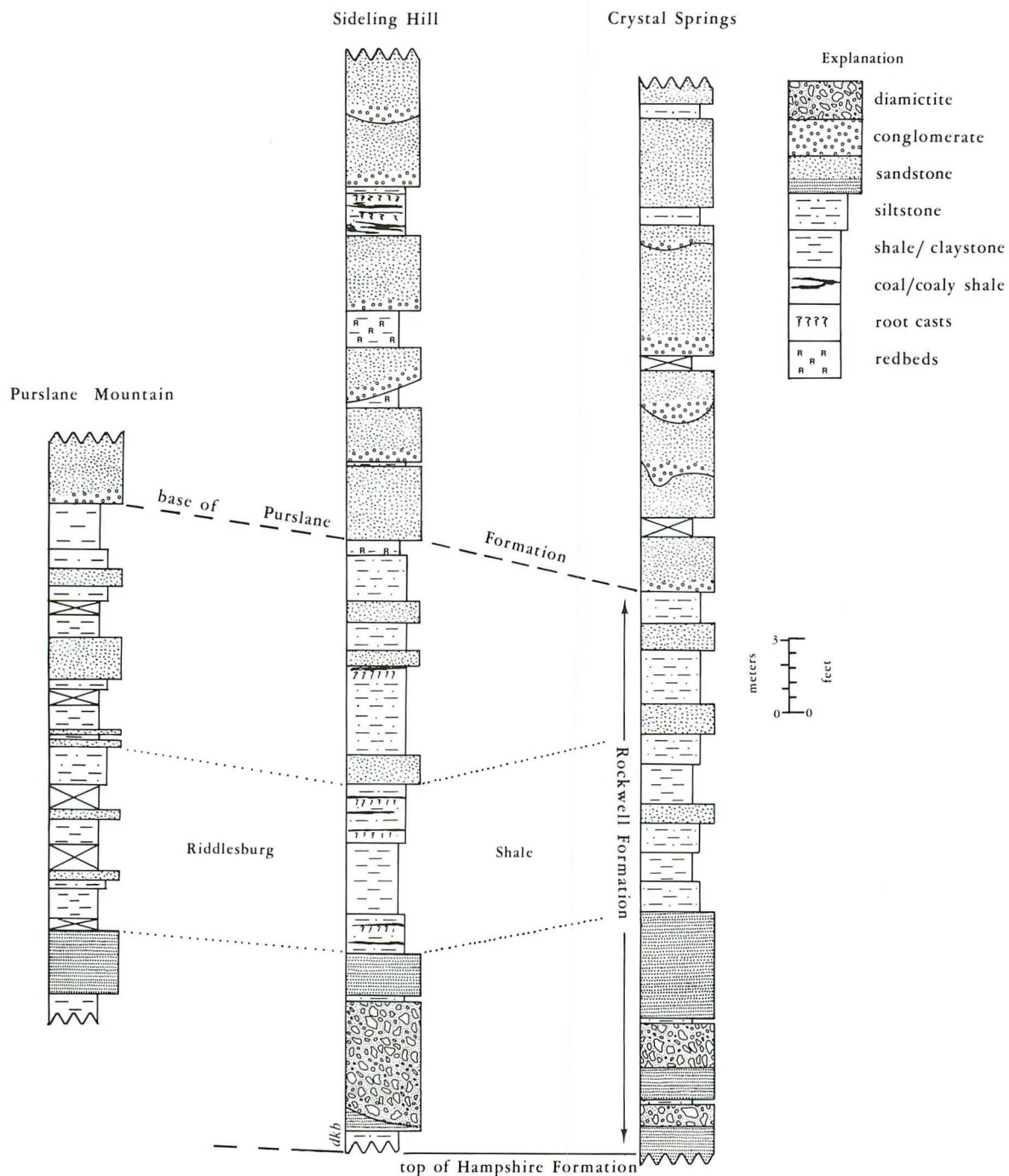


Figure 7.— Correlation of Rockwell and Purslane lithologies in a north-south cross section from the type area to Sideling Hill, Maryland to Crystal Spring, Pennsylvania (taken from Brezinski, 1989, figure 4).

even this is interspersed with variably thick nonmarine intervals. East of La Vale this marine unit can no longer be recognized. However, in southern Garrett County at Altamont (locality 21), 72 feet of the "Finzel Tongue" is well exposed.

Kammer and Bjerstedt (1986) and Bjerstedt (1987) correlated the Finzel Marine Tongue with the Oswayo Formation of northwestern Pennsylvania. Based upon preliminary spore studies of locality 10, this correlation appears to be correct.

The marine lithologies associated with the Finzel Tongue grade upsection into gray-green siltstones and sandstones of fluvial origin. In the Finzel section this interval consists of interbedded, tan to red-brown claystones and tan to gray-green lenticular sandstones exhibiting erosional bases and shale-pebble basal conglomerates.

At Keyzers Ridge and Piney Grove (localities 10 and 11) a thin marine facies, less than 20 feet thick, is present within a part of the nonmarine strata that overlie the Finzel Marine Tongue. This marine facies is characterized by interbedded, gray to gray-green silty shales and gray-green argillaceous fine-grained *Skolithos*-bearing sandstones. Through the examination of cuttings from gas wells from the Accident Anticline in Garrett County, Maryland and Fayette County, Pennsylvania, Dennison et al. (1986) recognized this marine unit, and equated it with the Bedford transgression of Ohio. Based on current information there is no way to determine whether this marine facies indeed represents an eastward extension of the Bedford transgression or simply a digitation of the Finzel Marine Tongue. Strata coeval to this marine facies to the east and overlying it at Keyzers Ridge and Piney Grove consist of interbedded gray to green-gray siltstones and shales and thin (less than 10 feet thick) tan-weathering, lenticular sandstones of nonmarine origin.

Riddlesburg Member

Overlying this nonmarine part of the section are deposits that indicate another marine incursion inundated the area. At Keyzers Ridge (locality 11A) this unit is characterized by two marine sandstones, both underlain by shaly intervals containing either coaly beds or root zones. The lower and thinner of these two sandstones is 3 to 4 feet thick, contains *Skolithos* burrows, and is underlain by a thin black shale containing a 4-inch coal bed. The sandstone grades upsection into 10 feet of green-gray silty shale which is in turn overlain by a second, thicker, conglomeratic sandstone. This sandstone is up to 15 feet thick and has yielded abundant molds and casts of the brachiopods *Verkhotomia* and *Schucertella*, as well as indeterminate bivalves (Appendix II, Plate 1, Figures J, K). The top of the Finzel section is composed of more than 15 feet of flaggy,

medium-grained sandstone containing abundant ichnofossils and molds of bivalves and brachiopods. This sandstone is interpreted to represent the Riddlesburg marine episode. At Altamont, what is probably this same marine unit consists of 38 feet of gray to black shale containing orbiculoid brachiopods and bivalves. This shale is similar in overall appearance and faunal constituents to the Riddlesburg Shale at Sideling Hill. At Piney Grove, interbedded green-gray siltstones and shales and *Skolithos*-bearing sandstones are present at the approximate stratigraphic position of the Altamont shale and the Keyzers Ridge fossiliferous sandstones. The La Vale section contains, at this stratigraphic interval, a 90-foot-thick sandstone and diamictite unit which has been correlated with the diamictite unit at Sideling Hill (Bjerstedt, 1986, fig. 5). Overlying the La Vale diamictite are 30 feet of well-sorted, tabular cross-bedded, medium-grained sandstone similar to that found overlying the diamictite at Sideling Hill. Although no fossils were recovered from this sandstone, the sorting, tabular cross-bedding, and similarity to the herringbone cross-bedded sandstones in the Sideling Hill area suggest it is of marine origin. Consequently, it appears that the Riddlesburg Member of the Rockwell Formation is a widespread and easily recognized unit, and can be utilized as a means of correlation in the study of Rockwell and equivalent strata of western Maryland and adjacent areas (Figure 8).

The character of the Rockwell strata overlying the Riddlesburg Member is similar in Garrett County to the coeval sequence at Sideling Hill. This part of the Rockwell is characterized by interbedded red-brown, root-mottled siltstones and claystones, and relatively thin, tan to red-brown lenticular sandstones. The top of the Rockwell Formation, as discussed for the Sideling Hill area, is placed at the base of the lowest thick (> 20 feet) cross-bedded sandstone of the overlying Purslane Formation (Figure 9A).

DEVONIAN-MISSISSIPPIAN CONTACT

Kammer and Bjerstedt (1986) and Bjerstedt (1986) placed the base of the Mississippian in West Virginia and Maryland at what they interpreted to be a regionally developed unconformity equivalent to the interval of the Berea Sandstone of Ohio. This unconformity is present at the base of the Riddlesburg Member of the Rockwell Formation at Sideling Hill, Town Hill, and La Vale. At these locations the Riddlesburg Member consists of interbedded diamictite intervals and cross-bedded, light-gray sandstones. The environments of deposition for these lithologies appear to be shallow marine or shoreline environments. These areas were quite likely highly erosive in nature. As a result one would expect to find unconformable contacts at the base of such units. Where these lithologies are not pres-

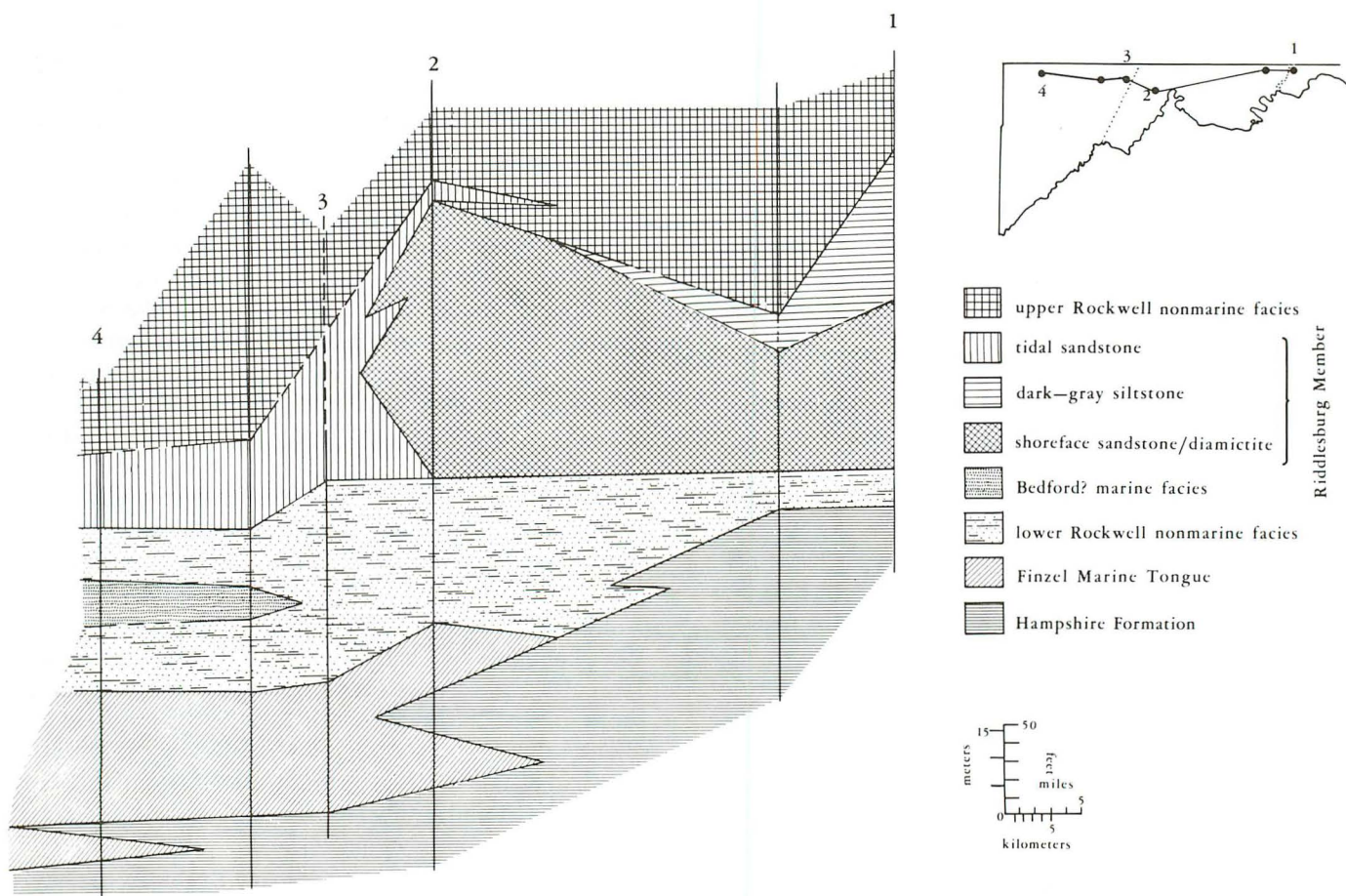


Figure 8.—Lateral lithofacies relationships within the lower Rockwell Formation of western Maryland.

ent at the base of the Riddlesburg Member, no evidence of an unconformable relationship exists. At Altamont and Keyzers Ridge (localities 11 and 21), the Riddlesburg Member grades into the underlying Rockwell strata, indicating that no unconformity is present. Consequently, it appears that the Devonian-Mississippian contact is conformable throughout much of Maryland, and that Berea equivalents are present, even though they may be represented by more terrestrial deposits. The Devonian-Mississippian contact can be placed at the top of the Finzel Marine Tongue. At Sideling Hill, since the diamictite and the Riddlesburg Member occur very near the bottom of the Rockwell, the Devonian-Mississippian boundary can be placed at the Hampshire-Rockwell contact.

Paleontology. The Finzel Marine Tongue contains only a very sparse invertebrate fauna of *Macroptamorhynchus?* and lingulid brachiopods, but abounds in trace fossils. Bjerstedt (1987) has shown that this marine interval contains a diverse shallow marine trace-fossil assemblage. Near Pleasant Union (locality 31) a moldic fauna of chonetid brachiopods and nuculid

bivalves was recovered. The Riddlesburg Member, on the other hand, has yielded an invertebrate fauna of low diversity, but relatively high in abundance. From Sideling Hill the following fauna was recovered (see Appendix I plate 1).

brachiopods

Rhipidomella? sp.

Lingulidiscina sp.

Rugosochonetes sp.

bivalves

Phestia sp.

Edmondia? sp.

A somewhat less diverse, but more abundant fauna given below was recovered from the upper of the two sandstone units at Keyzers Ridge (locality 11A).

Verkhotomia sp.

Schucertella sp.

unidentified plant fragments

From the Sideling Hill road cut, poorly preserved specimens of *Adiantites* were recovered from the coaly intervals above and below the Riddlesburg marine strata.

Age and Correlation. Inasmuch as biostratigraphic analysis of the Rockwell Formation is lacking, determination of the age and correlation of the formation must, at present, be based on lithostratigraphy alone. Although Read (1955) was able to discern two distinct floras within the Pocono, his work did little to aid in our understanding of the age and equivalence of the Rockwell or Purslane.

Dennison et al. (1986) have shown, on the basis of lithostratigraphic correlation, that as many as three marine episodes punctuate the Rockwell of Garrett County. According to Dennison et al. (1986) and Beuthin (1986), the Finzel Marine Tongue was deposited in response to a marine transgression correlative with the Cleveland transgression (Late Devonian, Famennian) of Ohio and the Oswayo Formation of Pennsylvania. Above the Finzel Marine Tongue, a very localized marine unit, which is recognized only at Piney Grove and Keyzers Ridge, was equated by Dennison et al. (1986) to the Bedford transgression of Ohio. They correlated the Riddlesburg Member with the Sunbury (Lower Mississippian, Kinderhookian) transgression of Ohio. This would then indicate that a part of the lower Rockwell in westernmost Maryland is Devonian in age, and that the Rockwell Formation straddles the Devonian-Mississippian boundary.

The intertonguing relationship of the Rockwell-Hampshire contact, the eastward pinchout of the Finzel Marine Tongue, and apparent upsection migration of the contact from west to east (Figure 4) indicate that the Hampshire-Rockwell transition is time-transgressive.

Estimating the age of the upper limit of the Rockwell is somewhat more tenuous. Scheckler (1986) proposed that the floral genus *Adiantites*, which characterizes much of the Rockwell of Pennsylvania, is restricted to the Kinderhookian, and that *Triphyllopteris*, which characterizes the Burgoon Sandstone (formerly upper Pocono of Read, 1955) of Pennsylvania, is probably Osagean. Correlation of the Riddlesburg Member of the Rockwell with the early Kinderhookian Sunbury of Ohio, in conjunction with the proposal of Scheckler (1986) that *Adiantites* is characteristically Kinderhookian, would suggest that upper strata of the Rockwell Formation of western Maryland are middle to late Kinderhookian in age.

PURSLANE FORMATION

Overlying the Rockwell Formation is a variably thick formation composed of highly cross-bedded, medium to coarse-grained sandstones, conglomeratic sandstones, and conglomerates with intervals of red, green and gray siltstone and shale. Stose and Swartz (1912) named this unit the Purslane Formation for exposures on Purslane Mountain, an extension of Sideling Hill south of the Potomac River in Morgan County,

West Virginia. In the area of Sideling Hill, Stose and Swartz noted that the Purslane is composed of three ledge-making sandstones with softer beds between. The character of the Rockwell-Purslane contact is not addressed by Stose and Swartz; therefore, its placement requires definition. Bjerstedt (1986) placed the contact at the top of a red claystone interval that he equated to the Patton Shale of Pennsylvania. However, the irregular presence and recessive character of the Patton Shale in Maryland argues against its being used for demarcating the Rockwell-Purslane contact. For this reason and for reasons discussed previously under the section on the Rockwell Formation (p. 14), the contact is placed at the base of the lowest thick sandstone (> 30 feet) interval (Figure 9). The expedience of this contact should facilitate its recognition for both stratigraphic and field mapping studies. Placement at this position, however, does increase the thickness of the Purslane in the vicinity of Sideling Hill from approximately 130 feet, as recognized by Stose and Swartz, to well over 300 feet. The character of the contact at the base of a channel-phase sandstone, by its very nature, is disconformable. Consequently, the definition of the Purslane Formation, as utilized in the report, is much broader, yet it is hoped that it is clearer than the original designation.

At the Sideling Hill road cut (locality 1), the Purslane is composed of 3 main sandstone units, all greater than 50 feet in thickness with intervening sequences of red claystone and black to dark-gray carbonaceous shale and siltstone (Figure 9B). The stratigraphically lowest sandstone unit ranges from 85 to 145 feet in thickness and consists of green-gray to tan, cross-bedded, medium- to coarse-grained sandstone. The base of this sandstone, which marks the bottom of the Purslane Formation, is disconformable with the underlying red claystones. Near the base of the sandstone unit, several beds of quartz and shale-pebble conglomerate containing coal spars are present. An overall fining-upward of this sandstone can be recognized.

Overlying the thick basal sandstone is an interval of red claystone 60 to 110 feet thick and containing a 23-foot-thick cross-bedded medium- to coarse-grained sandstone near the middle. The lower claystone part of this interval pinches out laterally, so that on the south side of the road cut the 23-foot-thick sandstone merges with the underlying sandstone unit to form a sandstone package up to 150 feet thick. The red claystone interval is correlated with the Patton Shale of Pennsylvania by Bjerstedt (1986).

This red claystone unit is overlain by 62 feet of trough cross-bedded, white, coarse-grained to conglomeratic sandstone. The lowest 30 feet contains numerous beds of conglomerate composed of milky quartz, shale pebbles, and coal spars. The lower contact of the sandstone is erosional. The coarse-grained to conglomeratic basal interval fines upsection into a medium-

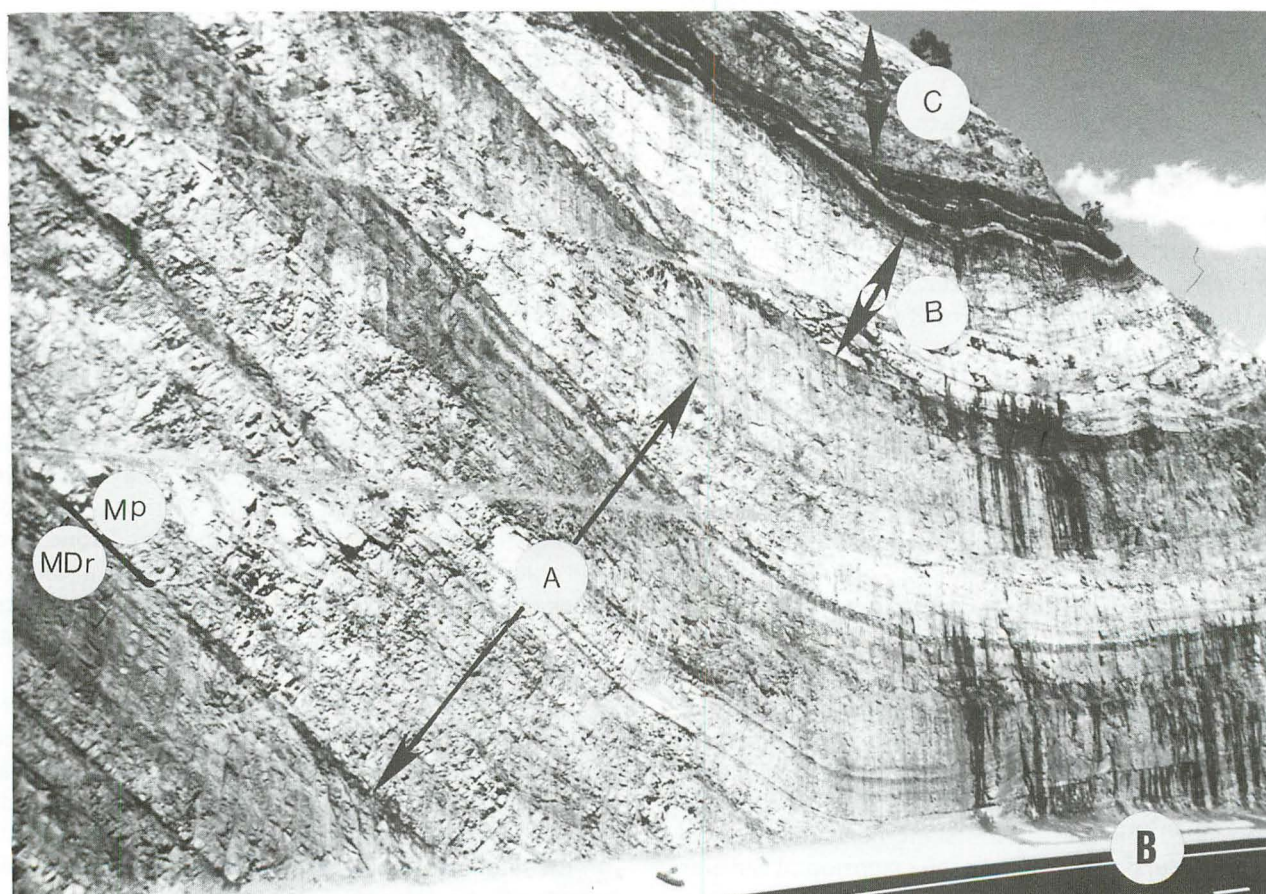


Figure 9.—A, upper Rockwell and lower Purslane strata at Sideling Hill road cut. Note the sharp lithologic change between the Rockwell fine-grained strata and light-colored sandstones of the Purslane Formation. Contact located at Mp; r = Riddlesburg Member of the Rockwell Formation; ur = upper Rockwell. B, Sandstone units of the Purslane Formation at Sideling Hill road cut (locality 1). The Rockwell-Purslane contact is located at the lower left of the photograph (Mp). Three sandstone units are marked by arrows A, B, and C.

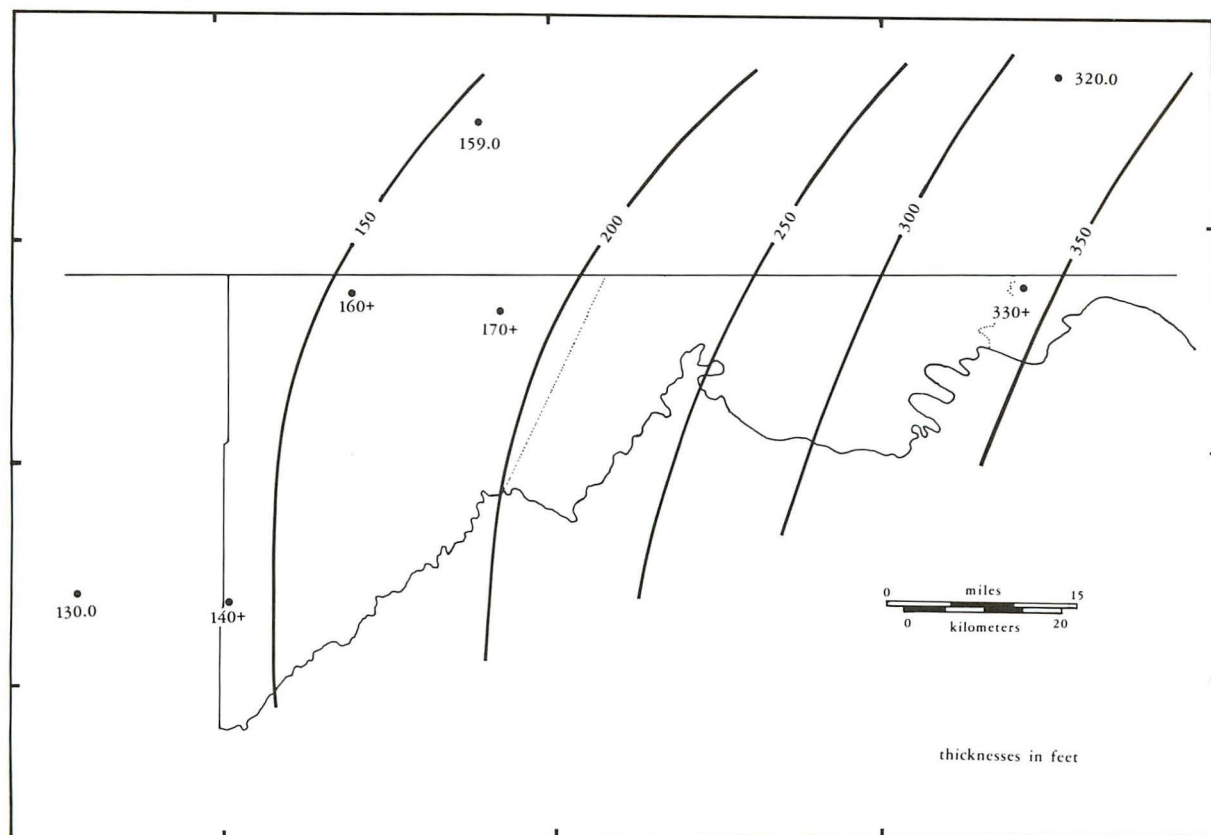


Figure 10.—Generalized isopach map of the Purslane Formation in western Maryland and adjacent Pennsylvania and West Virginia.

grained sandstone at the top. The sandstone is overlain by a sequence, 34 feet thick, composed of interbedded carbonaceous siltstone and shale, and medium-gray, fine-grained sandstone and siltstone. Sandstone beds range in thickness from 4 inches to 3 feet. Thin (less than 4 inches) coal beds are interspersed within the carbonaceous strata. Beneath such coals bedding is disrupted, suggesting that rooting has distorted the original stratification. Large nodules of pyrite (up to 4 inches in diameter) are common throughout the carbonaceous sequence.

The same shaly sequence is exposed and accessible at the crest of Sideling Hill along Scenic U.S. 40. At this locality only one coal bed, approximately 4 inches thick, was observed. Consequently, coal beds within this interval are quite localized and laterally discontinuous.

Overlying the carbonaceous interval is the uppermost sandstone of the Purslane Formation. The upper

sandstone is approximately 85 feet thick and comprised of tan to white, trough cross-bedded, medium- to coarse-grained sandstone. Intervals containing quartz and shale-pebble conglomerates and coal spars are common throughout. The base of the sandstone, like those of the sandstones lower in the formation, is erosional, and shale clasts of the underlying sequence are incorporated in the basal beds.

The upper contact of the Purslane Formation is not exposed at Sideling Hill, but to the north in central Pennsylvania equivalent Burgoon Sandstones are believed to be conformable with the overlying Mauch Chunk Formation. Moreover, within the Meadow Branch Syncline approximately 11 miles to the southeast in West Virginia, the Hedges Shale is known to overlie the Purslane Formation (Stose and Swartz, 1912). Consequently, it is assumed that in Maryland the upper limits of the Purslane and a considerable thickness of

suprajacent Carboniferous strata have been removed by erosion.

Characteristic Purslane lithologies are not well exposed on Town Hill, and are only present near the Potomac River at the southern end of the ridge. In Garrett and western Allegany Counties, the Purslane is much thinner than at Sideling Hill and not nearly as well exposed (Figure 10). At La Vale, approximately 100 feet of interbedded red-brown to medium-gray, cross-bedded sandstone and green-gray to red-brown mudstone, shale, and siltstones that are present near the top of the exposure is herein considered to be equivalent to the Purslane Formation of Sideling Hill. The red sandstone at this interval is traceable along the Allegheny Front and serves as an excellent marker unit for mapping purposes. The red coloration to the sandstone differs from the character of the sandstones in the type area. However, intertonguing of the red sandstone with green-gray, coarse-grained conglomeratic sandstones present in this part of the section allow correlation with the thicker, lighter colored sandstones of Sideling Hill. Similar red sandstones occur within the upper 160 feet of the Piney Grove section (locality 10). The alternation of red and green-gray along some of the cross-bedding foresets at this outcrop suggests that the coloration is diagenetic, rather than syndepositional, in origin. Also, within the Piney Grove section thin coaly shales and coals are present within the shaly intervals between the thicker sandstone units.

Along Little Savage Mountain south of U.S. Route 48, strata interpreted as belonging to the Purslane consist of tan, medium-grained, cross-bedded, flaggy sandstone. This sandstone interval can be observed in numerous small quarries along the crest of Little Savage Mountain where it is removed for use as a dimension stone.

Over 60 feet of the Purslane Formation is exposed at the U.S. 48 and U.S. 219 interchange at Keyzers Ridge (locality 11A). At this exposure, the Purslane consists of a basal medium- to coarse-grained, tan sandstone which grades upsection into a white, flaggy, medium-grained sandstone, and is capped by 15 feet of red-brown, argillaceous, medium-grained sandstone. Thin shaly intervals, which are characteristic of the Purslane elsewhere in western Maryland, are notably absent at this exposure.

Along Bear Creek Road (locality 12), approximately 130 feet of the Purslane is exposed, consisting predominately of tan, cross-bedded to flaggy, medium-grained sandstone. The lower part consists of 30 feet of cross-bedded quartz-pebble conglomerate. A similar lithology can be observed along the east side of U.S. 219 immediately south of Thayerville and Deep Creek Lake.

No thickness measurements were taken along this discontinuous section because of the poorness of exposure. The same unit may be observed at the east end of the Glendale bridge across Deep Creek Lake.

A variant lithology of the Purslane occurs in an abandoned quarry along Silver Knob Road (locality 23). At the quarry approximately 100 feet of poorly indurated, white, highly cross-bedded, quartz-pebble conglomerate is exposed (Figure 11). The well-rounded pebbles of milky quartz that comprise this rock range in size from 0.25 to 3.5 inches in diameter (Figure 11). The base of the conglomerate interval is approximately 20 feet above the top of the Hampshire Formation and is overlain by a white, medium- to coarse-grained sandstone. Judging from the location of this sandstone section on the dip-slope of the ridge it appears to be very near the top of the Purslane Formation. Consequently, the Rockwell Formation is absent in the area around and immediately south of Oakland. The Purslane Formation makes up the entire interval between the Hampshire and Greenbrier Formations. For this region it appears as though a considerable hiatus exists between the Hampshire and Purslane Formations.

Paleontology. The Purslane contains only floral assemblages and no marine invertebrate fossils. Read (1955) listed a large variety of plants including:

Triphyllopteris alleghanensis
Triphyllopteris latilobata
Triphyllopteris lescuriana
Triphyllopteris virginiana
Triphyllopteris rarinervis
Tryphyllopteris biloba
Lepidodendropsis scobiniformis
Lepidodendropsis sigillariodes
Lepidodendropsis vandergrachtii
Cardiopteris antecedens
Cardiopteris irregularis
Rhodea blacksburgensis
Rhodea vespertina

Several of these species have been collected from the carbonaceous interval of the Purslane at the Sideling Hill road cut. Numerous unidentified plant fragments have also been collected from the dark-gray coaly strata at Finzel Road and Piney Grove.

Age and Correlation. Inasmuch as no marine units or marine fossils have been recognized within the Purslane Formation, any age determination must be largely based on floral biostratigraphy. Read (1955) has shown that the Purslane Formation (i.e., upper Pocono) contains a *Triphyllopteris* flora. Read and Mamay (1964) and Scheckler (1986) proposed that the Carbonif-

Figure 11. — A, Unusual exposure of friable Purslane conglomerate in quarry located along Silver Knob Road, southeast of Oakland (locality 23). B, Close-up of pebbly conglomerate of the Purslane at above quarry.



erous floral zone 2 (flora containing *Triphyllopteris*) was restricted to the upper Pocono (Burgoon Sandstone of Pennsylvania) and was representative of an Osagean and Meramecian age.

Based on its stratigraphic position and the lower boundary as defined herein, the Purslane Formation of Maryland is a lateral equivalent to the uppermost Rockwell and Burgoon Formations of central Pennsylvania and the upper Price Formation of south-central West Virginia (Scheckler, 1986). Although an argument may be made, based on overall similarity and priority, to consider the Purslane equivalent to the Burgoon, sufficient dissimilarity exists to maintain the Purslane as a separate and distinct formation. The Burgoon of the type area consists of a nearly continuous sequence of cross-bedded, tan sandstone that overlies the Rockwell Formation in south-central Pennsylvania and the Huntley Mountain Formation in the north-central part of the state. In contrast, the Purslane is characterized by thin, but recognizable intervals of red, gray-green, to gray shales and siltstones and locally dark-gray carbonaceous shales separating distinct units of sandstone and conglomerate.

SUB-GREENBRIER UNCONFORMITY

Martin (1902) considered the contact between the Pocono and Greenbrier Formations to be gradational. However, Amsden (1954) contended that it was sharp and unconformable. Subsequently, the contact between the Purslane (i.e., upper Pocono) and the overlying Greenbrier Formation has generally been considered unconformable in Maryland (Adams, 1970). In south-western Pennsylvania (Berg et al., 1986) the contact between the Burgoon Sandstone and Loyalhanna Limestone is thought to be partly disconformable; elsewhere it appears to be conformable (Berg written communication, 1989). In the Broad Top area, the contact between the Burgoon Sandstone and Trough Creek Limestone appears to be conformable. The actual surface was observed at only one locality in western Maryland (locality 12); however, the interval near the contact is exposed at numerous localities. At locality 12 the contact surface is very sharp, although no erosional relief is apparent. No clasts of the underlying Purslane were observed incorporated within the basal Greenbrier unit, the Loyalhanna. However, at two localities (8, 15) somewhat unusual lithologies separate the two units. At locality 8 approximately 6 feet of very pure micritic limestone separates the brown medium-grained, micaceous sandstone of the Purslane and the sandy-lime grainstones of the Loyalhanna. Additionally, the basal lithology exposed in the Savage and Bishoff Quarries (localities 14 and 15) is brown sandstone of the

Purslane. The sandstone forms a broad undulating surface overlain by 4 feet of red siltstone identical to the typical Mauch Chunk Formation (Figure 12A).

The presence of these intervening lithologies argues for an unconformable relationship between the Purslane and the Greenbrier Formations. These anomalous lithologies suggest that prior to Loyalhanna deposition there was an episode of deposition. Throughout most of Maryland the material was eroded prior to or during the deposition of the Loyalhanna Limestone. Moreover, the change in depositional mode from the alluvial-plain sandstones of the Purslane to shallow-marine limestones of the lower Greenbrier intimates, at the very least, that a short depositional hiatus exists between the two formations.

In West Virginia, a northward pinchout of the sub-Greenbrier Maccrady Formation and several of the lower Greenbrier units (Hillsdale through Pickaway Formations) (Yeilding and Dennison, 1986) indicates increased duration of nondeposition in a northerly direction. The absence of these units in northern West Virginia and western Maryland suggests that a considerable hiatus is present between the Price (or Purslane) and Greenbrier Formations. Scheckler (1986, fig. 3) believed that the Purslane is Osagean in age. Furthermore, the basal Greenbrier unit, the Loyalhanna, is generally correlated with the upper Meramecian Ste. Genevieve Limestone of the upper Mississippi Valley (Weller et al., 1948; Adams, 1970; Scheckler, 1986; Berg et al., 1986). If these correlations are correct, then strata equivalent to most of the Meramecian are absent from western Maryland.

GREENBRIER FORMATION

The Greenbrier Limestone was originally named in southeastern West Virginia for the carbonate formation lying between the Pocono (or Maccrady) and Mauch Chunk Formations. Although quite thick and consisting of numerous formations in the type region, northward pinchout of the units lower in the section results in a dramatic thinning of the group into northern West Virginia and western Maryland. Concurrent with this thinning is a reduction in rank from group (or even series) to formation (see Amsden, 1954, fig. 6).

Martin (1902) subdivided the Greenbrier Formation of Garrett County into three informal members, the lower, middle, and upper. According to Martin, the lower member consisted of a siliceous limestone, the middle member was lithologically similar to the Mauch Chunk Formation, and the upper member was a fossiliferous limestone. Martin (1902) and Amsden (1954) correlated the lower siliceous member with the Loyalhanna Limestone of Pennsylvania. However, Amsden (1954,

p. 41) did not believe that either the middle or upper members were traceable units and as a result abandoned the threefold subdivision.

In southern Somerset County, Pennsylvania, Flint (1965), in addition to recognizing the Loyalhanna Limestone, formally named two limestone units present in the lower Mauch Chunk Formation (equal to the Greenbrier Formation of Maryland). The two members named by Flint, the Deer Valley and Wymps Gap Limestones, are well-developed and recognizable units in western Maryland. The Deer Valley Limestone lies directly upon the Loyalhanna and can be distinguished from it by the sandy character of the latter unit. The Wymps Gap Limestone, formerly termed the Greenbrier of Pennsylvania, occurs somewhat higher stratigraphically, and is separated from the Loyalhanna and Deer Valley Limestones by an interval of red detrital strata similar to typical Mauch Chunk lithologies. Hoque (1968) and Brezinski (1984) informally called this sequence of clastic rocks the "clastic interval." It appears, from overall similarity of sequence, that the Wymps Gap Limestone is equivalent to Martin's upper member, and that the "clastic interval" is correlative to the middle member of the Greenbrier Formation of Maryland.

On this basis the Greenbrier Formation of western Maryland in the present report is subdivided into four members. The basal member, the Loyalhanna Limestone, is overlain by the Deer Valley Limestone, which is overlain by an interval of predominately red clastic rocks (equivalent to the middle member of Martin, 1902) herein designated the Savage Dam Member, and topped by the upper member, the Wymps Gap Limestone which is in turn overlain by the Mauch Chunk Formation.

Loyalhanna Limestone Member

The basal unit of the Greenbrier Formation is the Loyalhanna Member. Butts (1904) named the Loyalhanna Limestone for exposures along Loyalhanna Creek, where it breaches Chestnut Ridge Anticline in Westmoreland County, Pennsylvania. Although lateral variations in composition of the Loyalhanna are known, it is typically characterized by high quartz sand content (sometimes greater than 50%) and medium- to large-scale festoon cross-bedding (Figure 13C). The basal contact is typically sharp (see preceding discussion on sub-Greenbrier unconformity). A thorough discussion regarding the provenance, paleocurrents, and depositional origin of the Loyalhanna throughout its extent has been provided by Adams (1970).

In Maryland the Loyalhanna exhibits a southeast to northwest thickening from less than 20 feet to greater than 30 feet (Figure 13). Lithologically, it ranges from a sandy lime grainstone to a calcareous sandstone, green-

gray to red-brown in color, and locally a gray marlstone. In thin section the quartz silt and sand varies from angular to subrounded. Carbonate grains commonly exhibit a multitude of origins ranging from intraclasts, ooids, and coated grains to rounded and abraded fossil fragments. In western Maryland the Loyalhanna Member commonly contains a much lower percentage of terrigenous quartz than is characteristic of the unit in Pennsylvania. However, in northern Garrett and adjacent Allegany Counties the Loyalhanna exhibits a red-brown coloration. Apparently this color difference is the result of a small admixture of red clay carried into this area during deposition (Adams, 1970). Good examples of the red Loyalhanna may be observed at localities 6, 12, and near 33; along the Western Maryland railroad tracks at Barrelville; along Bear Creek Road 2 miles east of Friendsville; and along Pigs Ear Road 0.25 mile south of where it intersects U.S. Route 40 at the Pennsylvania-Maryland state line. In central and southern Garrett County, the characteristic Loyalhanna cross-bedding becomes less distinctive, as beds become interstratified with intervals of medium- to dark-gray marlstone. At the Gaylord Quarry (locality 17) and in an abandoned quarry on Backbone Mountain (locality 19), such gray marlstone intervals cap the Loyalhanna and serve to demarcate it from the overlying Deer Valley Member.

The uppermost layers of the Loyalhanna, near the contact with the Deer Valley Member, typically consist of either a tan argillaceous dolomitic siltstone or a red calcareous siltstone 0.5 to 6.0 inches in thickness. This thin interval usually allows easy separation of the Loyalhanna from the Deer Valley Members (Figures 13C, D).

Paleontology. Owing to the abrasive and apparently high-energy environment of deposition of the Loyalhanna, fossils are commonly comminuted to a point beyond identification. In thin section several fragments of indeterminate bryozoans and brachiopods were observed. Possibly the most common fossil type are endothyrid foraminifers. Although no identification of these forams was undertaken for this study, their abundance and preservation may present an opportunity for future biostratigraphic work. Conodonts are also known from the Loyalhanna. However, they are usually abraded and difficult to identify. Consequently, they are unlikely to improve our understanding of the age or correlation of this unit (A. Harris, oral communication, 1987).

Preservation of macrofossils within the Loyalhanna is exceedingly rare. The Bishoff Quarry (locality 14) is the only location of which I am aware where both well-preserved megafauna have been recovered. Fauna recovered from the basal 6 feet of this section are concentrated along cross-bed foresets. This low diversity

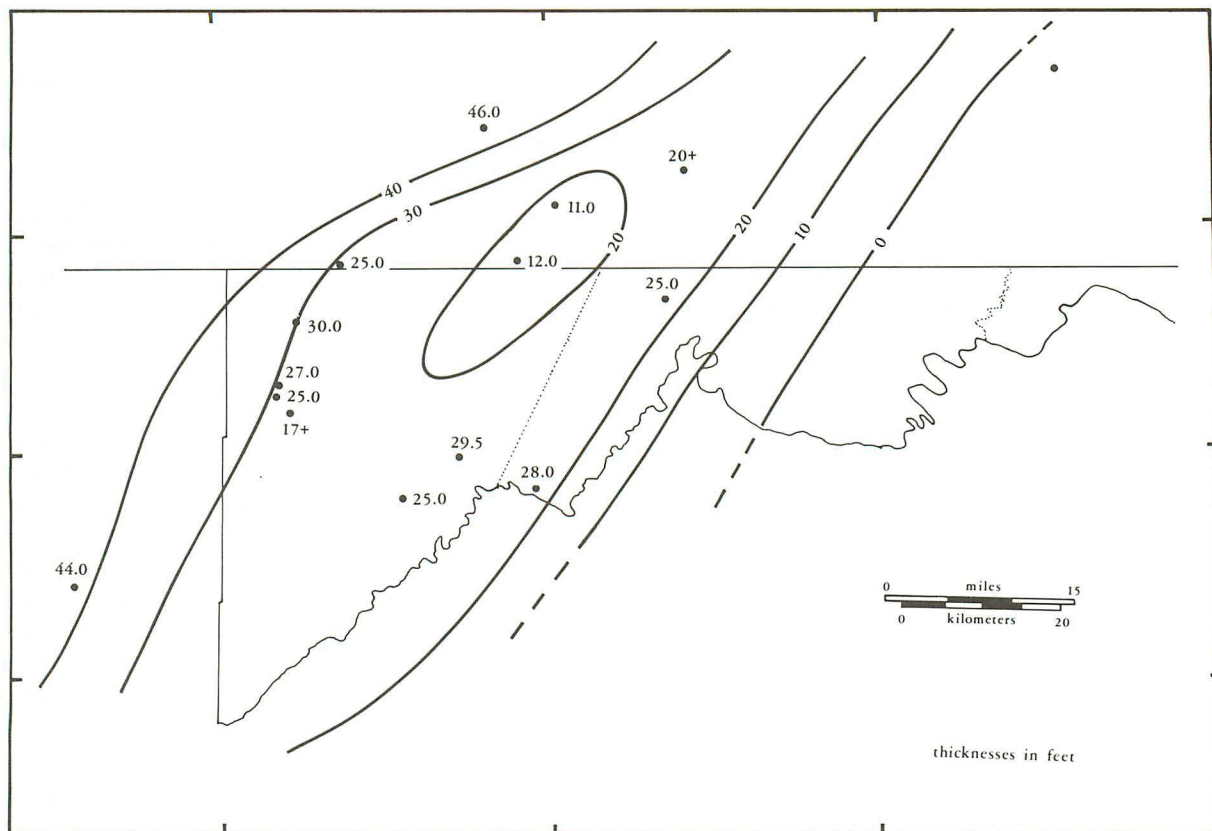


Figure 12.— Generalized isopach map of the Loyalhanna Member of the Greenbrier Formation in western Maryland and adjacent Pennsylvania and West Virginia.

fauna consist of:

Anthracospirifer cf. *A. pellaensis*
Composita subquadrata
Orthotetes kaskaskiensis
Straparollus sp.
Girtyella? sp.

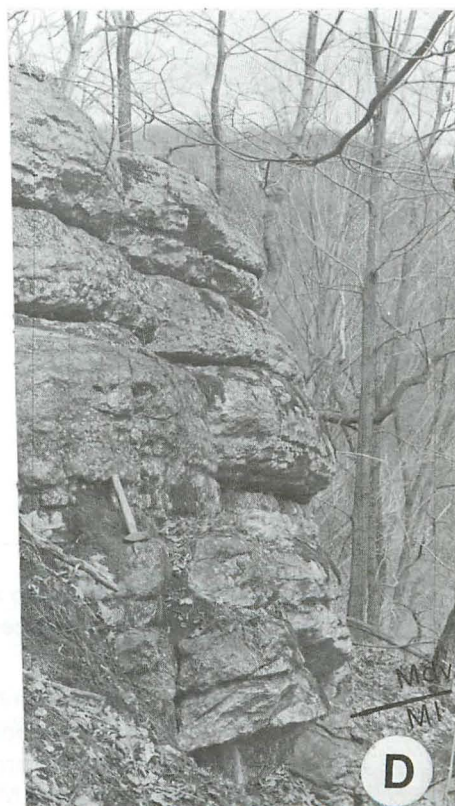
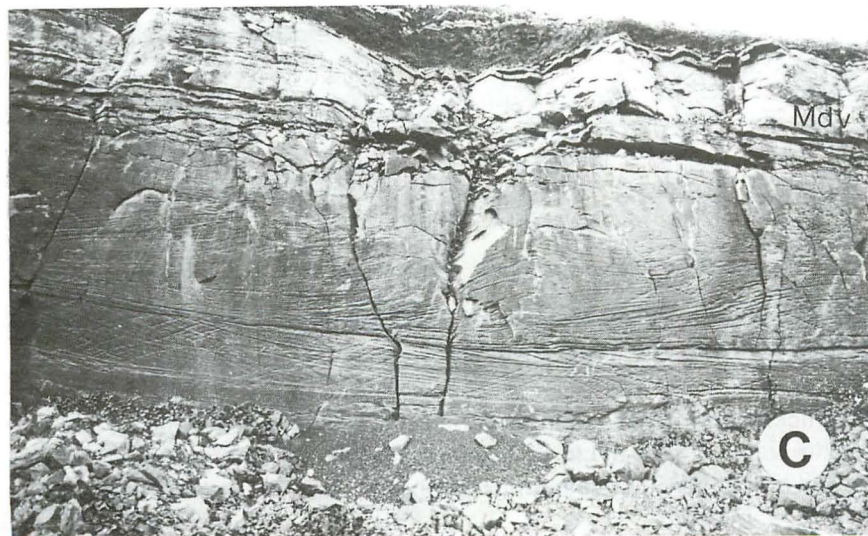
Deer Valley Limestone Member

Overlying the Loyalhanna Member is a relatively thin carbonate unit which Flint (1965) named the Deer Valley Limestone for exposures in the area of Deer Valley near Mount Davis, in Somerset County, Pennsylvania (locality 29). The medium-bedded, pure limestones of the Deer Valley contrast noticeably with the cross-bedded sandy limestones of the underlying

Loyalhanna (Figure 13B). Bedding within the Deer Valley Member is accentuated by the presence of thin (0.25 to 1.0 inch) layers of quartz silt and red clays, which weather more readily than do the purer carbonate strata.

Individual carbonate strata within the Deer Valley are typically light-gray to gray-green, locally variegated, and very dense. At first glance they appear to be composed of lime mud, but in thin section the rock is comprised of well-cemented lime grainstone composed of ooids, intraclasts, micrite-coated grains, and grapestone aggregates. Along Maryland Route 135 near the mouth of Stoney Run (locality 8), the upper 3 feet of the Deer Valley is composed of a well-developed oolite. Near Swanton (locality 19) the lower 6 feet of the Deer Valley is composed of a dark-gray argillaceous fetid

Figure 13.— A, Loyalhanna (Ml), Deer Valley (Mdv), and lower Savage Dam (Msd) Members of the Greenbrier Formation at locality 15. Note the 5 feet of red (dark) mudstones similar to Mauch Chunk lithologies at base of Loyalhanna, and separating the Loyalhanna from the underlying Purslane Formation. B, Contacts between the Loyalhanna (Ml), Deer Valley (Mdv), and Savage Dam (Ms) Members of the Greenbrier Formation at locality 17. C, Characteristic large-scale cross-bedding of the Loyalhanna as exposed in quarry near Mount Davis, Pennsylvania (near locality 29). Note Deer Valley Member (12 feet thick) at top of exposure. D, Deer Valley Member of the Greenbrier Formation exposed near railroad tracks at locality 6. Loyalhanna-Deer Valley contact is exposed in the lower right hand corner of photograph.



lime mudstone dissimilar to any other known Deer Valley lithology in western Maryland.

The Deer Valley thins from south to north, attaining a maximum thickness of 20 feet in southern Garrett County and pinching out in southern Somerset County, Pennsylvania (Figure 14). Along its northern extent Brezinski (1984) noted that the Deer Valley is quite sandy, apparently from the reworking of underlying Loyahanna, so that the Deer Valley is thicker where it has infilled swales in the top of the Loyahanna (Figure 15A).

The Deer Valley typically grades upsection into a red argillaceous silty sandstone or siltstone that marks the base of the next overlying unit.

Paleontology. Although present, macrofossils are not abundant within the Deer Valley. Possibly the most common component is an undetermined rugose coral. *Anthracospirifer* sp., *Diaphragmus* sp., and *Straparolus similis* are often present, but never common.

Microfauna, as in the Loyahanna, are largely

composed of endothyrid forams. As determined from thin section, as much as 15% of the rock may be composed of their remains (Brezinski, 1984, p. 23). Indeterminate echinoderm ossicles are also relatively common components of any thin section.

Savage Dam Member

Overlying the Deer Valley Member is a variably thick sequence of terrigenous rock that Hoque (1968) and Brezinski (1984) informally termed the "clastic interval." This interval is equivalent to the middle Member of the Greenbrier as proposed by Martin (1902). It is herein designated the Savage Dam Member inasmuch as the distinctive lithologies that comprise this sequence set it apart from the overlying and underlying carbonate members. A complete stratigraphic section of the unit designated as the type section is exposed at the spillway and along the railroad tracks opposite the spillway at the Savage River Dam 5 miles west of Westernport (locality 9) (Figures 15B, 16).

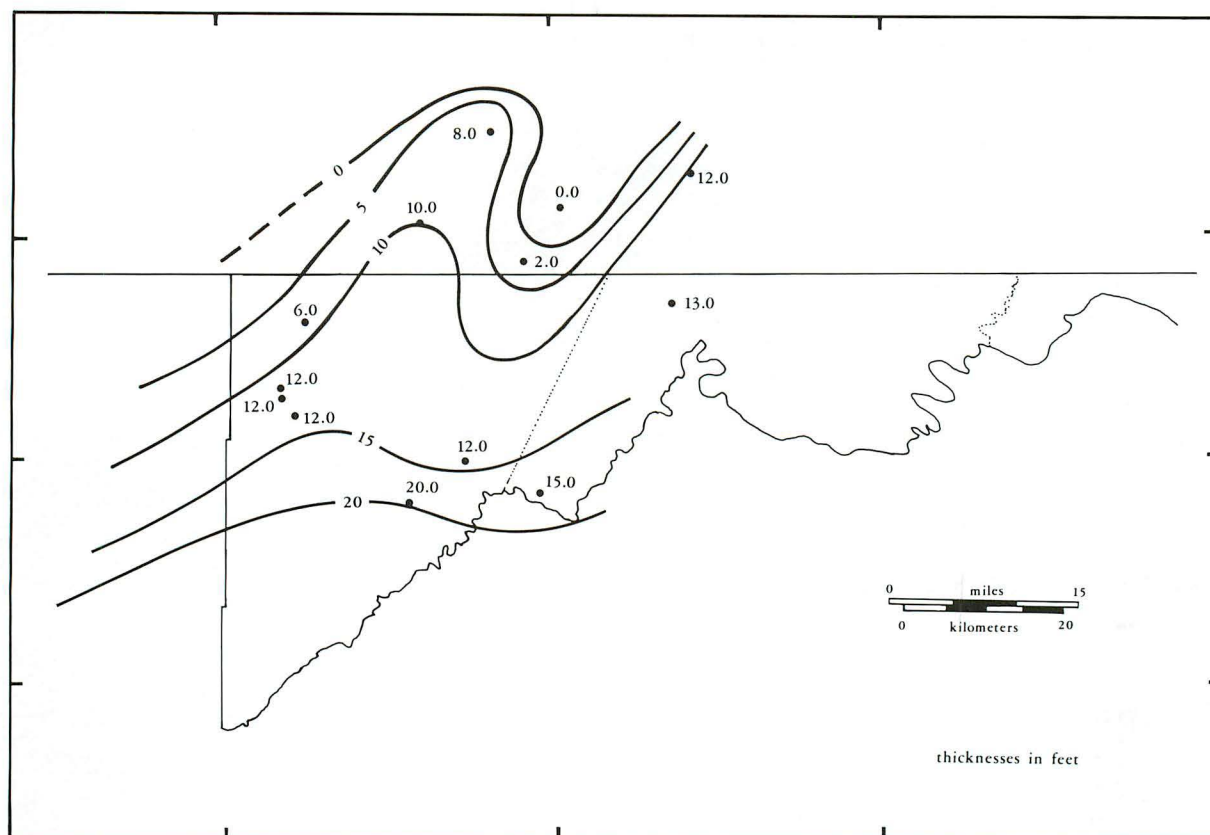
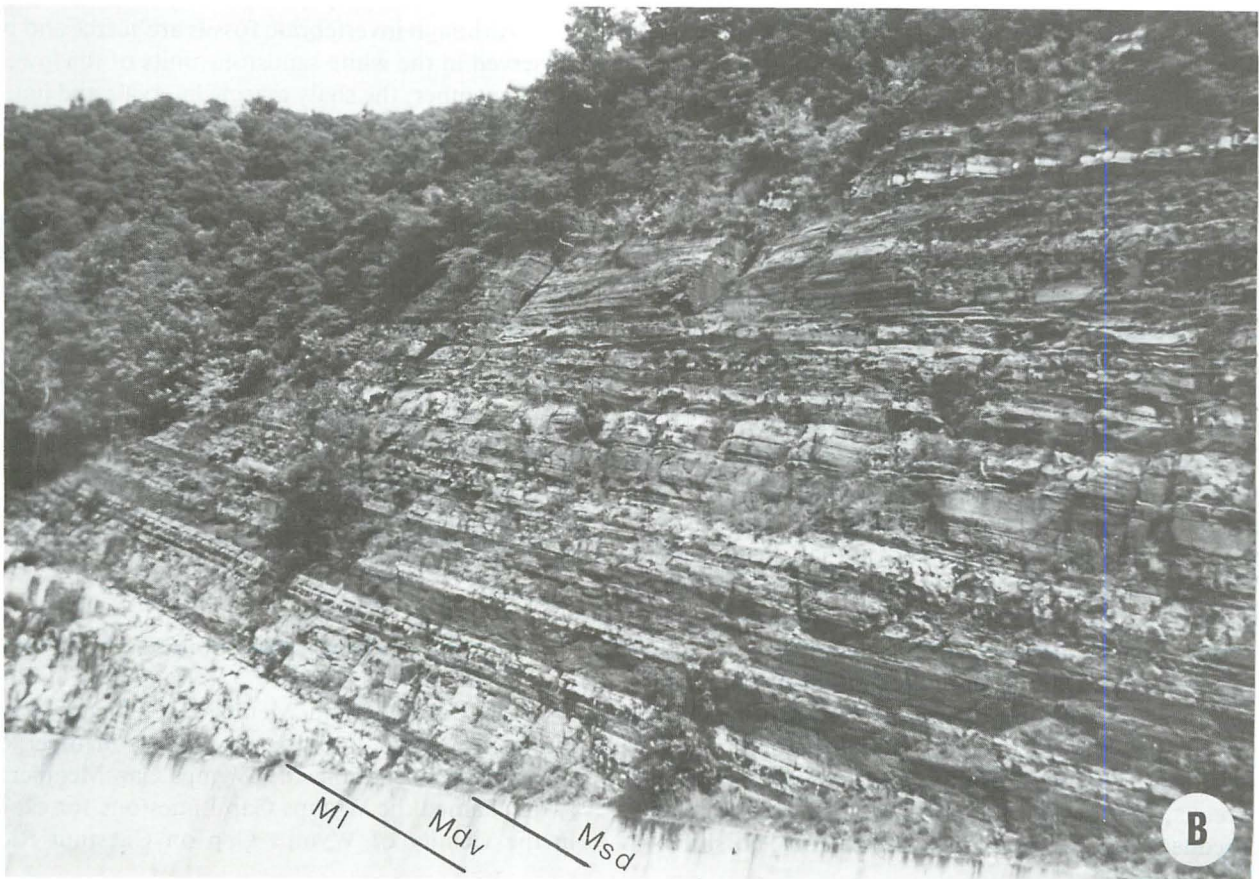


Figure 14.— Generalized isopach map of the Deer Valley Member of the Greenbrier Formation in western Maryland and adjacent Pennsylvania and West Virginia.

Figure 15.— A, Deer Valley Member thickening into swale in underlying Loyahanna Member at locality 15. Deer Valley is approximately 10 feet thick. B, Type section of the Savage Dam Member of the Greenbrier Formation at locality 9. Loyahanna Member = MI, Deer Valley Member = Mdv, Savage Dam Member = Msd.



The Savage Dam Member is characterized by interbedded thin white sandstone, green-gray silty shales and red-brown to chocolate siltstone, sandstone, and shale. Near the top of the member, thin (1 to 3 feet) limestone intervals are interbedded with the green-gray shales and red-brown siltstone and shale. The predominance of red-brown coloration of this interval bears a marked similarity to the overlying Mauch Chunk. It is for this reason that coeval strata in Pennsylvania are considered a part of the Mauch Chunk. However, the Savage Dam Member differs by including numerous interdigitated marine beds with nonmarine red siltstone, shale, and sandstone. At the type section as many as seven of these marine beds are present (Figure 16). Marine strata near the base of the member are characterized by white, calcareous, well-sorted sandstones, 3- to 9-feet thick, which locally contain abraded carbonate clasts and brachiopod fragments. The basal contacts of these sandstones are typically sharp and presumably erosional in origin. In contrast, the tops are gradational with overlying green gray, silty shale, which in turn grade into red siltstone, sandstone, and shale replete with root casts and desiccation cracks. At the Gaylord Quarry (locality 17) the lowest sandstone in the Savage Dam Member exhibits well-developed herringbone cross-bedding, attesting to a tidal origin (Figure 12C). Higher in the member the white marine sandstone units are interbedded with green-gray calcareous shales and siltstones which contain a relatively abundant marine fauna composed of articulate brachiopods, bivalves, corals, and bryozoans. Thin intervals of limestone, present near the top of the member, are light gray in color and consist of lime grainstones. Examples of such limestones may be observed in small abandoned quarries along Bear Creek Road (locality 12), Accident-Friendsville Road 2 miles southeast of Friendsville (locality 13), and New Germany Road 1 mile south of New Germany State Park (locality 25).

The Savage Dam Member is the thickest member of the Greenbrier Formation in Maryland. It has its greatest development of over 200 feet along the Western Maryland railroad tracks near Barrelville (locality 6), and thins to the west in Garrett County (Figure 17). The thinnest occurrence of this member was measured at the Gaylord Quarry, where it attains a thickness of only 76 feet. Thinning of the Savage Dam Member appears to continue to the west, as I have shown that this interval of clastics attains a thickness of only 32 feet near Rowlesburg in Preston County, West Virginia (Figures 17, 19) (Brezinski, 1984).

The Savage Dam Member intertongues with and grades upsection into the Wymps Gap Limestone. This relationship is poorly exposed, but can be observed at the Gaylord Quarry (locality 17). At this locality calcareous, green-gray shale, 6 inches to 2 feet thick, is interbedded with medium-gray, argillaceous, fossilifer-

ous limestone of the Wymps Gap Member. This relationship can also be seen along the Accident-Friendsville Road at locality 13.

Paleontology. The numerous marine intervals present within the Savage Dam Member have yielded a relatively diverse macrofaunal assemblage. Fauna recovered from these strata are predominately bivalves and gastropods; however, brachiopods and bryozoans are present near the top of the unit. The most common faunal elements include the genera:

bivalves

Paleoyoldia

Septimyalina

Edmondia?

Phestia

Niadites

Wilkingia

indeterminate nuculids

gastropods

Bellerophon

Bulimorphia?

Straparollus

bryozoans

Fenestella

Rhombopora

brachiopods

Composita subquadrata

Diaphragmus elegans

Anthracospirifer cf. *A. pellaensis*

Although invertebrate fossils are scarce and poorly preserved in the white sandstone units of the lower part of the member, the shaly marine intervals and limestone strata near the middle and upper parts of the member contain a well-preserved fauna. A fairly diverse fauna consisting of the bivalve genera *Edmondia*, *Wilkingia*, *Paleoyoldia*, and *Phestia* were recovered from a greenish gray shale approximately 15 feet below the top of the member at locality 34. Within several separate marine intervals along the railroad tracks at the type section, a fauna of *Diaphragmus elegans*, *Anthracospirifer* sp., *Composita subquadrata*, *Fenestella* sp., *Straparollus similis*, *Paladin chesterensis*, and an indeterminate rugose coral were recovered. In Pennsylvania (locality 35) red, silty sandstone intervals in the Savage Dam Member contain abundant disarticulated crinoid remains and bryozoan fragments.

Wymps Gap Member

The Savage Dam Member interfingers with and grades upsection into the uppermost member of the Greenbrier Formation, the Wymps Gap Member. Flint (1965) named the Wymps Gap Limestone for exposures in the vicinity of Wymps Gap on Chestnut Ridge in

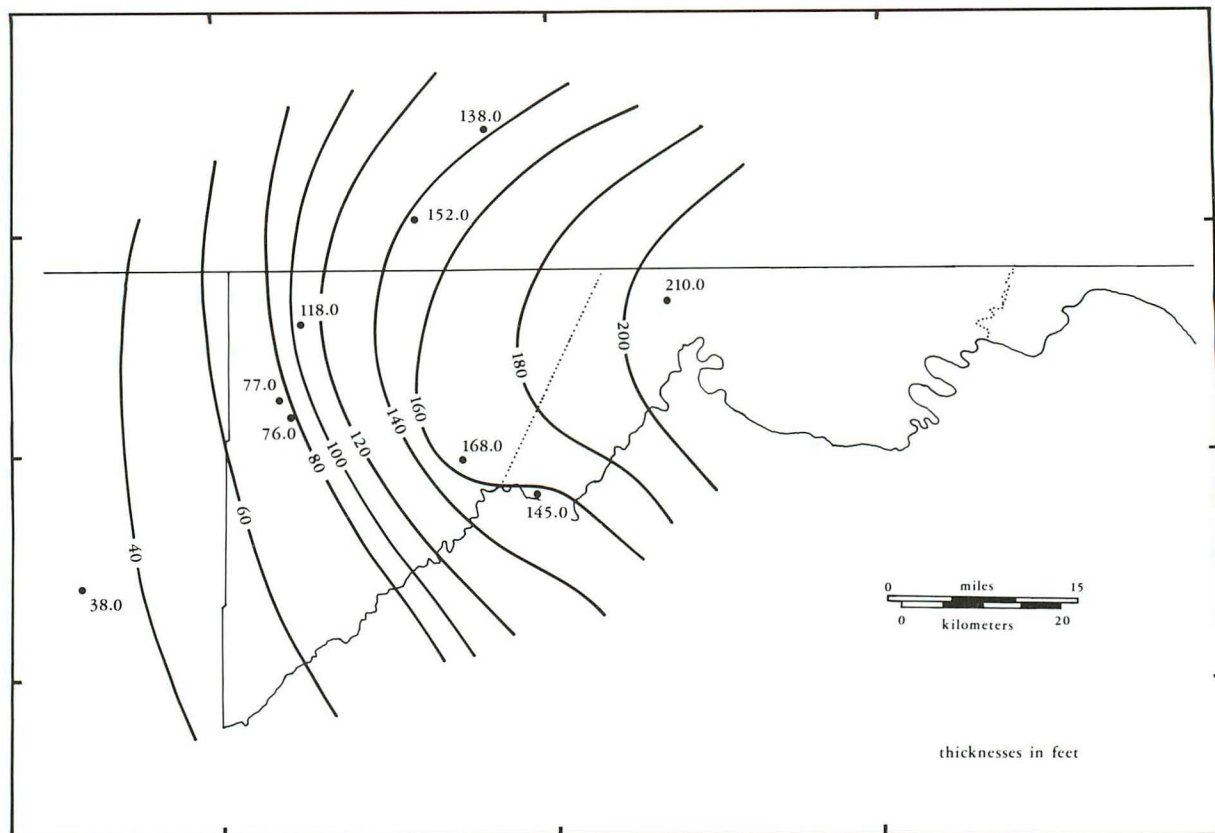


Figure 17.—Generalized isopach map of the Savage Dam Member of western Maryland and adjacent Pennsylvania and West Virginia.

southern Fayette County, Pennsylvania very near the West Virginia-Pennsylvania state line. Flint's rationale for erecting a new name is based mainly on the confusing fact that, previously, this limestone member had been called the Greenbrier Limestone of Pennsylvania. Although it represented a partial equivalent to the group of the same name of West Virginia, he believed that renaming this unit would reduce the chance of future confusion. I am in agreement with Flint's reasoning, inasmuch as the Greenbrier of West Virginia is correlative with the entire Loyahanna through Wymps Gap sequence of Pennsylvania and Maryland.

In western Maryland the Wymps Gap Member increases in thickness from the northeast to southwest. Near Barrelville (locality 6) in western Allegany County, less than 10 feet of Wymps Gap section is present. However, it thickens quite rapidly to the southwest to more than 40 feet at Sang Run (locality 18). At Rowlesburg, West Virginia the Wymps Gap is greater than 60 feet in thickness (Figure 20).

Concurrent with the increase in thickness, there is a northeast to southwest change in the lithologic character. At Sang Run three general lithofacies can be recognized. The first lithofacies, which comprises the lower 15 feet at the Sang Run quarry, is characterized by an interbedding of gray fossiliferous lime wackestones

to grainstones and dark-gray, calcareous, brittle shale. The limestone beds range in thickness from 2.0 to 4.0 inches and locally exhibit current-rippled upper surfaces. Shaly layers range in thickness from 0.5 to 6.0 inches, and appear to diminish in thickness upsection. This limestone and shale lithofacies is present beneath the main limestone bench at localities 12 and 13 and, although much more shaly, was observed along the Western Maryland railroad tracks at Barrelville (locality 6). This lithofacies has been described at Mount Davis, Pennsylvania (locality 29) (Brezinski, 1984, Plate 3B), but the exposure is now covered (Figure 21B).

The second lithofacies at Sang Run Quarry (locality 18) (Figure 21A) directly overlies the interbedded limestone and shale lithology, and consists of medium-bedded, dark-gray to black argillaceous lime wackestone. Fossils are common to abundant and rarely are there any indications of transport or abrasion. This lithology emits a fetid odor on freshly broken surfaces. Good exposures also are present at the Gaylord Quarry (locality 17) and in abandoned quarries at Deep Creek Lake (locality 24) and southwest of Oakland (locality 22). The dark-gray argillaceous wackestone lithofacies thins and changes character to the northeast (Figure 22). In adjacent Pennsylvania (localities 29, 34, and 35) the unit grades into a light-gray, locally crossbedded, coated

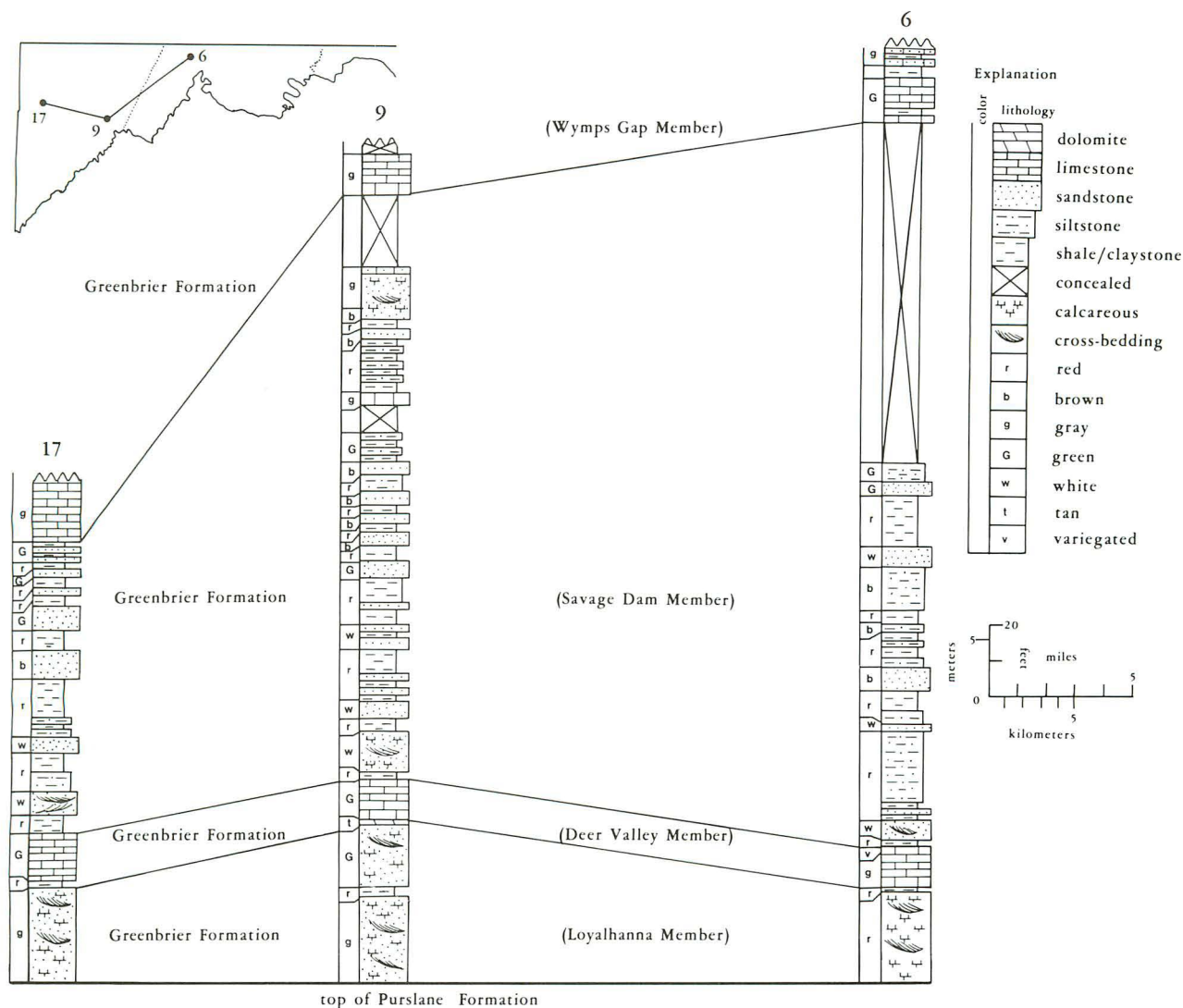


Figure 18.— Lateral relationships between members of the Greenbrier Formation in western Maryland.

grainstone. Locally, ooids are present, but faunally, this facies provides the lowest abundance and least diversity macrofauna of any Wymps Gap lithology. Further northeastward, the coated grainstone lithofacies grades into a green-gray, locally variegated, argillaceous, nodular-bedded wackestone. This lithofacies is well developed where the Wymps Gap is thinnest and is best exposed in Maryland near Barrelville (locality 6) (Figure 21C) and in adjacent Pennsylvania along Wills Creek near Fairhope (locality 30).

The uppermost 9 feet of the Wymps Gap Member at Sang Run comprises the third lithofacies. The lithofacies consists of interbedded light-green-gray, sparsely fossiliferous, lime wackestone and green-gray to red-brown, silty shale. The limestone units commonly range in thickness from 0.5 to 3.0 feet and the shaly intervals from 1.0 to 4.0 feet. Interlaminated within the shaly sequences are very thin beds (0.25 to 0.50 inch thick) of brachiopod, bryozoan, and crinoid coquinites.

Graded-bedding and cross-bedding are common within these shale intervals. In contrast, the limestone units only rarely exhibit indications of agitation. This lithofacies caps the Wymps Gap Member wherever it is exposed in western Maryland; however, at Barrelville it is poorly developed and consists of interbedded sandy lime grainstones and red calcareous silty shales.

Paleontology. The Wymps Gap Limestone Member is without question the most diversely fossiliferous Mississippian unit in Maryland. From these strata a well-preserved brachiopod-bryozoan-crinoid assemblage may be collected. The following forms were recovered in Maryland and adjacent Pennsylvania:

brachiopods

Petrocrania? sp
Diaphragmus elegans
Anthracospirifer pellaensis
Composita subquadrata

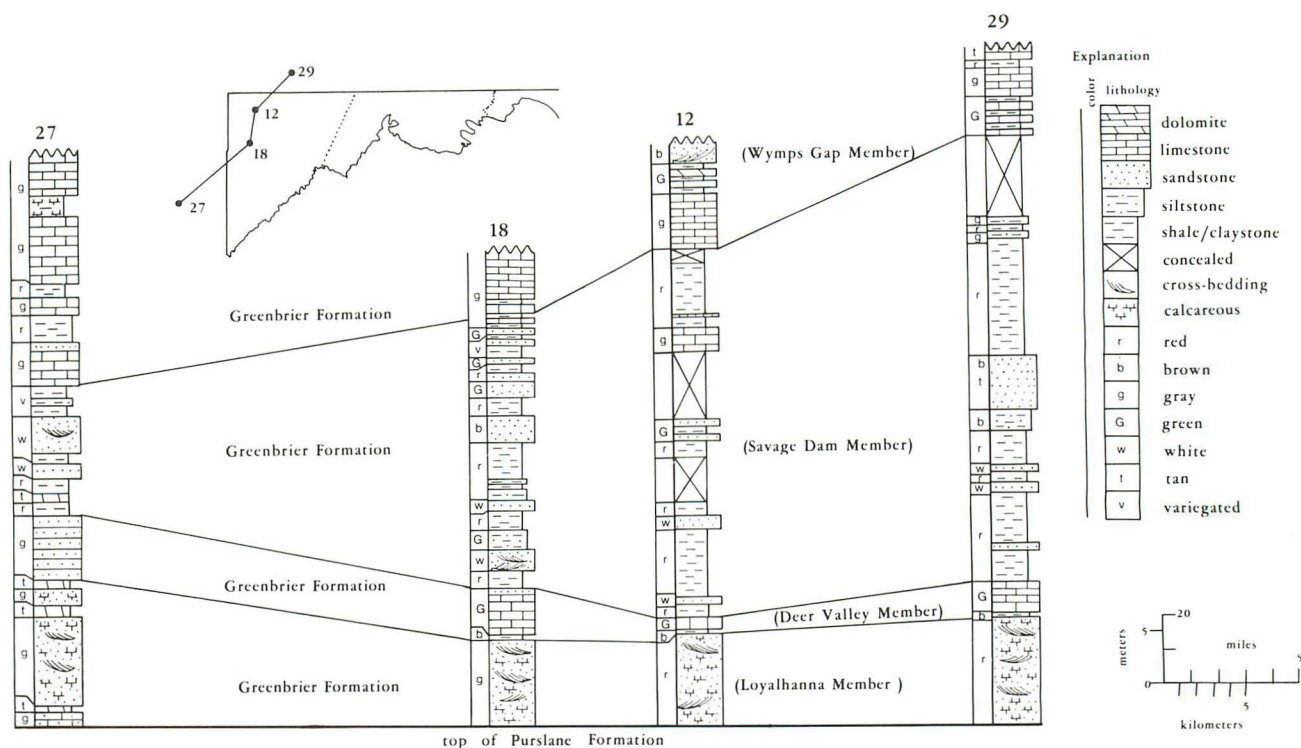


Figure 19.— Lateral relationships between the members of the Greenbrier Formation in western Maryland and adjacent Pennsylvania and West Virginia.

Martinia contracta
Dielasma sp.
Inflatia sp.
Phrycodothyris sp.
Orthotetes kaskaskiensis
Cleiothyridina sublamelosa

bryozoans

Septopora sp.
Archimedes sp.
Fenestella sp.
Rhombopora sp.
Eridopora sp.

mollusks

Straparollus similus
Platyceras sp.
Wilkingia sp.

pelmatozoans

Pentremites sp.
Agassizocrinis sp.
Platycrinites sp.

miscellaneous

Cornulites sp.
Paraconularia chesterensis
Paladin chesterensis

In all likelihood the best exposure in Maryland for collecting such fauna is at Sang Run (locality 18). Many of the brachiopod and bryozoan genera are present at this locality. Also present are crinoids, gastropods and the bivalve *Wilkingia*. Other accessible localities include

Deep Creek Lake (locality 24), southwest of Oakland (locality 22), and small abandoned quarries southeast of Friendsville (localities 12 and 13). At the mouth of Stoney Run (locality 8), fauna from the upper beds of the Wymps Gap Member may be collected. At Barrelville, a thin Wymps Gap provides a low diversity fauna of *Diaphragmus*, *Composita*, *Anthracospirifer*, and *Fenestella*.

Conodonts are known from the Wymps Gap of adjacent Pennsylvania (Horowitz and Rexroad, 1972), but their abundance and diversity are low and their biostratigraphic utility minimal. Endothyrid forams are also present within the Wymps Gap Member; however, their utilization for biostratigraphic purposes has yet to be realized.

Age and Correlation

Studies regarding the biostratigraphy and correlations of the Greenbrier Formation of Maryland have been rare and inconclusive. This is mainly because faunal components, which in other parts of the geologic column provide the main basis for biostratigraphic correlation, are not particularly useful in the Chesterian. For example, brachiopods provide a relatively good biostratigraphic breakdown of the Lower Mississippian sequence; however, species are long-ranging, geographically widespread, and generally undiagnostic for subdivision of Chesterian strata. Conodonts also pro-

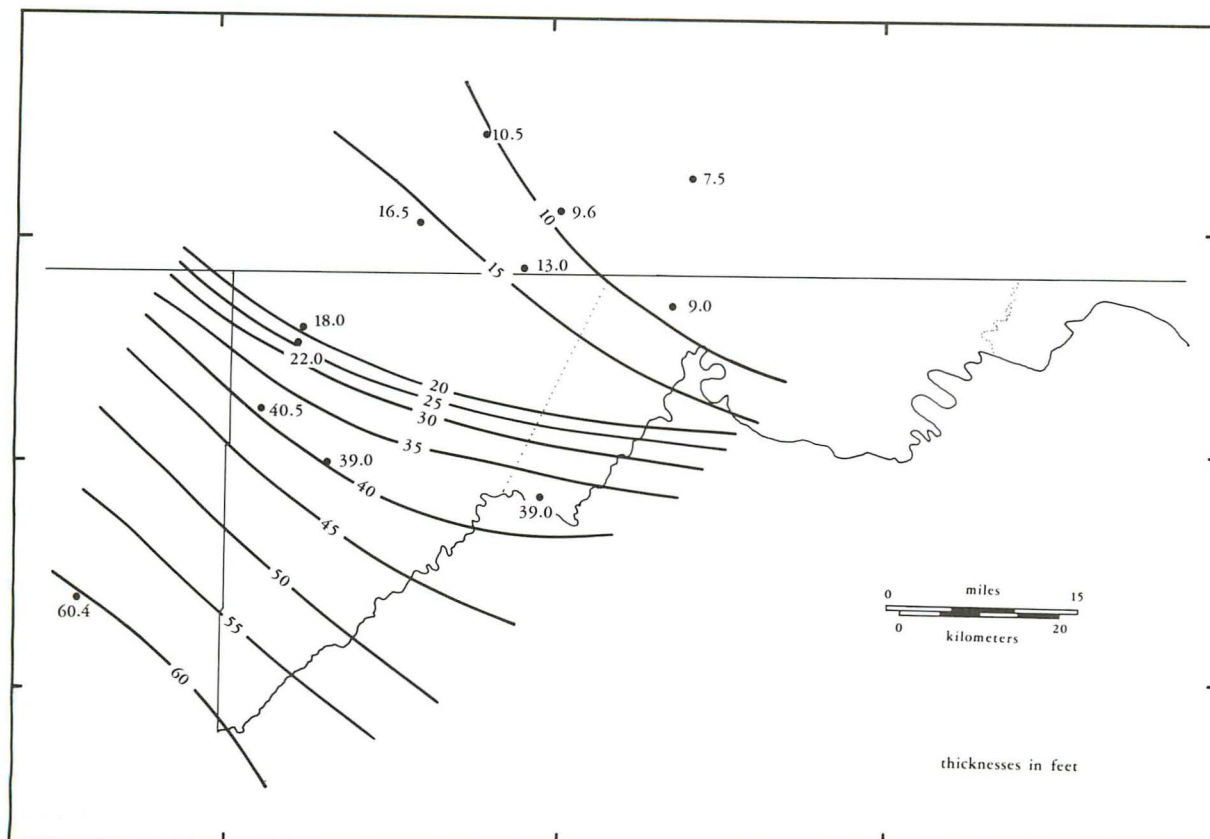


Figure 20. — Generalized isopach map of the Wymps Gap Member of the Greenbrier Formation in western Maryland and adjacent Pennsylvania and West Virginia.

vide little help in subdividing the lower Chesterian, inasmuch as they, like brachiopods, are long-ranging and widespread.

Endothyrids could be utilized in the biostratigraphic breakdown of the Appalachian Chesterian. In the midcontinent of the United States, such forams are a useful biostratigraphic tool (Baxter and Brenckle, 1982). Wray (1952) noted the presence of such forams in the Greenbrier of West Virginia, but was unable to determine any biostratigraphic zonation. The presence of endothyrid forams in most of the marine units of the Greenbrier of Maryland suggests that these forms may provide the key for the unequivocal correlation of the Appalachian Chesterian with that of the type area.

In the absence of such biostratigraphic controls, correlation of the Greenbrier units with equivalent units in West Virginia must be accomplished by lithostratigraphic means alone. Amsden (1954, p. 36) correlated the Greenbrier Formation of western Maryland with the Union, Cypress, and Alderson Formations of Randolph County in central West Virginia. Furthermore, Amsden tentatively correlated the Fredonia Member of the Union Limestone to the Loyalhanna Member in western Maryland. Inasmuch as Amsden failed to discern any other subdivision of the Greenbrier Formation in Maryland, further correlation was not possible.

The subdivisions of the Greenbrier proposed in the present report should aid in evaluating these tenuous correlations. Figure 23 gives tentative correlation of the Greenbrier Formation of western Maryland with the Greenbrier Group of central West Virginia (Reger, 1931). The Rowelsburg exposure serves as a known intermediate section which helps facilitate this correlation. Correlation of units between central West Virginia and western Maryland is generally good; however, the tenuous nature of the Cypress Sandstone correlation must be noted. The Cypress Sandstone, as recognized by Reger (1931) in northern Randolph County, is a laterally discontinuous unit that is absent from many of his measured sections. Consequently, its utility for local correlation is suspect. Based on relative position of the stratigraphic sequence and overall similarity in lithologic character, the Denmark Limestone is equivalent to the Loyalhanna and Deer Valley Members in western Maryland. The Taggard Shale and Pickaway Limestone correlate both in stratigraphic position and general character with the Savage Dam Member of the Maryland Greenbrier. In West Virginia the Union Limestone is distinguished from the Alderson Limestone by either the presence of the intervening Cypress Sandstone or, more commonly, by the change in lithology from an oolitic Union to an argillaceous, dark-gray Alderson

Limestone. In Maryland the upper part of the Savage Dam Member and the Wymps Gap Member can be correlated with the Union Limestone and the Alderson Limestone of central West Virginia. The dark-gray wackestone lithology of the Wymps Gap is identical to that of the Alderson. Consequently, the thinly interbedded limestone and shale lithology of the Wymps Gap at Sang Run might be a facies of the Union Limestone. Furthermore, the lime grainstone known from the upper part of the Savage Dam Member at localities 12 and 13 may be correlative to the upper member (Gasper Member of Reger, 1931) of the Union Limestone in West Virginia.

Much of the Greenbrier Formation of Maryland (Deer Valley, Savage Dam, and Wymps Gap Members) is equivalent to the lower Mauch Chunk of southwestern Pennsylvania. The Loyalhanna Member is correlative to the Trough Creek Limestone of the Broad Top area of Pennsylvania (Adams, 1970).

Correlation of the Greenbrier Formation of Maryland with the type Mississippian of the Upper Mississippi Valley can be done in only a general way. Numerous authors (see for example, Reger, 1931; Weller et al., 1948) have correlated the Loyalhanna Limestone of the Appalachians to the Ste. Genevieve Limestone of the type Chesterian (Figure 24). Other than this correlation, no satisfactory parity of the Maryland units with those of the type section has been indicated. Weller et al. (1948) correlated the Glen Dean of Illinois with the Mauch Chunk of western Maryland. Owing to the intrabasinal correlations outlined above, it appears that the Haney through Glen Dean (Homburgian) of the Illinois Chesterian can now be correlated with the Alderson Limestone of West Virginia (Reger, 1931) and thus to the Wymps Gap of Maryland. The Cypress, as presented above, is equivalent to the Savage Dam Member of western Maryland. No evidence, other than relative position in sequence, currently allows definitive correlation of the Deer Valley Member with an Illinois equivalent.

MAUCH CHUNK FORMATION

The uppermost, and perhaps the most easily recognized, Mississippian formation in Maryland is the Mauch Chunk Formation. Named by Lesley (1876) for the village of Mauch Chunk (now Jim Thorpe), Carbon County, Pennsylvania, this formation is composed of red shales, mudstones, siltstones, sandstones, and conglomerate. Edmunds et al. (1979) believed that perhaps as much as 8,000 to 9,000 feet of Mauch Chunk strata are present in the Southern Anthracite Field of Pennsylvania, but a more reasonable estimate is 3,000 to 4,500 feet (Wood et al., 1969). However, Lesley (1895) reported only slightly over 2,000 feet of Mauch Chunk



Figure 21.—Lithologies of the Wymps Gap Member in western Maryland and adjacent Pennsylvania. A, dark-gray limestone at Sang Run quarry (locality 18). Reeds at base of quarry face approximately 5 feet in height. B, light-gray, oolitic limestone (massive unit) as previously exposed near Mount Davis, Pennsylvania. Hammer within thin-bedded lithology for scale. C, nodular-bedded argillaceous limestone exposed along railroad tracks at locality 6. Hammer in foreground for scale.

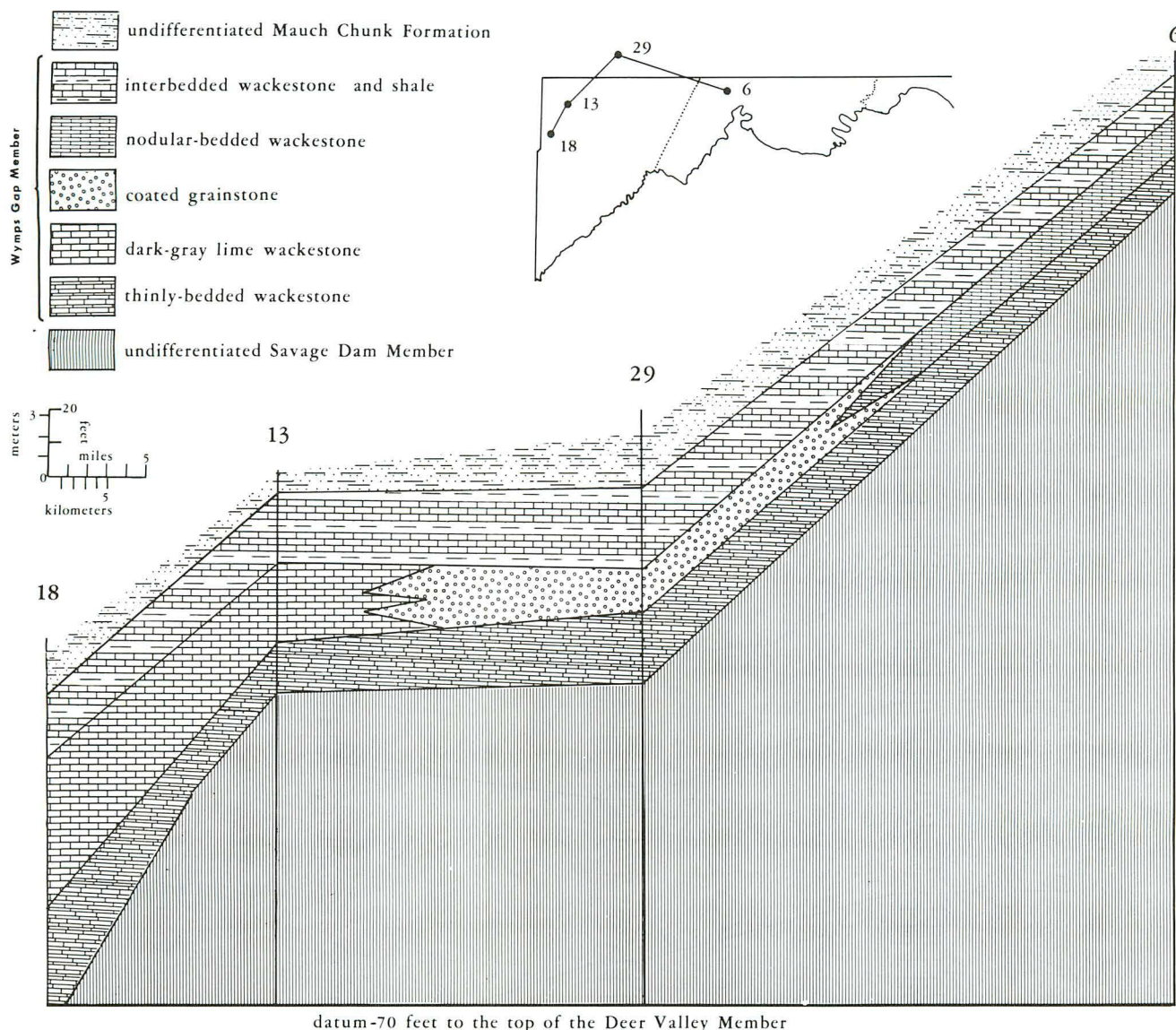


Figure 22.—Lateral facies relationships within the Wymps Gap Member of the Greenbrier Formation in western Maryland and adjacent Pennsylvania.

in the type area. In Maryland, judging from the width of the outcrop belt, the Mauch Chunk probably ranges in thickness from 500 to 800 feet (Figure 25).

The Mauch Chunk is the most poorly exposed Mississippian formation in Maryland. Commonly, the wooded slopes that are underlain by this formation are covered with colluvium from the overlying Pottsville Formation. However, the several partial exposures in Maryland are sufficient to ascertain the lithologic

character of the formation. The Mauch Chunk consists of red mudstone, shale, and siltstone interbedded with green-gray to chocolate- or red-brown, medium-grained sandstones. The mudstone and shale intervals are dominant in the sections examined, although the sandstone units can be quite thick and multiply stacked. Commonly, the mudstone intervals exhibit no bedding and have a hackly fracture. The most common and pervasive sedimentary structures within these intervals are desiccation

cracks and root casts. Rooted zones commonly show a variegated appearance where the green-gray root casts contrast with the surrounding red sediments.

The sandstone units are most commonly green-gray in color although thinner units (less than 5 feet) are typically red brown. These sandstone units generally fine upward, are cross-bedded, exhibit erosional bases and shale-pebble basal lag conglomerates, and range in thickness from 3 to 30 feet. The sandstones are sub-graywackes composed of chert, metamorphic rock fragments, and micas in addition to monocrystalline quartz (Hoque, 1968). Near Barrelville (locality 6) three separate sandstone units are present within the upper part of the Mauch Chunk (Figure 26A). Other examples include the section along U.S. Route 40 at the Penn-

sylvania-Maryland state line (locality 26), along the highway on Backbone Mountain 1 mile east of Swanton (locality 20), and along Maryland Route 135 approximately 1 mile east of Westernport.

Reynolds Member

A thin marine unit occurs approximately 20 feet above the top of the Greenbrier Formation in an abandoned quarry near Deep Creek Lake (locality 24) Brezinski, 1984). This marine unit is 3 feet thick and is composed of tan calcareous shale with abundant molds of fragmented bivalves. The unit appears to be present at the same interval at locality 22. Here the marine strata consist of 2.5 feet of soft fossiliferous clay, which

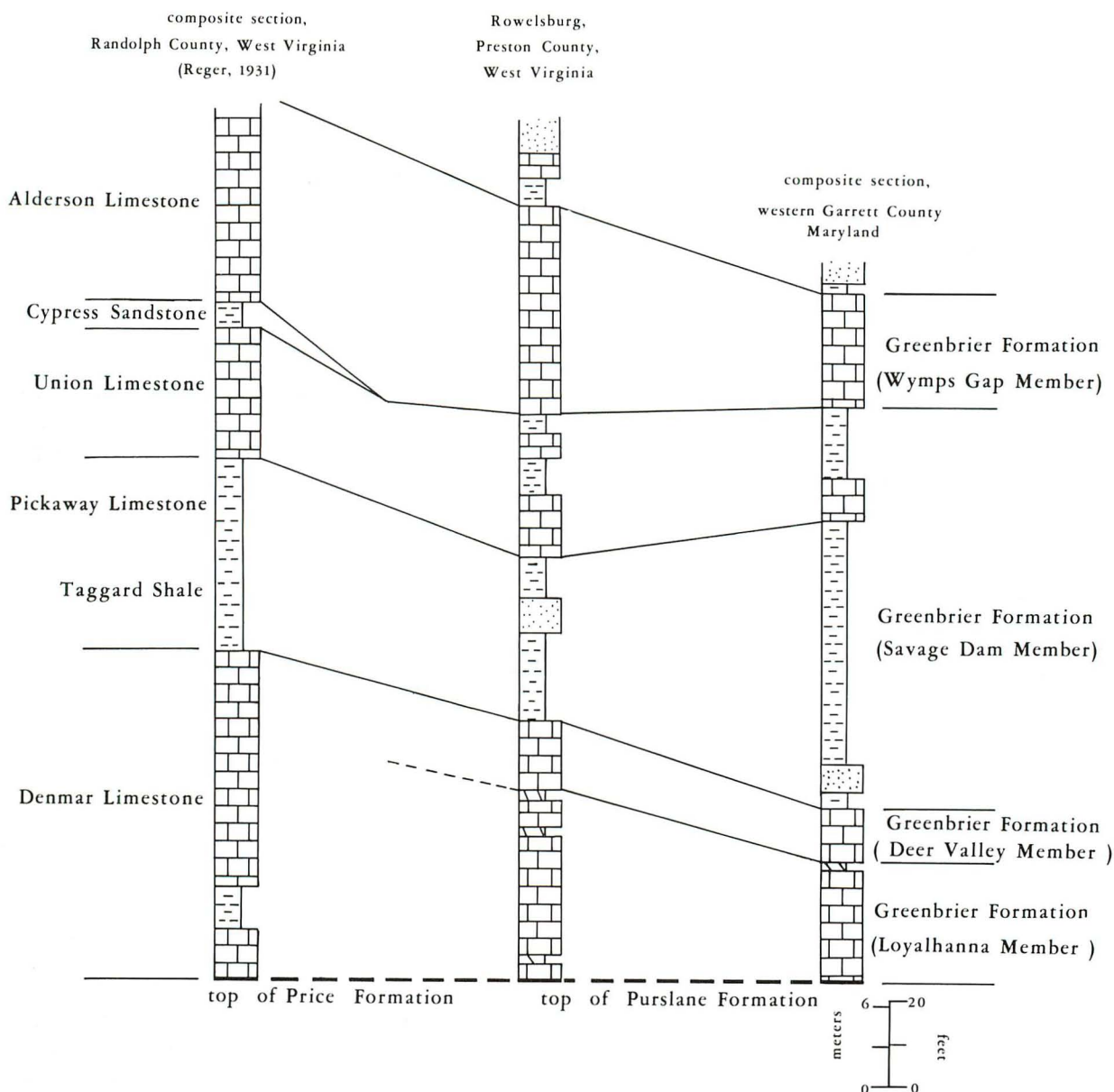


Figure 23. — Interpreted correlation of the members of the Greenbrier Formation of western Maryland and the Greenbrier Formation of Randolph County, West Virginia.

when excavated more deeply into the bank is seen to be a light-greenish-gray argillaceous limestone. This marine zone is at the approximate interval of the Reynolds Limestone in northern West Virginia (Busanus, 1974; Brezinski, 1984). Along Route 42 near Scherr in Mineral County, and near Rowelsburg in Preston County, West Virginia, 6 to 10 feet of medium-gray, highly fossiliferous, argillaceous limestone of the Reynolds Member is exposed. The thin development of this unit in Maryland indicates an eastern and northern extension of the Reynolds sea near its lateral limits.

The Mauch Chunk Formation is superficially similar to the Savage Dam Member of the Greenbrier Formation. In fact, under present Pennsylvania Geologic Survey nomenclature, this member is included within the Mauch Chunk. Several criteria serve to separate the two units. Firstly, the Savage Dam Member of the Greenbrier Formation is characterized by inter-

stratified marine and nonmarine lithologies. The Mauch Chunk, save for the Reynolds Member, has no marine units. Secondly, the multi-stacked, green-gray and red-brown fluvial sandstones which characterize the Mauch Chunk are generally lacking from the Savage Dam Member.

Paleontology. Fauna present in the Mauch Chunk is restricted to the Reynolds marine interval. It consists of the following:

Phestia sp.
Septimyalina sp.
Aviculopecten sp.
Wilkingia
Edmondia
Composita subquadrata
Diaphragmus sp.
 crinoid fragments

In northern West Virginia the Reynolds Limestone is much better developed, and Busanus (1974) has documented a diverse brachiopod-bryozoan-bivalve assemblage from it. The following brachiopods were recovered from the exposure near Scherr, West Virginia:

Diaphragmus
Orthotetes
Ovatia
Girtyella
Composita
Cleiothyridina

The depauperate nature of the Maryland Reynolds fauna suggests that the Reynolds was deposited under extremely restricted circulation conditions (Brezinski, 1984).

Aside from the Reynolds fauna, no fossils have been documented from the Mauch Chunk of Maryland. In southern West Virginia numerous marine intervals punctuate the Mauch Chunk sequence, and in that area fossiliferous intervals are abundant. However, in Pennsylvania and Maryland the red coloration to this formation attests to oxidizing depositional conditions. Under such conditions the extant flora and fauna would not easily have been preserved.

Age and Correlation

Weller et al. (1948) believed that the Mauch Chunk of West Virginia and Maryland was middle to late Chesterian in age (Hombergian-Elviran Series). In central Pennsylvania the inclusion within the Mauch Chunk of Greenbrier equivalents would lower the Mauch Chunk basal age to early Chesterian or even late Meraecian. The Reynolds Member is recognized from eastern Kentucky into Maryland and Pennsylvania. In West Virginia, drillers term this marine unit the "Little

European stage	stage	series	upper Mississippi Valley (Swann, 1963)	western Maryland	
VISEAN	NAMURIAN	ELVIRAN	Menard	Reynolds Member	Mauch Chunk Formation
			Waltersburg		
			Vienna		
			Tar Spring		
	CHESTERIAN	HOMBERGIAN	Glen Dean	Wymps Gap Member	Greenbrier Formation
			Hardinsburg		
			Haney		
			Fraileys		
		GASPERIAN	Beech Creek	Savage Dam Member	
			Cypress		
			Ridenhower	Deer Valley Member	
			Bethal		
			Downeys Bluff		
			Yankeetown		
MERAMECIAN	Renault	Loyalhanna Member			
	Aux Vases				
	Ste. Genevieve				

Figure 24.—Correlations of members of the Greenbrier Formation of western Maryland and the Chesterian units of the Illinois Basin.

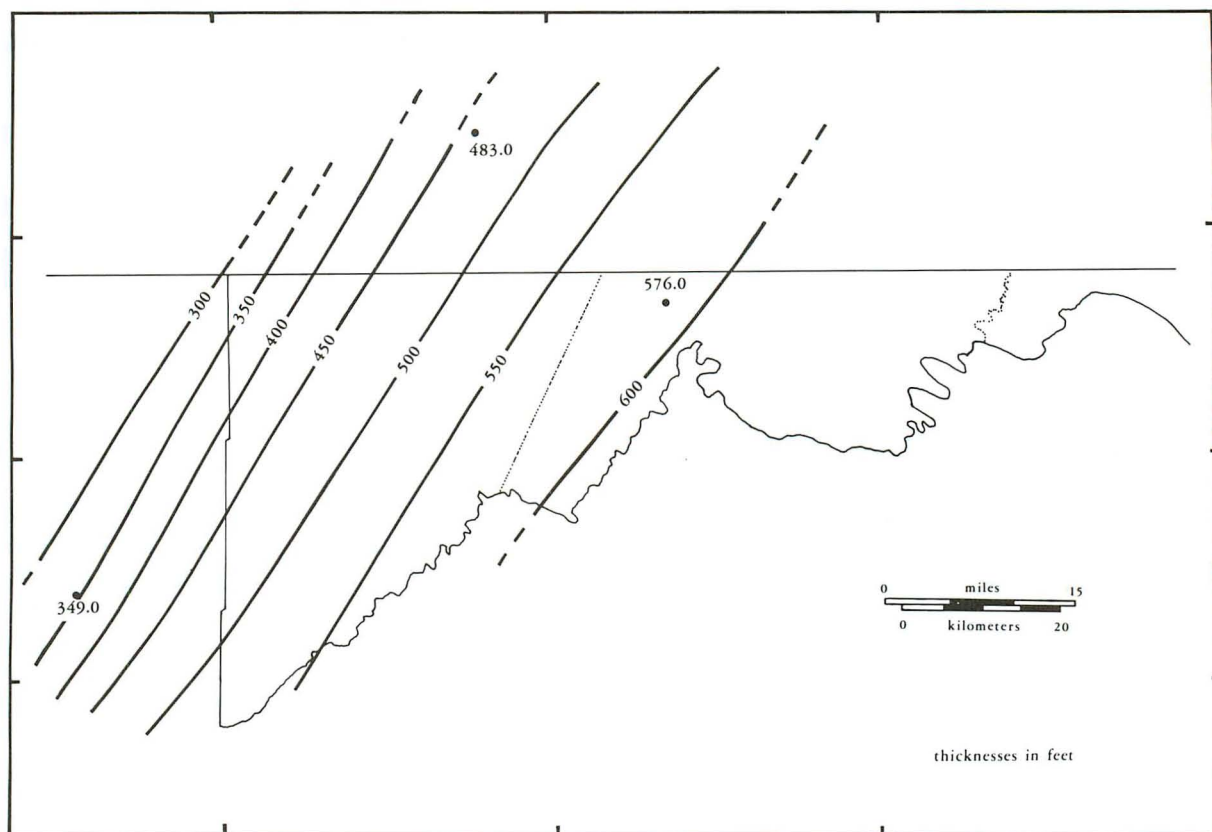


Figure 25. — Generalized isopach map of the Mauch Chunk Formation of western Maryland and adjacent Pennsylvania and West Virginia.

Lime.” Correlations based on it can be considered fairly precise. Uttley (1974) equated the Reynolds with the Glen Dean of the type Chesterian section and the upper part of the Maxville Limestone of Ohio. However, Reger (1931) believed that the Glen Dean was equivalent to the Alderson Limestone. This would make the Reynolds Limestone equivalent to one of the later limestone units of the type Chesterian, such as the Menard or Clore. Rexroad and Clark (1960) demonstrated that conodonts of the Bluefield Formation of southern West Virginia (of which the Reynolds is a Member) were equivalent to those recovered from the Glen Dean Formation of the Illinois Basin.

MISSISSIPPIAN-PENNSYLVANIAN UNCONFORMITY

The boundary between the Mississippian and Pennsylvanian is conventionally placed at the contact of the Mauch Chunk Formation and Pottsville Group. For that very reason, the contact, as is currently recognized in Maryland, must be unconformable insofar as the base of the Pottsville Group is an erosional scour sur-

face. One of the few exposures of the contact can be seen along U.S. Route 48 at the crest of Big Savage Mountain 0.5 mile east of the Finzel Road exposure (locality 7). Here red-brown, green-gray, and variegated mudstones, and green-gray, cross-bedded sandstones of the upper Mauch Chunk are unconformably overlain by medium- to coarse-grained, tan, cross-bedded sandstones of the Pottsville (Figure 26B). The duration of the hiatus manifested by this disconformity is not known. In northeastern Pennsylvania and southern New York, Pottsville strata of Pennsylvanian age lie unconformably upon Devonian strata, whereas in the Southern Anthracite Field the relationship is believed to be conformable (Meckle, 1970; Edmunds et al., 1979; Berg et al., 1986). Edmunds et al. (1979) have shown that several floral zones are absent throughout much of Pennsylvania, lending evidence to the belief a sub-Pennsylvanian hiatus exists. The sharp change in depositional tempo and mode at the contact of the Mauch Chunk and Pottsville (from oxidizing red alluvial-plain sediment to coal-bearing strata) suggests that either rapid and major basinal changes occurred to

Figure 26. — A, Multi-stacked fluvial sandstones of the upper Mauch Chunk exposed along railroad tracks at locality 6. B, Contact between the Mauch Chunk Formation (Mmc) and Pottsville Group (lPp) as exposed on Big Savage Mountain along U.S. Route 48 near Finzel Road (locality 7).



B

facilitate this change in depositional style, or indeed a hiatus of some duration is represented by this contact.

PALEOGEOGRAPHY AND DEPOSITIONAL HISTORY

During the Mississippian, North America was situated at low latitudes (Scotese et al., 1979), and much of the central and western part of the continent was submerged beneath shallow cratonic seas (Gutshick and Sandberg, 1983) (Figures 27A, B). During this time Maryland was located at approximately 15 degrees south latitude. The western part of the state bordered a shallow extension of the cratonic sea that extended from northeastern Kentucky into Ohio and western Pennsylvania. In what today is eastern Maryland, a mountain chain uplifted during the Acadian Orogeny (Devonian) supplied large quantities of clastic sediments. Muds, silts, sand, and pebbles eroded from this mountain system were transported westward by river systems and deposited on an aggrading alluvial-plain in central portions of Maryland. To the east the gradient of the alluvial plain increased (Pelletier, 1958) adjacent to the mountain chain. During periods of marine transgression, westernmost Maryland was submerged beneath shallow marine waters. Conversely, with sea level lowering, much of what was inundated became a subaerial coastal plain.

During the Late Devonian, the Catskill (Hampshire) deltaic progradation intensified. As it began to wane during the latest Devonian, a marine transgression (Cleveland) submerged much of the previously deposited red clastics and produced the Oswayo Member. This marine transgression inundated most of Garrett County. However, to the east, deposition of coeval non-marine red clastics continued (Figure 28A). Throughout Maryland this interval resulted in deposition of shallow-water (littoral) sandstones, which commonly exhibit *Skolithos* burrows, but are otherwise devoid of marine fauna. That this marine transgression may have been episodic is indicated by its intertonguing relationship with subjacent red beds and the presence of intercalated coal beds and nonmarine strata with *Skolithos*-bearing intervals. To the north, in Pennsylvania, the "Murrysville delta" extended into western Pennsylvania, while to the south the Gay-Fink delta (Pepper et al., 1954) prograded into eastern West Virginia. Consequently, western Maryland during this time appears to have represented a shallow interdistributary bay environment. Concomitant with regression of the Oswayo marine waters was a progradation of the coastal plain. The lack of thick fluvial sandstone units suggests that progradation was mainly accomplished by lateral currents redistributing sediment contributed by the adjacent Murrysville and Gay-Fink deltas.

Shortly after the Cleveland regression, a second transgression marked the beginning of the Mississippian. Although more areally and temporally restricted than the first, this second transgression nonetheless submerged a small area of Garrett County (Figure 28B). Dennison et al. (1986) have equated this episode to the Bedford transgression of Ohio. Once again progradation and aggradation of the coastal plain brought an end to marine conditions. This regression is generally equatable to the deposition of the Berea Sandstone of Ohio. Kammer and Bjerstedt (1986) have proposed that this interval is marked by a regionally developed unconformity. This regression was followed by another transgression which inundated much of Garrett, Allegany, and Washington Counties (Riddlesburg Member).

In eastern Allegany and western Washington Counties, the Riddlesburg transgression initially was marked by deposition of shoreline sands and associated diamictos. Continued deepening resulted in the deposition of dark-gray muds, silts, peats, and sands of marsh and tidal flat origin over the shoreline sandstones. During maximum transgression a lagoon or interdistributary bay with restricted circulation developed on top of the previously deposited transgressive sediments. At La Vale unusually thick shoreline sands and diamictos created a topographic high that inhibited the development of full-fledged marine conditions. However, in western Garrett County (Keysers Ridge) the presence of well-developed marine sandstones indicates deposition of shallow marine sand bars (Figure 28C). Regression of the Riddlesburg sea and concomitant coastal plain progradation led to the development of a broad low-relief alluvial plain during latest Rockwell deposition (Figure 28D). This alluvial plain was drained by relatively small rivers between which green-gray, red-brown, and variegated muds and silts were deposited. Oxidizing conditions in these overbank areas prevented the accumulation of organic material, yet root casts indicate these areas were vegetated.

Continued aggradation of the alluvial plain and development of major trunk streams mark the beginning of Purslane deposition (Figure 28E). Between these major tributaries oxidizing overbank conditions are indicated by the highly localized red claystones of the "Patton Shale." Overall upsection increase in the grain size of the Purslane suggests that stream gradients increased from the lower to upper Purslane. This increase in stream gradient led to the development of anastomosing braided-stream deposition during the upper Purslane (Figure 28F). Within the interfluvial areas sufficient moisture was apparently retained and conditions were quiet enough to produce and preserve organic accumulations that subsequently became coal beds and coaly shales. To the west, stream gradients decreased and braided streams, unable to carry their coarse sedi-

ment load, gave way to meandering fluvial deposition (Figure 29). In southern Garrett County sediment distribution centers were active, as indicated by the thick, coarse conglomerates in the Purslane of that area.

Throughout most of the Meramecian, the upper surface of the Purslane was exposed to erosion. In Maryland the lack of demonstrable erosional relief suggests that significant erosion was not taking place during this interval of time as it was in north-central Pennsylvania. In central Pennsylvania a southward tilting produced erosion of correlative deposits (Edmunds et al., 1979).

During the late Meramecian, marine waters again inundated much of western Maryland and deposited the

Loyalhanna Member of the Greenbrier Formation (Figure 30A). Throughout most of its extent, the Loyalhanna was deposited in very shallow waters, probably in the form of submarine sand-waves (Adams, 1979; Brezinski, 1984). An admixture of red clays, contributed from an eastern, coeval Mauch Chunk source, imparted a red coloration to an area of Loyalhanna in Allegany and Garrett Counties, and southern Somerset County, Pennsylvania. In southern Garrett County somewhat deeper waters of deposition are indicated by the intertonguing of typical cross-bedded Loyalhanna and dark-gray argillaceous lime mudstones. Regression was accomplished by aggradation to and perhaps above sea level, as indicated by the tan dolomitic siltstone

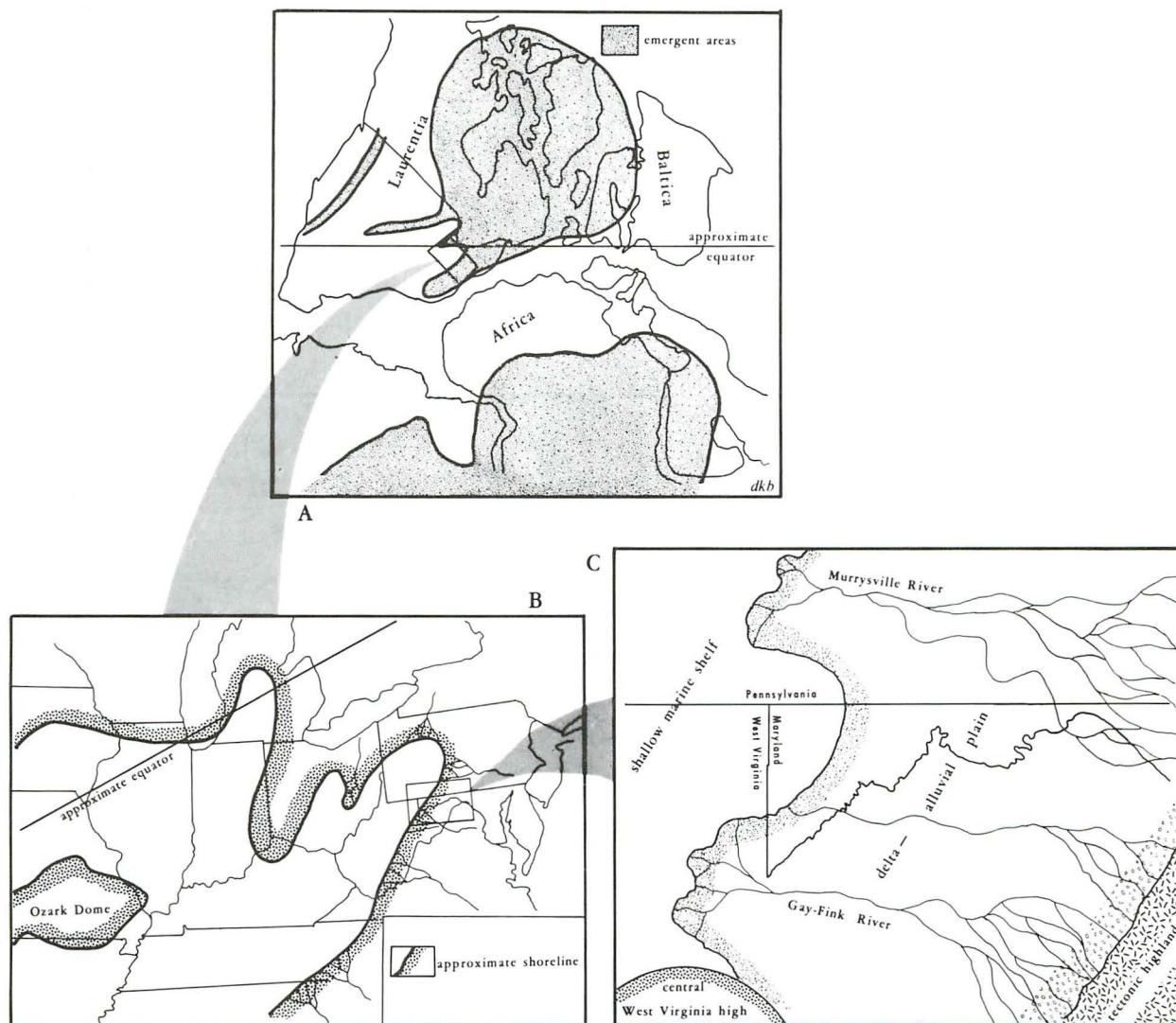


Figure 27.—Mississippian paleogeography (modified from Brezinski, 1989, Figure 2). A, Distribution of North America, Africa, and the Baltic region during the Early Mississippian. B, Shoreline paleogeography of the eastern United States during the Upper Mississippian. C, Salient geographic features of western Maryland, Pennsylvania, and West Virginia during the Early Mississippian (modified from Pepper et al., 1954; Bjerstedt and Kammer, 1988).

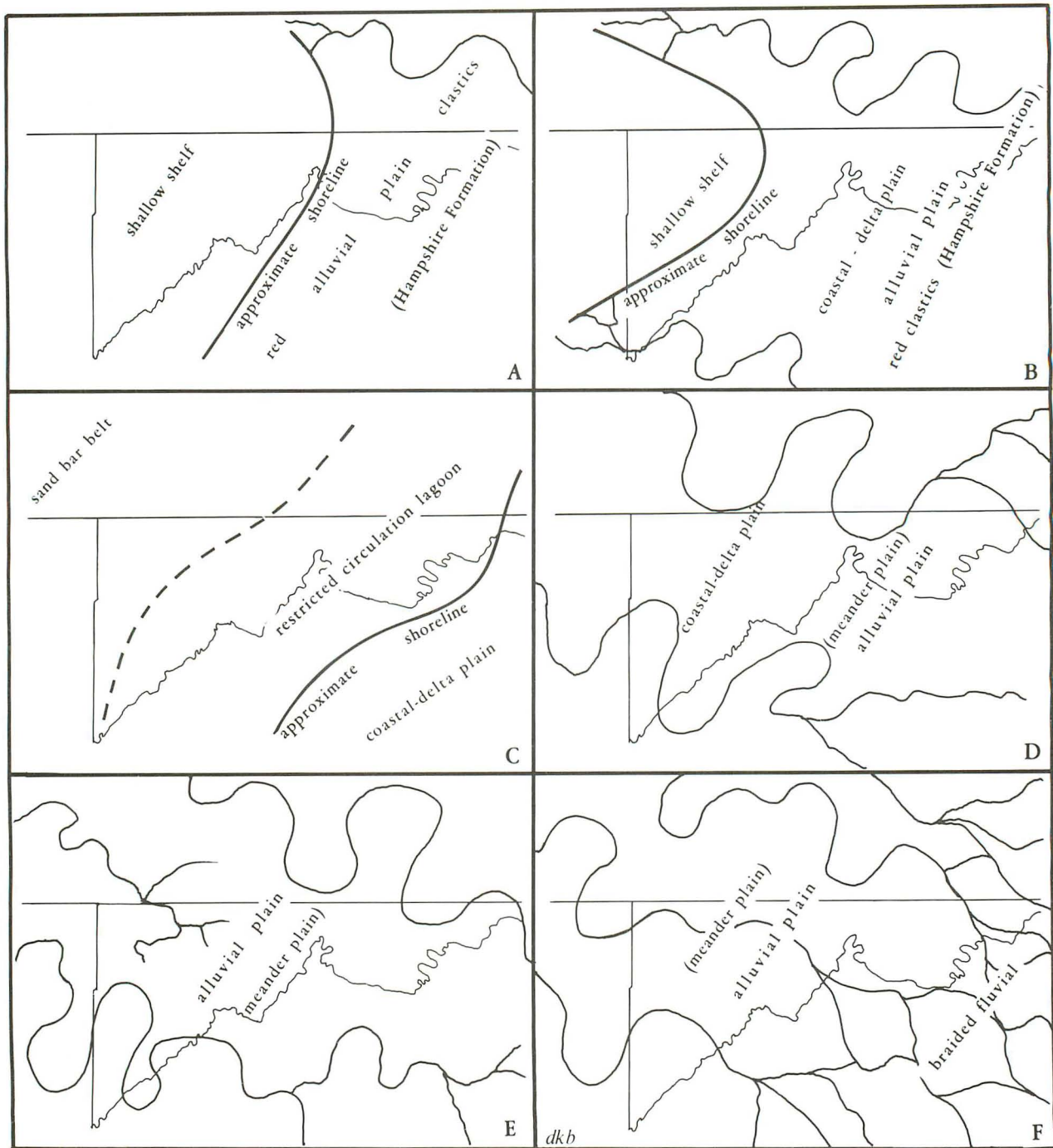


Figure 28.—Interpreted distribution of environments during the Early Mississippian (modified from Brezinski, 1989, Figure 10). A, Finzel Marine Tongue deposition. B, Bedford deposition. C, Riddlesburg deposition. D, upper Rockwell deposition. E, lower Purslane deposition. F, upper Purslane deposition.

which commonly caps the Loyalhanna.

Following the Loyalhanna regression a short-lived marine episode (Deer Valley) inundated all of Garrett and much of western Allegany Counties, but extended only a short distance into southern Pennsylvania (Figure 30B). The Deer Valley Member, like the Loyalhanna, was deposited in shallow agitated water, as indicated by

ooid formation. To the south interstratified layers of dark-gray limestone and oolitic limestone suggest a deepening of marine waters in that direction. Regression of the Deer Valley sea was accompanied by clastic shoreline progradation of the Savage Dam Member and the development of a coastal plain environment in western Maryland (Figure 30C). The Savage Dam Mem-

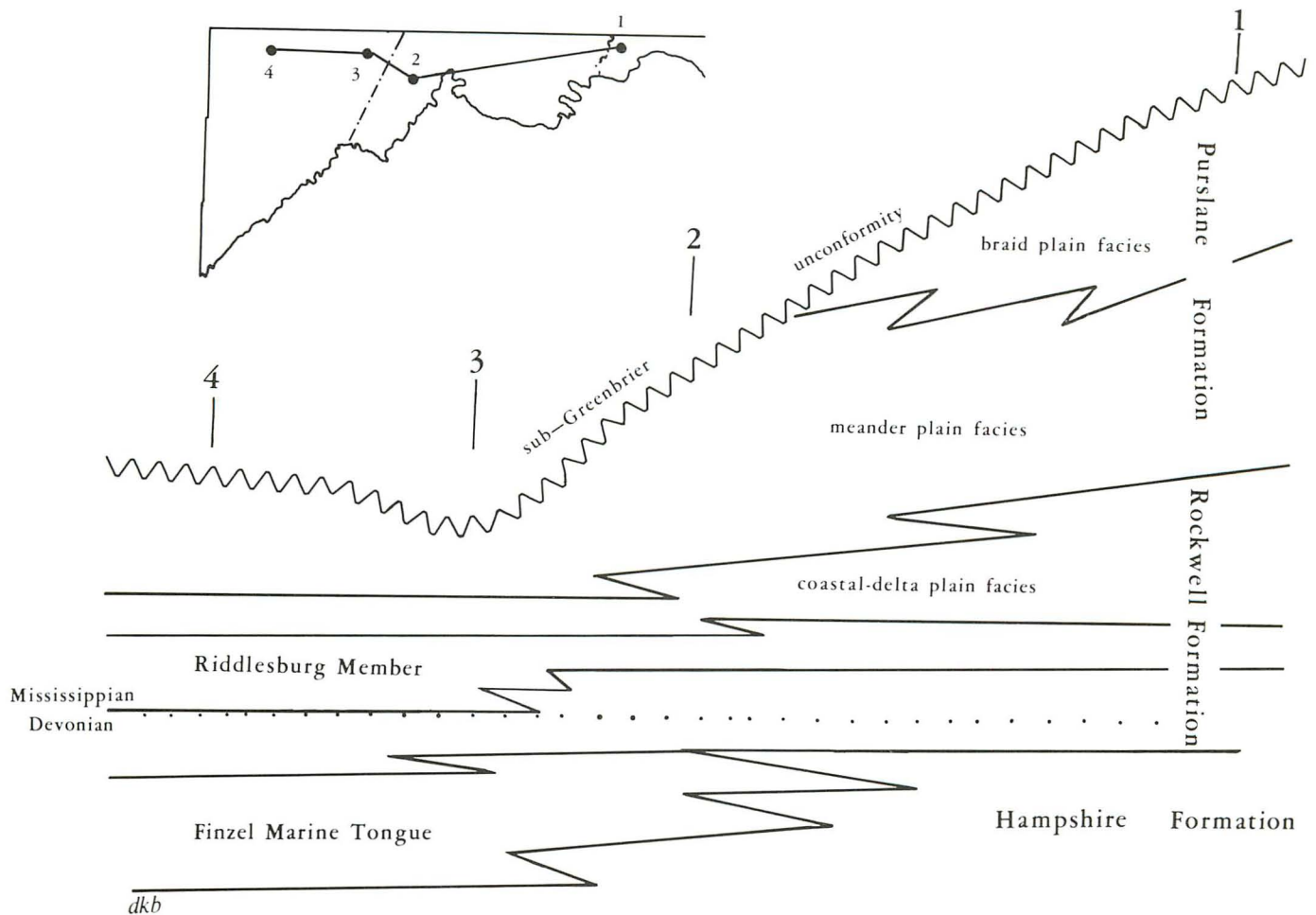


Figure 29.—Lateral facies relationships within Lower Mississippian strata of western Maryland (taken from Brezinski, 1989, Figure 9).

ber was deposited during a number of minor sea level oscillations that submerged the coastal plain as many as seven times. Each marine incursion was followed by a period of clastic influx and shoreline progradation, during which aggradation to subaerial conditions was completed. During the deposition of the Savage Dam Member, areas to the southwest (central and southern West Virginia) were continually experiencing marine conditions.

During the later stages of Savage Dam deposition, transgression of the Wymps Gap sea began. This transgression appears to have been episodic, as indicated by the intertonguing relationship exhibited by limestone of the Wymps Gap Member and clastic strata of the Savage Dam Member. The deepening of the marine waters continued throughout most of the Wymps Gap deposition. Areas in southwestern Garrett County ex-

perienced greater water depth than did areas to the east and north. This is indicated by: 1) the thinning of the member in those directions, and 2) the change from dark-gray limestone (open-shelf environment), to cross-bedded, oolitic grainstone (shoal environment), to variegated argillaceous limestone (lagoon environment) to the northeast (Figure 30D) (Brezinski, 1984). Regression of the Wymps Gap sea led to the progradation of alluvial-plain facies.

During a brief, but widespread transgression, the Reynolds sea once again inundated the northern part of the Appalachian Basin. The Reynolds Member in Maryland is represented by thin shoreline deposits of molluscan-bearing shales (Figure 30E). Alluvial deposits prograded westward as the Reynolds sea withdrew, and for the remainder of the epoch meandering river systems flowed west or northwest, depositing cross-bedded,

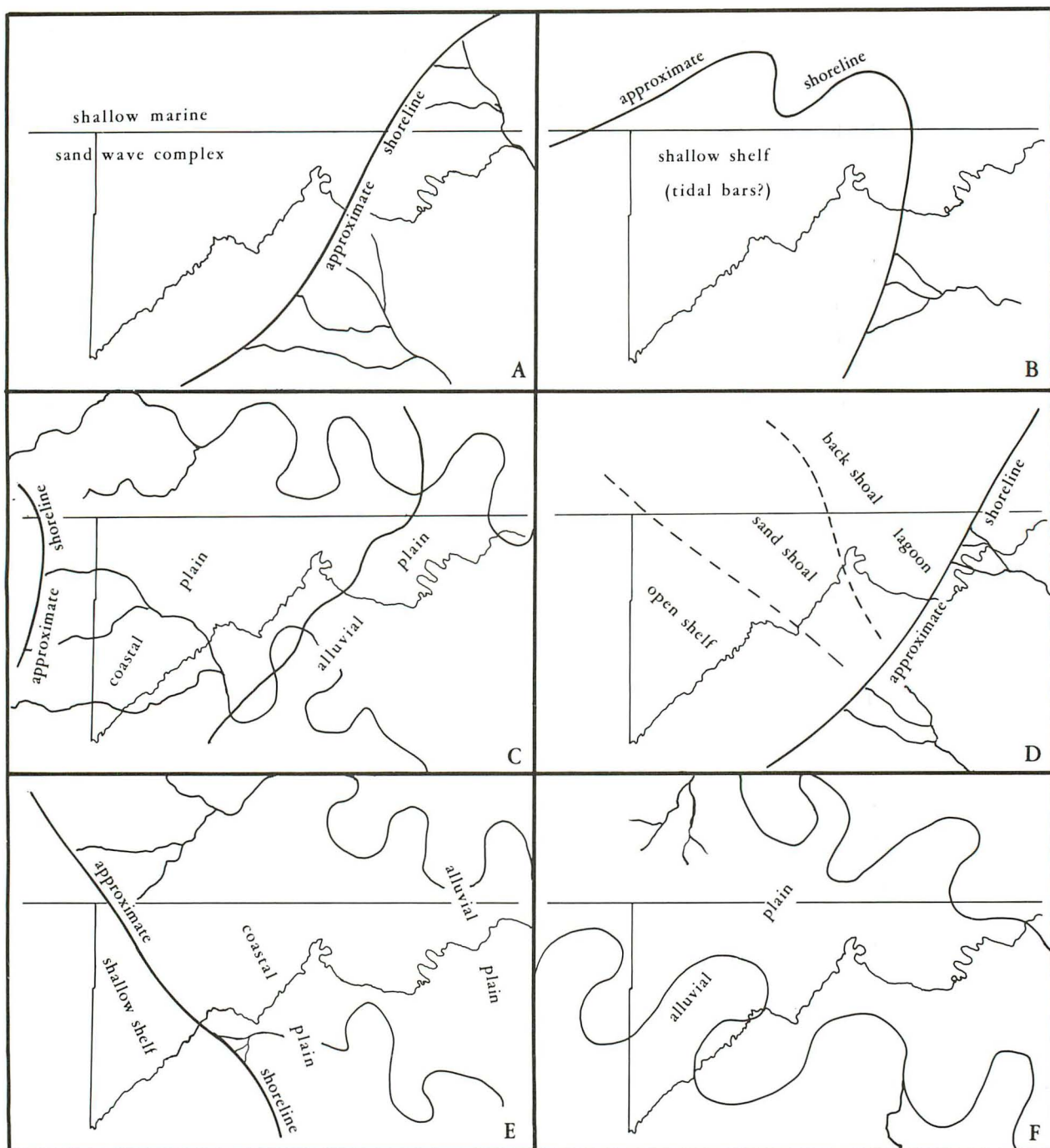


Figure 30.—Interpreted distribution of depositional environments for the Late Mississippian. A, Loyalhanna deposition. B, Deer Valley deposition. C, Savage Dam deposition. D, Wymps Gap deposition. E, Reynolds deposition. F, upper Mauch Chunk deposition.

channel-phase sandstones and overbank red claystones and siltstones (Figure 30F). A reduced sediment input and (or) initiation of erosion produced a hiatus of unknown duration toward the end of Mauch Chunk deposition (Late Mississippian), but prior to earliest Pottsville (Pennsylvanian) deposition (Figure 31).

ECONOMIC UTILIZATION OF MISSISSIPPIAN STRATA

On the whole, Mississippian strata of Maryland are not significant producers of economic materials. Unlike the Devonian which has, in the past, produced large quantities of natural gas, or the overlying Penn-

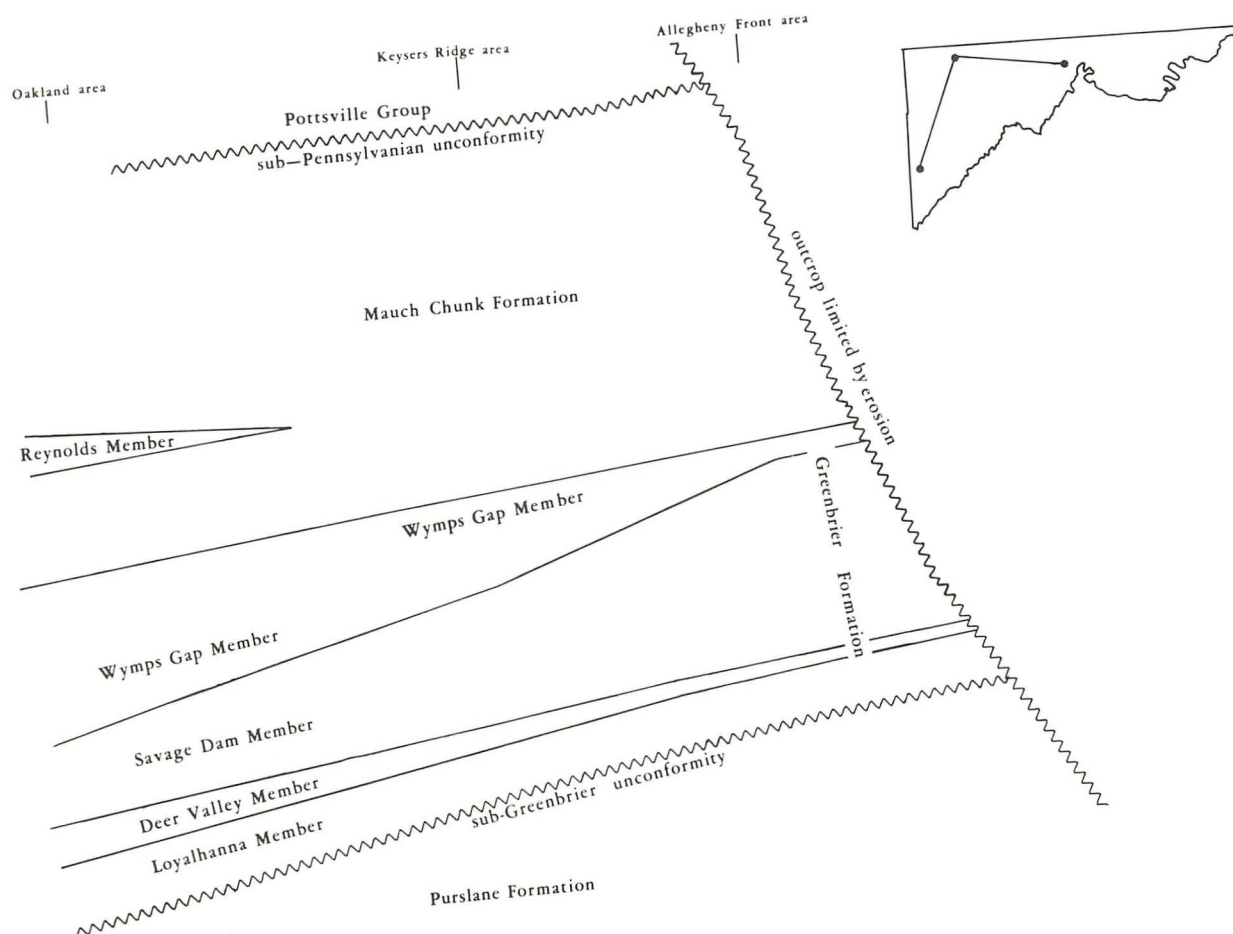


Figure 31.—Lateral facies relationship of Upper Mississippian strata in western Maryland.

sylvanian which contains large coal reserves, Mississippian strata are utilized almost solely for nonfuel rock products.

ROCKWELL FORMATION

Correlative strata of the Rockwell Formation in West Virginia and Pennsylvania are locally prolific oil and gas producers. The Murrysburg Sand, a Pennsylvania producer, represents a coeval facies of the lower Rockwell of Maryland. Likewise the Berea Sandstone, an oil-producing sand of Ohio, can be correlated with the interval of siltstones and shales which underlie the Riddlesburg Member in western Maryland.

In western Washington and eastern Allegheny Counties, the Riddlesburg Shale has been used for fill. There are several borrow pits on Town and Sideling Hills where this unit has been exploited (localities 2, 3, 4). Coalbeds are relatively common in the Rockwell

Formation; however, these coals are very thin, relatively impure, laterally discontinuous, and uneconomical (Table 1).

PURSLANE FORMATION

Like the Rockwell, equivalents of the Purslane Formation in West Virginia and Pennsylvania are oil and gas producers. The "Big Injun" of drillers' terminology represents a unit correlative to the Purslane of Maryland. Coal beds in the Purslane are not economic; however, the overlying Hedges Shale has been known locally to have marginally economic coals (Stose and Swartz, 1912).

In Garrett County, flaggy strata of the Purslane are extensively quarried as dimension stone. The regular bedding (1 to 8 inches thick) allows it to be removed and cut or broken into regular-sized slabs or blocks. Casselman Valley Ledge Stone Company currently quarries

this interval along the crest of Little Savage Mountain and Four Mile Ridge between U.S. Route 48 and Avilton-Lonaconing Road. Flint (1965) found that strata of this interval were used for the same purpose in southern Somerset County, Pennsylvania.

Poorly indurated Purslane conglomerate has been quarried along Silver Knob Road (locality 23) (Figure 11A). The pure quartz conglomerate was likely used for road base material.

GREENBRIER FORMATION

The Greenbrier Formation is the most extensively utilized Mississippian unit in Maryland. In southern West Virginia dolomitic zones in the lower Greenbrier are large oil- and gas-producing horizons; however, in Maryland this formation has not yielded hydrocarbon products (Youse, 1968).

The Greenbrier in Maryland is utilized almost solely for crushed stone. Current quarry operations within the Loyalhanna are conducted by Gaylord Fuel Corporation (locality 17) and Maryland Minerals Incorporated (locality 15). Within these operations sandy strata of the Loyalhanna Member and purer carbonates of the Deer Valley Member are quarried together. Abandoned operations at the Bishoff Quarry (locality 19) and along Jennings Run west of Corriganville were within the same units. In Pennsylvania these units are currently or have been formerly quarried near Mount Davis (locality 29), and in the Casselman River Gorge between Rockwood and Garrett (locality 28).

The Wymys Gap Member has also been extensively utilized for crushed stone. At the Browning's Deep Creek Quarry, the Wymys Gap Member is deep-mined, crushed, and used for road aggregate. Similar abandoned deep-mine operations are located immediately to the north of Browning's Quarry (locality 24). The Sang Run Quarry has also been utilized by the Garrett County Road Department for similar purposes. Numerous other abandoned quarries are present throughout Garrett County and adjacent Pennsylvania (locality 12, 13, 22, 29, 34, 35).

At several locations the relatively pure Deer Valley Member has been quarried by farmers and burned for agricultural lime. Several of these quarries may be observed near locality 33 and along the road which runs between High Point, Maryland, and Mt. Davis, Pennsylvania, west of Grantsville. A similar utilization is probable for the abandoned quarry 50 yards west of New Germany Road 1 mile south of New Germany State Park (locality 25). At this locality, a thin impure limestone of the upper Savage Dam Member has been quarried.

MAUCH CHUNK FORMATION

At present the only known economic utilization of the Mauch Chunk strata in Maryland is as artificial fill. Along U.S. Route 40 at the crest of Big Savage Mountain, a borrow pit indicates this use.

ACKNOWLEDGMENTS

This report is dedicated to the memory of the late Dr. Norman K. Flint of the University of Pittsburgh, under whose partial guidance some of the initial field work was conducted.

I would like to thank Drs. T.W. Kammer and T.W. Bjerstedt whose ideas, both in a written and verbal form, aided my study of the Lower Mississippian formations. Dr. John L. Carter of the Carnegie Museum of Natural History in Pittsburgh, Pennsylvania, identified or verified brachiopod species, and Dr. John Pojeta identified the bivalves. Comments and criticisms regarding this manuscript, by C.A. Kertis, K.A. Schwarz, J.D. Glaser, T.M. Berg, and E.T. Cleaves are appreciated.

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APPENDIX I — MEASURED SECTIONS

GENERAL

Stratigraphic sections were measured with a 5-foot Jacob's staff or Brunton and pace methods. Sections were measured between 1982 and 1989. Where individual members are recognized the footage and descriptions are indented. All longitudes are west of the Prime Meridian and all latitudes are north of the equator.

Locality 1

Section located at the road cut through Sideling Hill for U.S. Route 48, Washington County. Base of the section is on the southwest side of cut, Longitude 78°71' 10"; Latitude 39°43' 35". Base of the section is in the Hampshire Formation.

Thickness (feet)

20.0 Red-brown claystone with interbedded root-mottled siltstone.

Rockwell Formation

7.0 Light-gray claystone.
3.0 Tan to gray-green, argillaceous sandstone.
0.25 Black, coaly, slickensided shale.

Riddlesburg Member

25.0 Gray-green, micaceous, silty, medium-grained, cross-bedded sandstone. Abundant plant fragments and log remains.
11.0 Green-gray, sandy mudstone, highly slickensided.
5.0 Medium-gray, diamictite with large rounded white quartz pebbles, few plant fragments, shale pebbles and pink granite cobbles.
4.0 Red-brown, slickensided shale.
22.0 Medium-gray, polyimictic diamictite with rounded and angular pebbles and cobbles of hornfels, white quartz, and black chert (section moved to north side of cut).
1.5 Medium-gray to light-gray, silty shale.
27.0 Tan to light-gray, medium- to coarse-grained, cross-bedded sandstone containing a few layers of quartz pebbles, and herringbone cross-bedding.
2.0 Brown, friable, medium-grained sandstone.
32.75 Interbedded, medium-gray, medium-grained sandstones, dark-gray siltstones, and black carbonaceous shales with a few thin shaly coals 1 to 2 inches thick.

27.0 Very-dark-gray, silty shale to siltstone with abundant plant fragments. Marine brachiopods and bivalves present near the middle and layers of orbiculoid brachiopods present at the top.
21.5 Interbedded, dark-gray, fine-grained sandstone beds 0.75 to 1.5 feet thick, dark-gray siltstone, and thin coaly shales.
1.5 Black, coaly shale with layers of cleaved coal highly slickensided.
7.0 Dark-gray, laminated siltstone.
6.0 Thinly interbedded black, coaly shales and laminated dark-gray claystone.
13.0 Interbedded, gray-green, medium-grained, argillaceous sandstone and siltstone.
0.2 Black, coaly shale.
5.0 Dark-green-gray siltstone with coaly stringers.
0.8 Black, coaly shale.
5.0 Green-gray, sandy siltstone.
5.5 Gray-green, lumpy, silty mudstone to claystone.
15.0 Light-gray-green, medium-grained, cross-bedded sandstone, conglomeratic at the base, containing shale pebbles. Erosional base. Fines upward into overlying unit.
4.5 Dark-gray-brown, silty mudstone, containing a few coaly stringers.
8.0 Interbedded, gray-green, fine-grained, sandstones and very sandy laminated siltstone.
7.0 Medium-gray, slickensided claystone to mudstone, becoming silty and green-gray at the top.
5.0 Green-gray, laminated siltstone.
3.0 Gray-green, slickensided claystone.
6.0 Gray-green, silty, fine-grained sandstone.
5.0 Green-gray to red-brown, silty mudstone to claystone, slickensided.
5.0 Green-gray, sandy siltstone.
2.0 Interbedded, olive-gray mudstone, and light-gray-green, fine-grained sandstone.
5.0 Light-olive-gray, argillaceous, silty sandstone interbedded with sandy mudstone.
6.0 Light-olive-gray, medium- to fine-grained sandstone becoming shaly at the top.
4.0 Gray-green, silty, mudstone.
0.25 Coaly, olive-gray sandstone.
2.0 Black, coaly, silty shale.

6.0	Light-green-gray, silty shale.	10.0	Tan to light-gray-green, micaceous siltstone, with thin red beds up to 1 foot thick.
0.2	Black, coaly shale.		
2.0	Olive-gray, silty mudstone.		
7.0	Light-gray-green, medium- to fine-grained, cross-bedded sandstone, grading upward into overlying unit.	10.0	Red-brown, silty mudstone.
		59.0	Light-gray-green to light-gray, coarse to conglomeratic sandstone. Very highly cross-bedded with shale clasts, limonite pebbles, and plant fragments in the lower 10.0 feet. White quartz pebbles in the upper 40.0 feet. Erosional base.
8.0	Olive-gray to light-green-gray, silty mudstone to siltstone, very-dark-gray and coaly at the top, containing root casts below coal.		
5.0	Very fine-grained, silty sandstone.		
15.0	Red-brown to gray-green or variegated, silty mudstone with root casts.	9.0	Medium- to dark-gray siltstone with interbeds of black shale.
0.75	Green-gray, very fine-grained sandstone.	3.0	Black, brittle, coaly shale with thin coal layers and abundant plant fragments and root zones.
3.0	Red-brown claystone.		
Purslane Formation		0.8	Black, coaly shale with pyrite nodules up to 5 inches in diameter.
45.0	Light-gray-green to tan, medium-grained, cross-bedded sandstone. Erosional base, and coaly stringers.	3.2	Medium-gray, fine-grained sandstone with root casts at the top.
2.0	Gray-green mudstone.	0.4	Coal, highly slickensided.
10.0	Light-olive-gray, medium- to coarse-grained, cross-bedded sandstone, containing a few beds of dark-gray shale. Erosional base.	0.25	Black, brittle siltstone.
		0.8	Black, coaly shale.
		0.1	Slickensided coal.
		1.0	Black, laminated, brittle siltstone.
32.0	Light-gray-green, medium-grained, cross-bedded sandstone, becoming finer grained, silty at the top.	0.2	Black, coaly shale, highly slickensided.
		5.0	Black, sandy siltstone with plant fragments, root zones, and pyrite nodules interbedded with thin sandstone layers.
4.0	Tan to gray-green siltstone.		
5.0	Red-brown mudstones to claystone with abundant root casts.	1.0	Gray-green, medium-grained sandstone, with root casts.
7.0	Olive-gray claystone, weathers tan.	0.1	Slickensided coal.
9.0	Red-brown claystone with root casts.	7.0	Black, shaly siltstone, laminated, containing pyrite nodules, plant fragments, and root zone at the top.
25.0	Medium-gray to gray-green, locally white, medium- to coarse-grained, cross-bedded, micaceous sandstone, with shale pebbles at the base and coaly stringers throughout.	3.3	Black, shaly coal, slickensided.
		42.0	Tan to light-gray-green, medium- to coarse-grained, cross-bedded sandstone. Shale-pebble conglomerate at the base, abundant plant fragments especially near the top and bottom.
6.0	Reddish-brown, silty mudstone.		
7.0	Green-gray claystone.		
5.0	Reddish-brown claystone to mudstone becoming gray-green at the top.	45.0	White, coarse-grained to conglomeratic, cross-bedded sandstone, shale pebbles, white quartz conglomerate layers, and plant fragments abundant throughout.
23.0	Green-gray, cross-bedded, medium-grained, micaceous sandstone, fining upward into overlying unit. Plant fragments and shale-pebble conglomerate at base.		

Locality 2

This section is located at the south end of Sideling Hill at the Potomac River along Pearre Road in Washington County, Longitude 78°20'00"; Latitude 39°37'23". Entire section is in the Riddlesburg Member of the Rockwell Formation.

Thickness (feet)

Rockwell Formation

Riddlesburg Member

37.0	Medium-gray, cross-bedded, pebbly, well-sorted sandstone exhibiting herringbone cross-bedding.
4.5	Dark-gray, silty shale with root casts.
5.0	Medium-gray, coarse-grained, cross-bedded sandstone.
6.0	Very-dark-gray, silty shale with thin interbeds of dark-gray siltstone.
4.0	Dark-gray siltstone with thin layers of shale and rippled sandstone.
3.0	Dark-green-gray, silty shale.
4.0	Dark-gray siltstone with thin (1 to 2 inch) interbeds of shale.
1.0	Dark-olive-gray, argillaceous sandstone.
30.0	Very-dark-gray to black, pencil shale (Riddlesburg Shale).
9.0	Very-dark-gray, silty shale interbedded with dark-gray siltstone.
5.0	Dark-olive-gray siltstone.
3.0	Black, carbonaceous shale.
10.0	Dark-olive-gray shale interbedded with 2 to 3 inch thick siltstone beds.
0.8	Black, carbonaceous shale with 1.0 inch coaly layers at the top.
1.5	Dark-gray, silty shale.
7.0	Very-dark-gray, sandy siltstone with a few shaly beds < 1 inch thick.
0.8	Dark-gray, root-mottled siltstone.
0.3	Dark-gray, sandy siltstone with shaly interbeds with pinch out laterally.
1.0	Carbonaceous shale.
0.5	Black, carbonaceous siltstone.
10.0	Dark-gray, shaly siltstone.
0.1	Black, carbonaceous shale.
1.5	Dark-gray, silty shale.
0.15	Black, carbonaceous shale.
2.0	Dark-gray, silty shale.
7.0	Dark-olive-gray siltstone to silty shale interbedded with shale beds 2 to 3 inches thick, and containing abundant plant fragments.
0.5	Black, carbonaceous shale with 1 inch layers of shaly coal in the middle.
2.0	Dark-olive-gray siltstone.

Locality 3

Section is located along Scenic U.S. 40 on the east flank of Town Hill, Allegany County, Longitude 78°23'45"; Latitude 39°42'00". Base of the section is in the Hampshire Formation.

Thickness (feet)

Hampshire Formation

26.0 Mostly covered, red siltstone and shale.

6.0 Reddish-brown, silty shale.

Rockwell Formation

Riddlesburg Member

25.0	Tan to pink, herringbone cross-bedded, medium-grained sandstone.
35.0	Reddish-brown, highly slickensided, sandy diamictite.
10.0	Green-gray, argillaceous, sandy siltstone to sandstone.
0.85	Light-gray claystone.
50.0	Tan, medium- to coarse-grained, cross-bedded sandstone. Abundant rounded quartz pebbles and herringbone cross-bedding. Weathers to spheroidal boulders, and becomes silty at the top.
17.0	Interbedded, olive-gray, silty shale, siltstone, and very-fine-grained sandstone.
3.0	Covered.
25.0	Dark-gray to dark-olive-gray, silty, pencil shale with a few beds of siltstone, especially near the top. Contains marine brachiopods and bivalves (Riddlesburg Shale).
20.0	Interbedded, dark-olive-gray, shaly siltstone, and silty shale.
5.0	Dark-gray, medium-bedded siltstone.
8.0	Covered.
2.0	Dark-olive-gray, silty shale.
23.0	Olive-gray, silty shale with thin (2 to 3 inch) interbeds of gray siltstone and a few thin carbonaceous shale beds.
3.0	Light-olive-gray, shaly, platy siltstone interbedded with silty shale.
26.0	Tan to light-gray-green, silty shale with a few thin siltstone interbeds.
1.0	Light-gray, argillaceous, medium-grained sandstone.
5.0	Interbedded, gray-green shaly siltstone.
3.0	Olive-gray, medium-grained sandstone, shaly at top.
9.0	Olive-gray, silty shale.
3.0	Gray, medium-grained sandstone.
8.0	Tan to olive-gray, silty shale with interbedded argillaceous sandstone beds

3.5	up to 1.0 foot thick. Tan, fine-grained, argillaceous sandstone.
25.0	Interbedded, silty, fine-grained sandstone and silty, gray shale.

Locality 4

Section along Mertens Avenue on the west flank of Town Hill in Green Ridge State Forest, Allegany County, Longitude 78°28'45"; Latitude 39°36'00". Base of the section is in the Rockwell Formation.

Thickness (feet)

Rockwell Formation

7.0	Red and brown to variegated, sandy siltstone.
10.0	Covered.

Riddlesburg Member

28.0	Tan, coarse-grained, cross-bedded sandstone.
15.0	Covered.
10.0	Gray-green, fissile shale.
4.0	Light-olive-gray, silty, fine-grained sandstone.
10.0	Olive-gray, silty shale.
15.0	Covered (probably green-gray siltstone and shale).
32.0	Olive-gray to dark-gray, silty, pencil shale.
10.0	Covered.
10.0	Olive-gray siltstone to silty shale.
12.0	Olive-gray shale with interbedded thin siltstone beds.
6.0	Olive-gray to light-olive-gray, shaly siltstone.
14.0	Tan, sandy siltstone with shaly intervals.
5.0	Tan claystone.
3.0	Tan, silty shale to siltstone.
6.0	Tan claystone with root casts.
15.0	Covered.
7.0	Tan, thinly interbedded siltstone and sandstone.
3.0	Reddish-brown claystone.

Locality 5

Section is located along the eastbound lane of U.S. Route 48 along the Allegany Front 0.9 mile west of Vocke Road Exit, Longitude 78°51'00"; Latitude

39°38'10". Base of the section is in the Hampshire Formation.

Thickness (feet)

Hampshire Formation

5.0	Reddish-brown mudstone.
5.0	Interbedded, red mudstone and siltstone.
2.0	Reddish-brown claystone.
1.0	Reddish-brown mudstone.
1.5	Reddish-brown, silty sandstone.
7.0	Reddish-brown siltstone.
1.6	Red claystone.
4.0	Interbedded, reddish-brown claystone and siltstone.
12.0	Reddish-brown mudstone grading upward into a siltstone at the top.
2.0	Reddish-brown siltstone.
15.0	Interbedded, red-brown siltstone and mudstone.
8.0	Red-brown, silty, argillaceous, medium-grained sandstone.

Rockwell Formation

Finzel Marine Tongue

7.0	Dark-gray-green, silty shale with thin siltstone interbeds.
6.0	Green-gray and tan, silty shale interbedded with thin, fine-grained sandstone beds, and becoming red in color at top.
5.0	Green-gray, silty shale.
3.0	Olive-gray, laminated siltstone.
3.0	Red-brown siltstone.
3.0	Light-olive-gray, argillaceous, fine-grained sandstone containing <i>Skolithos</i> burrows.
2.0	Reddish-brown, silty mudstone.
6.0	Reddish-brown, argillaceous sandstone, laminated at the top.
5.0	Olive-gray and red-brown, silty shale thinly interbedded with siltstone.
4.0	Red-gray, argillaceous sandstone.
2.0	Red-brown mudstone.
1.0	Thinly interbedded, reddish-brown siltstone and shale.
2.0	Olive-gray, silty, argillaceous, fine-grained sandstone with <i>Skolithos</i> burrows.
4.5	Thinly interbedded, gray shale and siltstone, with <i>Skolithos</i> burrows.
6.0	Gray-green, medium-grained sandstone.
2.0	Green-gray to olive-gray, argillaceous, fine-grained sandstone with <i>Skolithos</i> burrows.

10.0	Interbedded, gray shale and shaly siltstone with a few beds containing <i>Skolithos</i> burrows.	0.8	Medium-gray claystone.
2.0	Interbedded, olive-gray shale with thin, fine-grained, green-gray sandstone beds.	29.0	Tan to light-gray, coarse-grained, medium-bedded sandstone.
0.5	Dark-gray, carbonaceous shale.	1.0	Gray claystone.
2.0	Thinly bedded, fine-grained sandstone with <i>Skolithos</i> burrows(?).	20.0	Gray-green, cross-bedded sandstone.
12.0	Green-gray, medium- to fine-grained, medium-bedded sandstone with <i>Skolithos</i> burrows.	6.0	Interbedded, reddish-brown, silty shale and siltstone.
1.0	Green-gray shale to claystone.	5.0	Reddish-brown claystone.
6.0	Green-gray, medium-bedded, medium-grained sandstone.	5.0	Gray-green, argillaceous, lumpy-bedded, medium-grained sandstone. Faint indications of <i>Skolithos</i> present.
0.5	Olive shale.	3.0	Red-brown, silty mudstone.
1.5	Green-gray, argillaceous, fine-grained sandstone.	2.0	Thinly-bedded, olive-gray, sandy siltstone.
1.3	Olive-gray, silty shale.	26.0	Red-brown and olive-gray mudstone with a few thin siltstone interbeds.
1.0	Green-gray to dark-gray, medium-grained sandstone with <i>Skolithos</i> burrows.	Purslane Formation	
0.8	Interbedded, green-gray claystone and siltstone.	23.0	Reddish-brown, argillaceous, cross-bedded, coarse-grained sandstone.
0.05	Coaly shale.	6.5	Interbedded, reddish-brown mudstone to shale and greenish-gray, medium-grained sandstone.
0.25	Black, carbonaceous shale.	37.0	Red-brown, medium- to coarse-grained, cross-bedded, sandstone with basal shale-pebble conglomerate. Fines upward into overlying unit.
0.8	Green-gray, argillaceous sandstone.	3.0	Red-brown claystone.
2.0	Green-gray siltstone with layers of platy coal.	4.0	Red-brown, cross-bedded, medium- to coarse-grained sandstone.
6.0	Medium-gray, medium-grained, well-sorted sandstone with <i>Skolithos</i> burrows at the top.	17.0	Interbedded, red-brown and olive-gray mudstone and siltstone and thin beds of green-gray sandstone.
0.8	Green-gray shale.	12.5	Reddish-brown, cross-bedded, coarse-grained sandstone.
6.5	Green-gray, argillaceous, medium-bedded sandstone with <i>Skolithos</i> burrows.	Locality 6	
0.5	Black, carbonaceous shale.		
12.0	Reddish-brown and grayish-green, silty claystone.		
2.0	Reddish-brown, sandy siltstone.		
3.0	Interbedded, greenish-gray, silty shale and siltstone.		
6.5	Green-gray to red-brown, silty, argillaceous sandstone.	Section located along the Western Maryland railroad tracks 1.0 mile southeast of Barrelville, and 2.0 miles west of Corriganville, Longitude 78°49'55"; Latitude 38°41'45". Base of the section is in the Loyalhanna Member of the Greenbrier Formation.	
2.5	Red-brown mudstone.		
15.0	Red-brown and green-gray claystone and shale with interbeds of silty sandstone and coaly lenses and pyrite nodules near the top.	Thickness (feet)	
Riddlesburg Member		Greenbrier Formation	
57.0	Light-olive-gray, coarse- to medium-grained, cross-bedded sandstone. Few coaly plant fragments throughout.	Loyalhanna Member	
30.0	Medium-gray to dark-gray, polymictic diamictite.	25.0	Red-brown, cross-bedded, sandy limestone.
		0.2	Red-brown, silty shale.
		Deer Valley Member	
		12.0	Green-gray, variegated at top, medium-bedded limestone, with abundant crinoid fragments on weathered surface.

Savage Dam Member			um-grained sandstone.
0.3	Red-brown siltstone.	6.0	Red-brown siltstone.
5.0	White, medium-grained, cross-bedded sandstone.	3.0	Red-brown shale.
4.0	Red-brown sandstone interbedded with red-brown shale.	4.0	Red-brown siltstone.
3.0	Reddish-brown siltstone.	21.0	Interbedded, red-brown, silty mudstone and siltstone.
0.5	Interlaminated, red-brown siltstone and shale.	6.0	Red-brown mudstone.
0.8	White, cross-bedded and cross-laminated sandstone.	7.0	Reddish-brown to chocolate-brown, silty sandstone.
45.0	Interbedded, red-brown mudstone, silty shale, and laminated siltstone, and silty shale.	8.0	Red-brown mudstone.
6.0	White, cross-bedded, medium-grained sandstone.	10.0	Red-brown, shaly siltstone, becoming sandy at top.
11.0	Interbedded, red-brown, silty mudstone and siltstone.	4.0	Reddish-brown, cross-bedded, medium-grained, sandstone with sharp (erosional?) base.
3.0	Red-brown and green-gray, cross-bedded, friable, medium-grained sandstone.	3.0	Interbedded, reddish-brown sandstone and shaly siltstone.
4.0	Red-brown and green-gray, shaly siltstone.	8.0	Red-brown mudstone.
110.0	Covered.	4.0	Red-brown, silty, cross-bedded, medium-grained sandstone with erosional base.
Wymps Gap Member			Covered.
4.7	Interbedded, green-gray limestone and calcareous shale. Limestone beds 0.5 to 2.5 inches thick containing brachiopods and bivalves.	120.0	Red-brown, cross-bedded, medium-grained, silty sandstone.
0.5	Green-gray, calcareous shale.	12.0	Covered.
4.0	Light-green-gray, variegated at top, argillaceous, nodular-bedded lime wackestone.	10.0	Red-brown to chocolate-brown, cross-bedded, fine- to medium-grained sandstone with erosional base.
1.0	Red mudstone.	7.0	Covered.
1.5	Light-gray, cross-laminated, sandy limestone.	76.0	Red-brown mudstone.
0.5	Red, silty shale.	10.0	Reddish-brown to chocolate-brown, cross-bedded, medium-grained sandstone with sharp base, and gradational with overlying unit.
1.5	Light-gray, cross-laminated, silty, sandy limestone.	25.0	Interbedded, red-brown and green-gray mudstone, siltstone, and thin (less than 1 foot) sandstones.
1.0	Red-brown mudstone.	21.5	Reddish-brown, cross-bedded, fine- to coarse-grained sandstone. Silty at base, and gradational with overlying unit, exhibiting an erosional base.
0.1	Light-green-gray, sandy limestone.	17.0	Red-brown and green-gray, silty mudstone.
1.5	Red-brown siltstone.	12.0	Red-brown, cross-bedded, medium-grained sandstone with erosional base. Grades upward into thinly interbedded reddish-brown mudstone and argillaceous sandstone.
1.5	Red-brown mudstone.	3.0	Red-brown siltstone.
0.25	Sandy, cross-laminated and ripple-laminated limestone to calcareous sandstone.	20.0	Red-brown mudstone (mostly covered).
3.0	Red-brown mudstone.		
0.3	Light-gray, sandy limestone.		
Mauch Chunk Formation			
3.0	Red-brown siltstone.		
10.0	Red-brown mudstone with a few green-gray streaks.		
6.5	Interbedded, red-brown mudstone and silty fine-grained sandstone.		
8.0	Red-brown claystone to mudstone.		
5.0	Red-brown to chocolate-brown, medi-		

Locality 7

Section along westbound lane of U.S. Route 48 at its intersection with Maryland Route 546 (Finzel Road) at Little Savage Mountain, Garrett County, Longitude

78°58'00"; Latitude 39°40'45". Base of the section is in the Hampshire Formation.

Thickness (feet)

Hampshire Formation

2.0	Reddish-brown, medium-grained sandstone.
4.0	Red-brown mudstone.
2.5	Red-brown siltstone.
3.0	Red-brown siltstone and silty mudstone.
6.5	Red-brown mudstone.
1.0	Red-brown siltstone.
6.0	Green-gray and reddish-brown, silty, fine-grained sandstone.

Rockwell Formation

Finzel Marine Tongue

5.2	Interbedded, green-gray, silty shale, sandy siltstone, and fine-grained, argillaceous sandstone, with some layers containing <i>Skolithos</i> burrows.
5.0	Medium-gray, argillaceous, fine-grained sandstone with thin shaly interbeds.
4.2	Light-green-gray, thinly laminated siltstone.
6.0	Green-gray, medium-grained sandstone with <i>Skolithos</i> burrows at top.
2.0	Green-gray, bioturbated siltstone.
0.8	Green-gray, laminated, silty shale.
7.0	Green-gray siltstone with shaly interbeds, and becoming a sandstone at the top containing <i>Skolithos</i> burrows.
22.6	Interbedded, light-green-gray, and light-gray argillaceous, silty, fine-grained sandstones, silty shales, and laminated micaceous siltstones. Sandstones commonly exhibit <i>Skolithos</i> burrows.
2.5	Red-brown, laminated, shaly siltstone.
5.0	Light-green-gray, argillaceous, fine-grained, flaggy-bedded, fining-upward sandstone. <i>Skolithos</i> burrows at top.
2.0	Interbedded, light-gray-green, flaser-bedded, fine-grained sandstone and silty shale.
20.4	Interbedded, light-gray-green, fine- to medium-grained, sandstone, sandy siltstones, and thin shales. Sandstones commonly exhibit <i>Skolithos</i> burrows.
11.0	Gray-green, medium-grained, cross-bedded sandstone with shale pebbles and coal spars at the base. Erosional base. Sandstone fines upward.
17.0	Green-gray, flaggy to platy, micaceous, silty sandstone which fines upsection.

15.0	Green-gray, laminated, sandy siltstone with a few sandstone interbeds.
7.0	Reddish-brown to chocolate-brown siltstone.
0.5	Red-brown claystone.
0.25	Chocolate-brown, argillaceous, medium-grained sandstone.
4.0	Light-gray-green siltstone.
15.0	Red-brown and gray-green mudstone, iron-rich, locally containing siltstone beds.
5.0	Light-gray-green, sandy siltstone to very fine-grained sandstone exhibiting an erosional base.
3.0	Light-gray-green, silty shale.
4.3	Covered.
6.0	Light-gray-green, silty shale and claystone containing thin layers of sandstone and coaly shale beds.
8.0	Light-green-gray, cross-bedded, argillaceous, medium-grained sandstone with an erosional base.
3.0	Interbedded, light-green-gray, silty sandstone and sandy, micaceous siltstone.
1.0	Light-gray, laminated sandstone.
5.0	Interbedded, gray-green siltstone and shale.
0.15	Black, coaly shale.
4.0	Interbedded, green-gray siltstone and fine-grained sandstones.

Riddlesburg Member

16.0	Light-gray to white, planar to cross-bedded fine- to medium-grained, well sorted sandstone containing abundant horizontal burrows and some molds of bivalves.
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Locality 8

Section located along the north side of Maryland Route 133 and at the mouth of Stoney Run, Allegany County, Longitude 79°01'10"; Latitude 39°27'55". Base of section is in the Purslane Formation.

Thickness (feet)

Purslane Formation

5.0	Tan, cross-bedded, medium-grained sandstone.
10.0	Covered.
15.0	Medium-gray-brown to tan, cross-bedded, medium- to coarse-grained, micaceous sandstone with erosional base.
8.5	Interbedded, light-gray to gray-brown,

	medium-grained sandstone, silty shale, and siltstone.	23.0	Covered.
5.0	Covered.	3.0	Red-brown and gray, nodular-bedded limestone with abundant fossil fragments.
Greenbrier Formation		37.0	Covered.
Loyalhanna Member		Wymp's Gap Member	
6.0	Light-gray to grayish-brown, sublithographic limestone with thin shale laminae.	3.0	Dark-gray, argillaceous, nodular-bedded lime wackestone.
16.0	Reddish-brown and grayish-green, cross-bedded, sandy limestone.	2.0	Covered.
4.0	Red-brown mudstone.	3.0	Medium-gray, nodular-bedded lime wackestone.
8.0	Reddish-brown, cross-bedded, sandy limestone.	2.0	Medium-gray, fetid, lime grainstone.
0.8	Tan, sandy, calcareous siltstone, dolomitic.	10.0	Covered.
Deer Valley Member		2.0	Medium-gray, nodular-bedded, lime wackestone.
12.0	Light-gray to medium-gray, medium-bedded, sandy limestone, oolitic at top.	3.0	Medium-gray, lime grainstone, cross-bedded at top, and containing brachiopods and crinoids.
Savage Dam Member		1.0	Medium-gray, nodular-bedded packstone-grainstone.
7.0	Red-brown, silty mudstone.	3.0	Medium-gray, medium-bedded, dense, lime wackestone with abundant brachiopod and crinoid remains and pyrite.
2.0	White, friable, fine-grained sandstone.	1.0	Medium-gray, dense lime grainstone to packstone.
0.8	Red-brown shale.	0.5	Dark-gray, argillaceous, lime wackestone with a fetid odor.
1.5	White, fine-grained, calcareous sandstone.	0.5	Dark-gray, calcareous shale.
4.0	Red-brown, siltstone.	3.0	Dark-gray, argillaceous, fetid, lime wackestone, containing <i>Martinia</i> and crinoids.
1.0	Green-gray, argillaceous, laminated sandstone.	0.25	Dark-gray, calcareous shale.
5.0	Red-brown siltstone, locally root-mottled.	3.0	Dark-gray, thin-bedded, argillaceous, fetid, lime wackestone containing <i>Anthracospirifer</i> and <i>Martinia</i> .
6.0	Red-brown, silty mudstone.	4.0	Covered.
5.0	Red-brown, fine-grained, cross-bedded to ripple-laminated sandstone.	2.0	Red-brown to green-gray to variegated, nodular-bedded, argillaceous, lime wackestone.
3.0	Red-brown claystone.	Mauch Chunk Formation	
7.5	Interbedded, reddish-brown, platy siltstone, mudstone and root-mottled, argillaceous sandstone.	12.0	Red-brown mudstone with thin green-gray horizons.
1.0	White, coarse-grained, friable sandstone.	6.0	Red-brown, platy siltstone.
0.5	Red-brown claystone.	5.0	Green-gray, cross-bedded, medium-grained sandstone.
1.0	White, medium-grained sandstone.	11.0	Covered.
4.0	Interbedded, red brown, siltstone and mudstone.	5.0	Green-gray, sandy siltstone.
6.0	White, medium- to thin-bedded, medium- to coarse-grained, cross-bedded sandstone with thin green-gray to red siltstone interbeds.		
2.0	Red-brown, rippled, shaly siltstone.		
1.0	Red-brown sandstone to sandy claystone.		
1.5	Red-brown siltstone.		
4.0	Red-brown, silty mudstone.		
3.0	Red-brown, fine-grained, argillaceous sandstone.		
15.0	Red-brown mudstone.		

Locality 9

Composite section along the spillway at the Savage River Dam and along the railroad tracks and road opposite the spillway, Garrett County, Longitude 79°07'00"; Latitude 39°30'30". Base of the section is in

the Greenbrier Formation. Type section of the Savage Dam Member of the Greenbrier Formation.

Thickness (feet)

Greenbrier Formation

Loyalhanna Member

- 16.0 Light-greenish-gray, cross-bedded, sandy limestone.
- 2.5 Red-brown silty mudstone.
- 11.0 Red-brown, cross-bedded, sandy limestone.
- 0.2 Tan, argillaceous, dolomitic siltstone.

Deer Valley Member

- 3.5 Green-gray, thick-bedded, dense limestone.
- 4.0 Light-grayish-green, thin-bedded, dense limestone, with silty, calcareous shale interbeds.
- 2.0 Interbedded, reddish-brown, calcareous shale and greenish-gray, dense limestone.
- 0.15 Reddish-brown, fine-grained sandstone with mudcracks.
- 3.0 Light-gray, cross-bedded, sandy limestone.

Savage Dam Member

- 0.75 Red-brown, calcareous siltstone.
- 9.0 Light-gray to white and mottled red, calcareous, cross-bedded sandstone.
- 3.2 Red-brown, mottled mudstone with root casts.
- 2.7 Light-gray, calcareous sandstone.
- 12.0 Interbedded, reddish-brown, mudstone to shale and siltstone and thin brown to red-brown and gray-green sandstone. Mudcracks common in mudstone intervals at the top.
- 4.3 Light-gray, calcareous sandstone with a few interbedded shaly layers.
- 12.0 Interbedded, red-brown and brown siltstone and mudstone with mudcracks and root casts.
- 5.0 White to tan, thin-bedded, fine- to medium-grained sandstone becoming shaly and red at top.
- 3.0 Red, silty shale.
- 2.0 Chocolate-brown, argillaceous sandstone.
- 4.0 Red-brown, platy shale to siltstone.
- 1.0 Brown, medium-grained sandstone.
- 1.5 Red-brown, silty shale.
- 2.0 Reddish-brown, argillaceous sandstone.
- 1.0 Green-gray, sandy siltstone.
- 1.0 Red-brown and green-gray to varie-

gated, calcareous sandstone.

- 3.0 Variegated, calcareous shale and argillaceous limestone containing *Composita*, *Anthracospirifer*, *Diaphragmus*, and rugose corals.
- 1.0 Red-brown siltstone.
- 3.0 Red-brown, silty shale exhibiting root casts.
- 2.0 Light-green-gray, calcareous sandstone containing *Diaphragmus*, *Anthracospirifer*, and *Composita*.
- 4.0 Interbedded, green-gray, silty sandstone and shale with abundant brachiopod remains (*Anthracospirifer* and *Composita*).
- 4.0 Green-gray, silty shale.
- 5.0 Interbedded, gray-green, calcareous shale and fossiliferous sandstone.
- 4.0 Interbedded, green-gray shale to shaly siltstone and sandstone exhibiting root casts.
- 10.0 Covered.
- 3.0 Reddish-brown, calcareous shale becoming fossiliferous at the top, and containing root casts at the base.
- 3.2 Green-gray, dense limestone, red and mottled at the top. Containing *Composita*, *Anthracospirifer*, *Straparollus*, and bivalves.
- 5.5 Red-brown, calcareous shale, fossiliferous at the bottom and exhibiting root casts at the top. Fossiliferous part contains rugose corals, *Straparollus*, *Composita*, and *Anthracospirifer*.
- 6.0 Red-brown, silty shale to mudstone.
- 5.0 Interbedded, tan, calcareous sandstone and red and green-gray shales. Containing a few horizons of mudcracks.
- 2.0 Red-brown, silty shale.
- 1.0 Chocolate-brown sandstone.
- 4.0 Interbedded, tan to brown, medium-grained sandstones and red-brown shales and mudstones.
- 2.0 Red-brown, silty mudstone.
- 1.5 Light-gray, fine-grained sandstone.
- 1.0 Red-brown, silty mudstone with thin sandstone layers.
- 10.0 Tan to light-gray, calcareous, cross-bedded sandstone.
- 4.0 Light-gray, cross-bedded, sandy, medium- to coarse-grained limestone with layers of rugose corals.
- 0.5 Light-gray, sandy, lime grainstone with rugose corals and the brachiopod *Composita*.
- 25.0 Covered.

Wymps Gap Member [exposed along logging road above railroad grade]

- 11.0 Dark-gray, fetid, medium-bedded, argillaceous lime wackestone, with *Martinia*, *Composita*, *Anthracospirifer*, crinoids and fenestrate bryozoans.
- 3.0 Light-gray lime grainstone, locally containing beds of *Straparollus* and *Composita* as coquinas.

Locality 10

Section located along U.S. Route 48 at its intersection with Lower New Germany Road at Piney Grove, Garrett County, Longitude 79°04'20"; Latitude 39°41'00". Base of section is in the Hampshire Formation.

Thickness (feet)

Hampshire Formation

- 40.0 Red-brown, silty mudstone.
- 3.5 Interbedded, light-green-gray, sandy siltstone and mudstone.

Rockwell Formation

- 1.0 Green-gray, argillaceous, fine-grained sandstone, highly bioturbated.
- 7.0 Green-gray, to light-gray, silty shale.
- 0.8 Light-gray-green, fine-grained sandstone.
- 3.0 Green-gray claystone.

Finzel Marine Tongue

- 4.0 Green-gray, argillaceous, fine-grained sandstone with *Skolithos* and horizontal burrows, and thin shaly interbeds.
- 3.0 Dark-gray claystone.
- 2.0 Green-gray, fine- to medium-grained sandstone with *Skolithos* burrows.
- 2.0 Light-green-gray, punky sandstone.
- 0.8 Green-gray, silty shale.
- 0.8 Green-gray, argillaceous, fine-grained sandstone with *Skolithos* burrows.
- 10.0 Green-gray, cross-bedded, silty sandstone, platy at top.
- 2.0 Covered.
- 1.0 Green-gray siltstone.
- 5.0 Covered.
- 0.2 Thin coal to coaly shale with a basal root zone.
- 3.0 Dark-gray claystone becoming green-gray at top.
- 7.0 Green-gray, argillaceous, rippled, fine-grained sandstone with *Skolithos* burrows and a few coaly laminae.
- 10.0 Light-gray siltstone to silty shale with a

few thin (0.5 to 1.0 inch) siltstone interbeds.

- 9.0 Covered.
- 0.2 Coal.
- 0.45 Black, brittle shale.
- 0.85 Black claystone.
- 6.0 Tan to greenish-gray siltstone to silty shale.
- 0.3 Coal.
- 0.8 Black, brittle shale.
- 6.0 Green-gray siltstone to silty shale.
- 16.0 Interbedded, shale and thin fine-grained sandstone beds with *Skolithos* burrows (interval mostly covered).
- 30.0 Covered.

Riddlesburg Member

- 1.0 Black to very-dark-gray siltstone or bone shale.
- 2.0 Light-green-gray, fine-grained sandstone, highly bioturbated with *Skolithos*.
- 5.0 Covered.
- 2.0 Green-gray, limonitic siltstone with horizontal burrows and *Skolithos*.
- 3.0 Light-gray shale.
- 2.0 Covered.
- 1.0 Gray, sandy siltstone.
- 5.0 Light-gray, silty shale (mostly covered).
- 3.0 Light-green-gray, fine-grained, bioturbated sandstone with *Skolithos*.
- 4.0 Gray-green, sandy, platy siltstone with abundant plant fragments.
- 5.0 Covered.
- 7.0 Green-gray to tan, micaceous, medium-grained sandstone.
- 2.0 Gray-green, argillaceous, silty sandstone to platy, sandy siltstone. Contains orbiculoid brachiopods.
- 2.0 Covered.
- 2.0 Coaly shale.
- 3.0 Gray-green, medium- to fine-grained, argillaceous sandstone.
- 2.0 Gray-green, silty, platy sandstone.
- 15.0 Covered.

Purslane Formation

- 25.0 Tan to olive-gray, cross-bedded, medium- to coarse-grained sandstone.
- 7.5 Covered.
- 17.0 Interbedded, gray-green to red-brown siltstone, shale, and thin sandstone beds.
- 27.0 Tan to green-gray, medium- to coarse-grained, cross-bedded sandstone with an erosional base, grading upsection

	into overlying unit.
6.0	Interbedded, medium-gray, silty shale and micaceous siltstone.
20.0	Gray-green, medium-grained, cross-bedded sandstone, with shale pebble basal conglomerate and erosional base.
5.0	Green-gray to red-brown to mottled, coarse-grained sandstone with conglomerate of shale pebbles at base.
20.0	Green-gray, argillaceous, cross-bedded, medium-grained sandstone.
35.0	Reddish-brown and locally grayish-green, cross-bedded, coarse-grained to conglomeratic sandstone, with layers of shale pebbles and streaks of red and green at base.

Locality 11A

Section along U.S. Route 48 at the intersection of U.S. Route 48 and U.S. Route 219 at Keyzers Ridge, Garrett County, Longitude 79°16'00"; Latitude 39°41'45". Base of the section is in the Rockwell Formation.

Thickness (feet)

Rockwell Formation

2.0	Olive-gray, bioturbated, silty sandstone.
6.0	Covered.
3.0	Green-gray, silty claystone with siderite nodules.
2.0	Green-gray, silty shale.
2.0	Light-gray-green claystone.
1.0	Light-green-gray siltstone.
6.0	Green-gray, micaceous, silty shale with plant fragments.
5.0	Green-gray claystone with root casts.
0.35	Coal, shaly at top.
0.8	Black, carbonaceous shale.
0.45	Dark-gray siltstone with root casts.

Riddlesburg Member

6.0	Green-gray, platy, cross-bedded, fine-grained sandstone.
1.0	Tan, fine-grained sandstone with <i>Skolithos</i> burrows.
1.5	Green-gray claystone.
0.5	Green-gray, cross-laminated siltstone.
5.0	Light-greenish-gray, silty shale with plant fragments.
3.0	Green-gray siltstone with abundant root casts.
0.1	Dark-gray claystone.
0.35	Black claystone with abundant plant fragments.

0.15	Hematite-rich shale.
0.35	Green-gray, silty, fine-grained sandstone with horizontal burrows.
1.0	Green-gray, silty shale.
4.0	Tan to light-gray, argillaceous, medium- to coarse-grained, bioturbated sandstone.
1.0	Green-gray, silty shale.
4.0	Light-gray to tan or brown, medium-grained, well-sorted, bioturbated, cross-bedded sandstone with spirifer and productid brachiopods and locally layers of white quartz pebbles.
0.6	Green-gray, silty shale.
5.0	White, fine- to coarse-grained, cross-bedded sandstone with planar to low-angle cross-beds.
37.0	Covered.
1.0	Olive-gray, silty sandstone.
5.0	Covered (probably olive siltstone).
1.0	Olive-gray, laminated, micaceous, medium-grained sandstone.
3.0	Thinly interbedded, green-gray claystone and micaceous sandstone.
1.0	Gray siltstone.
7.0	Covered.
9.0	Tan, micaceous, medium-grained, cross-bedded sandstone with shale-pebble conglomerate at base and abundant coal stringers.
15.0	Red-brown and gray-green, silty shale and claystone with interbedded gray siltstone beds.
2.0	Green-gray siltstone.
7.0	Tan, laminated, sandy, micaceous siltstone.
3.0	Interlaminated, silty shale and siltstone.

Purslane Formation

27.0	Tan to light-gray, cross-bedded, medium- to coarse-grained sandstone with erosional base, shale-pebble conglomerate, and coaly plant fragments.
17.0	White, cross-bedded, flaggy, medium-grained sandstone with abundant plant fragments and shale-pebble conglomerate at base. Erosional base.
16.0	Red-brown, cross-bedded, argillaceous, medium-grained sandstone.

Locality 11B

Section along U.S. Route 48 0.7 mile east of Pigs Ear Road, and 2.0 miles west of locality 11A, Garrett County, Longitude 79°17'30"; Latitude 39°42'00".

Base of section is on the north side of the road and begins in the Hampshire Formation.

Thickness (feet)

Hampshire Formation

- 15.0 Interbedded, green-gray, red-brown, variegated, thin-bedded, cross-bedded, argillaceous sandstone and thin (0.25 to 0.5 inches) siltstone and shale.
- 5.0 Red-brown siltstone laterally equivalent to underlying unit.

Rockwell Formation

- 4.5 Light-greenish-gray, argillaceous, cross-bedded sandstone.
- 3.5 Greenish-gray, mottled claystone.
- 1.0 Olive-gray siltstone.
- 1.0 Light-gray claystone.
- 0.5 Gray claystone (underclay).
- 0.5 Black, coaly shale.
- 0.8 Gray claystone.
- 2.0 Greenish-gray, argillaceous, sandy siltstone.
- 6.0 Interbedded, red-brown siltstone and red claystone.
- 15.0 Light-grayish-green, medium-grained sandstone with coaly fragments and shale pebbles at base. Erosional base.
- 11.0 Covered.
- 2.0 Olive-gray, silty shale with thin siltstone beds.
- 3.0 Light-gray to white fine-grained, argillaceous, cross-bedded sandstone. Thickens laterally and has an erosional base.
- 1.0 Medium-gray siltstone.
- 3.0 Medium-olive-gray, silty shale.

Finzel Marine Tongue

- 2.5 Medium-gray siltstone with long *Skolithos* burrows.
- 3.0 Light-gray to tan, cross-bedded, medium- to fine-grained, argillaceous sandstone.
- 4.0 Interbedded, medium-gray, silty shale and siltstone.
- 6.0 Medium-gray shale.
- 3.0 Brown, medium-grained, bioturbated sandstone with thin shaly laminae.
- 5.5 Interbedded, medium-gray, sandy siltstone and silty shale.
- 3.0 Medium-brown, argillaceous, nodular-bedded, medium-grained sandstone with *Skolithos* burrows.
- 4.0 Interbedded, medium-gray, silty shale and siltstone with local *Skolithos* burrows.
- 3.7 Interbedded, light-gray to gray-green,

- 3.0 fine-grained sandstone and silty shale containing *Skolithos*, *Planolites*, and casts of brachiopods.
- 4.0 Dark- to medium-gray shale.
- 30.0 Interbedded, tan to gray-green shale and nodular-bedded siltstone.
- 12.0 Eroded. Section moved to south side of highway.
- 2.0 Tan, cross-bedded, flaggy, medium-grained sandstone, fines upsection.
- (marine member possibly equivalent to the Bedford Shale of Ohio)
- 5.0 Tan siltstone.
- 4.0 Light-gray-green, argillaceous, medium-bedded, medium-grained sandstone with *Skolithos*.
- 5.0 Greenish-gray, shaly siltstone.
- 3.0 Covered.
- 5.0 Interbedded, greenish-gray, medium-bedded, medium-grained sandstone and platy siltstone.
- 12.0 Tan, silty shale.
- 2.0 Interbedded, argillaceous sandstone and silty shale (channel filling).
- 0.8 Red-brown claystone.
- Green-gray claystone (underclay).

Riddlesburg Member

- 4.0 Light-gray, medium-grained sandstone with *Skolithos* burrows.
- 2.0 Interbedded, gray siltstone and coaly shale.
- 1.0 Greenish-gray, argillaceous sandstone.
- 6.0 Medium-gray, silty shale.
- 1.3 Light-gray claystone (underclay).
- 0.2 Sideritic siltstone bed.
- 13.0 White to light-greenish-gray, medium- to coarse-grained, cross-bedded sandstone, flaggy at top with plant fragments, brachiopods, and quartz-pebble layers. Probably equal to fossiliferous sandstone of locality 11A.

Locality 11C

Section along southbound lane of U.S. Route 219 2.3 miles south of intersection with U.S. Route 48 at Keyzers Ridge and 0.1 mile north of scenic pull-off, Longitude 79°17'00"; Latitude 39°40'50". Base of section is in the Hampshire Formation.

Thickness (feet)

Hampshire Formation

- 25.0 Interbedded, red-brown and green-gray, sandy, micaceous siltstone and mottled mudstone.

Rockwell Formation

Finzel Marine Tongue

- 1.5 Grayish-green, argillaceous, fine-grained sandstone with *Skolithos* burrows.
- 2.0 Dark-olive-gray, silty shale.
- 1.0 Greenish-gray to tan, argillaceous, fine-grained sandstone with *Skolithos*.
- 12.0 Interbedded, greenish-gray, slabby bedded, argillaceous, fine-grained sandstone and claystone. Sandstone contains *Skolithos* and *Planolites* burrows.
- 13.0 Interbedded, green-gray siltstone and shale (mostly covered).
- 22.5 Red-brown, silty, mudstone with interbedded green-gray and mottled siltstone and claystone. Laterally inter-tongues with red-brown lenticular sandstone.
- 11.0 Gray and gray-green shale and claystone (mostly covered).
- 3.0 Red-brown mudstone.
- 1.0 Greenish-gray, hummocky-cross-stratified, fine-grained sandstone.
- 6.0 Green-gray claystone with thin interbeds of very fine-grained sandstone with *Planolites*.
- 1.0 Green-gray, argillaceous, fine-grained sandstone with *Skolithos* burrows.
- 2.5 Interbedded, green-gray claystone and laminated, fine-grained sandstone.
- 1.0 Green-gray, bioturbated siltstone.
- 2.0 Interbedded, green-gray, argillaceous, fine-grained sandstone and claystone. Sandstone contains *Skolithos* burrows.
- 2.0 Dark-gray shale.
- 1.5 Greenish-gray, argillaceous, fine-grained sandstone with *Skolithos* burrows.
- 6.0 Dark-gray, limonitic shale.

Locality 12

Section along Bear Creek Road and on the hillside above the road, 2.0 miles east of Friendsville, Garrett County, Longitude 79°21'50"; Latitude 39°39'20". Base of section is in the Purslane Formation at road level and progresses up the hillside.

Thickness (feet)

Purslane Formation

- 6.0 Tan to light-gray, thin-bedded, cross-bedded, coarse-grained sandstone.
- 15.0 Tan, cross-bedded, medium-bedded,

- coarse-grained sandstone.
- 24.0 Light-brown to tan, coarse-grained to conglomeratic, thick-bedded sandstone with white quartz pebbles.
- 12.0 Light-brown, flaggy, medium- to coarse-grained sandstone.
- 27.0 Covered.
- 6.0 Tan, cross-bedded, platy, argillaceous sandstone.
- 5.0 Covered.
- 32.0 Tan, to reddish-brown, cross-bedded, flaggy, medium- to coarse-grained, micaceous sandstone.

Greenbrier Formation

Loyalhanna Member

- 28.0 Reddish-brown, cross-bedded, sandy limestone, pebbly at base.
- 0.2 Tan, dolomitic siltstone.

Deer Valley Member

- 2.7 Light-green-gray, thin-bedded lime wackestone.

Savage Dam Member

- 4.0 Red-brown mudstone.
- 2.0 Greenish-gray, calcareous, sandy limestone, shaly at top.
- 20.0 Interbedded, red-brown, silty mudstone and shale.
- 3.0 Green-gray to white, calcareous, medium-grained sandstone.
- 17.0 Covered.
- 4.0 Red-brown mudstone.
- 1.0 Red-brown to chocolate-brown, cross-bedded, argillaceous, micaceous sandstone.
- 2.0 Red-brown mudstone.
- 2.0 Reddish-brown, argillaceous sandstone.
- 17.0 Covered.
- 7.0 Greenish-gray, medium-bedded lime grainstone.
- 3.5 Red-brown, silty shale.
- 1.0 Greenish-gray, cross-bedded, medium-grained sandstone.
- 12.0 Interbedded, red-brown, cross-bedded, argillaceous sandstone, siltstone, and silty shale.
- 14.5 Red-brown and green-gray shale and silty mudstone, with a few layers of green-gray sandstone.
- 4.0 Covered.

Wymys Gap Member

- 7.0 Dark-gray, argillaceous limestone with *Anthracospirifer*.
- 3.0 Interbedded, dark-gray, argillaceous

	limestone and green-gray, ripple-laminated shale.
4.0	Dark-gray, argillaceous limestone.
2.0	Interbedded, greenish-gray and medium-gray limestone and calcareous shale containing <i>Orthotetes</i> and <i>Composita</i> .
2.5	Greenish-gray lime wackestone containing <i>Composita</i> .
1.0	Red-brown, silty mudstone.
1.5	Tan, argillaceous, silty dolomite.
Mauch Chunk Formation	
3.0	Red-brown, cross-bedded, medium-grained, argillaceous, micaceous sandstone.
11.0	Red-brown mudstone to shale.
7.0	Greenish-gray, cross-bedded, medium-grained sandstone.

Locality 13

Section along Accident-Friendsville Road, 1.8 miles southeast of Friendsville, Garrett County, Longitude 79°22'30"; Latitude 39°38'35". Base of the section is in the Savage Dam Member of the Greenbrier Formation.

Thickness (feet)

Greenbrier Formation

Savage Dam Member

5.0	Red-brown mudstone.
1.0	Reddish-brown, micaceous sandstone.
2.0	Red-brown, silty shale.
12.0	Interbedded, red-brown siltstone and mudstone.
2.0	Brown, argillaceous sandstone.
3.0	Reddish-brown mudstone.
1.0	Reddish-brown, argillaceous sandstone.
14.0	Red-brown mudstone.
3.0	Variegated, sandy limestone with brachiopods and crinoids.
2.0	Interbedded, greenish-gray, sandy shale and siltstone.
2.0	Thin-bedded, calcareous sandstone.
5.0	Green-gray, calcareous siltstone and shale.
10.0	White, highly cross-bedded, medium-grained, calcareous sandstone, containing brachiopods.
3.0	Variegated, sandy, thin-bedded grainstone.
7.0	Interbedded, red-brown siltstone and shale.
2.0	Red, platy, micaceous siltstone.
20.0	Covered.

Wymps Gap Member

7.0	Interbedded, greenish-gray, argillaceous limestone and shale. Limestone contains brachiopod and bryozoan fragments.
12.0	Dark-gray, nodular- to medium-bedded, fetid, argillaceous limestone.
3.0	Thinly interbedded, gray-green limestone and shale containing <i>Orthotetes</i> .
4.0	Dark-gray, argillaceous limestone.
2.0	Thinly interlaminated, greenish-gray limestone and shale containing <i>Orthotetes</i> and <i>Composita</i> .
2.0	Light-green-gray lime wackestone to lime mudstone.

Mauch Chunk Formation

3.0	Tan, cross-bedded, medium-grained, micaceous sandstone.
4.0	Red-brown, silty shale.

Locality 14

Section in abandoned quarry along Bishoff Road (Bishoff Quarry) currently owned by Keystone Lime Company Inc., Garrett County, Longitude 79°24'00"; Latitude 39°35'00". Base of section is at the top of the Purslane Formation.

Thickness (feet)

Purslane Formation

5.5	Greenish-gray to brown, medium-grained, cross-bedded sandstone exhibiting irregular upper surface.
2.0	Light tan, calcareous, mottled sandstone.

Greenbrier Formation

Loyalhanna Member

26.0	Reddish-brown and greenish-gray, cross-bedded, sandy lime grainstone with brachiopods in the lower 6 feet (<i>Composita</i> , <i>Anthracospirifer</i> , and <i>Orthotetes</i>).
0.5	Tan, silty dolomite to dolomitic shale.

Deer Valley Member

12.0	Gray to gray-green, slightly sandy, medium-bedded, dense limestone.
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Savage Dam Member

3.0	Red-brown, silty mudstone.
2.0	Interbedded, red-brown and green-gray shale and siltstone.
4.0	Red-brown siltstone.
2.5	White, calcareous, medium-grained sandstone.
2.0	Thinly interbedded, variegated mud-

- stone and argillaceous sandstone.
- 2.2 White, calcareous, medium-grained sandstone.
- 5.0 Thinly interbedded, red-brown siltstone and sandstone.
- 1.0 Green-gray claystone.
- 6.0 Red-brown claystone with green-gray calcareous nodules.
- 3.0 Red-brown claystone.
- 1.0 Red-brown siltstone.
- 5.0 Red-brown mudstone with thin siltstone interbeds.
- 3.0 Variegated red and green, argillaceous sandstone.
- 3.0 Red-brown claystone.
- 2.0 Red-brown, argillaceous, medium-grained sandstone.
- 5.0 Red-brown mudstone to claystone.
- 2.0 Chocolate-brown, argillaceous sandstone.
- 4.0 Red-brown mudstone.
- 5.0 White, cross-bedded, calcareous, fine-grained sandstone.
- 5.0 Red-brown siltstone, green-gray at the base.
- 6.0 Reddish-brown, planar-bedded sandstone.
- 3.0 Reddish-brown claystone.
- 6.5 White, massive sandstone.

Locality 15

Section in quarry owned and operated by Maryland Minerals, Inc. along Hoyes-Sang Run Road, Garrett County, Longitude 79°24'10"; Latitude 39°34'25". Base of the section is in the uppermost Purslane Formation.

Thickness (feet)

Purslane Formation

- 3.0 Tan, cross-bedded, fine-grained sandstone.
- 4.0 Red-brown siltstone.

Greenbrier Formation

Loyalhanna Member

- 17.0 Gray to gray-green, cross-bedded, sandy limestone.
- 2.5 Red-brown siltstone (pinches out laterally).
- 5.0 Light-gray, cross-bedded, calcareous sandstone.
- 0.2 Tan, dolomitic siltstone.

Deer Valley Member

- 12.0 Greenish-gray, medium-bedded, slightly sandy limestone.

Savage Dam Member

- 6.0 Interbedded, red-brown siltstone and white, calcareous sandstone.
- 3.0 White, fine- to medium-grained sandstone with a sharp base, grading up into laminated red and green sandstone.
- 10.0 Reddish-brown siltstone with thin beds of sandstone.
- 0.8 Green-gray, medium-grained sandstone.
- 6.0 Red-brown siltstone.
- 5.0 Red-brown, argillaceous, medium-grained sandstone.
- 2.3 White, fine-grained, calcareous sandstone exhibiting sharp base and grading up into red and green siltstone.
- 3.0 Red-brown siltstone.
- 1.5 White, calcareous, medium-grained sandstone.
- 5.0 Red-brown siltstone.
- 1.0 Green-gray, fine-grained sandstone.
- 4.0 Red-brown, sandy siltstone.
- 3.0 Red-brown mudstone.
- 7.0 Red-brown claystone.
- 5.0 White, cross-bedded, medium-grained, calcareous sandstone.
- 8.0 Covered.

Wymps Gap Member

- 10.0 Thinly bedded, dark-gray, lime wackestone (poorly exposed in quarry wall).

Locality 16

Section along U.S. Route 219 near its intersection with Friendsville-Hoyes Road, Garrett County, Longitude 79°22'15"; Latitude 39°34'20". Base of section is in the Rockwell Formation.

Thickness (feet)

Rockwell Formation

Finzel Marine Tongue

- 3.0 Greenish-gray to tan, fine-grained, argillaceous sandstone with *Skolithos* burrows.
- 7.0 Covered.
- 3.5 Greenish-gray, fine-grained sandstone bearing *Skolithos* burrows.
- 27.0 Covered.
- 3.0 Tan, quartz-pebble conglomerate with plant fragments.
- 1.0 Gray-green, platy, silty, micaceous sandstone.
- 5.0 Covered.
- 3.0 Gray-green, nodular-bedded, fine-grained sandstone with black coaly

- laminae and fragments.
- 4.0 Green-gray and tan, argillaceous, bioturbated sandstone with *Skolithos* and *Planolites*.
 - 3.5 Covered.
 - 4.0 Interbedded, green-gray shale and argillaceous, fine-grained sandstone. Sandstone contains *Skolithos*.
 - 3.0 Covered.
 - 2.0 Greenish-gray, bioturbated claystone with coaly fragments.
 - 2.0 Medium-gray, silty shale and claystone with plant fragments and root casts.
 - 6.0 Tan, fine-grained sandstone.
 - 0.15 Dark-gray shale.
 - 1.5 Greenish-gray, fine-grained, argillaceous sandstone with *Skolithos* burrows.
 - 1.0 Black, sandy, coaly shale.
 - 1.0 Gray-green, medium-grained sandstone with *Skolithos* burrows.
 - 5.0 Greenish-gray, laminated sandstone.
 - 0.8 Light-gray claystone with root casts.
 - 0.8 Dark-gray to black, coaly shale.
 - 2.0 Light-green-gray, argillaceous, bioturbated, medium-grained sandstone with *Skolithos* burrows.
 - 1.5 Covered.
 - 0.8 Light-gray, sandy shale.
 - 4.0 Light-greenish-gray claystone with siderite and root casts.
 - 2.0 Tan, medium-grained sandstone with *Skolithos* burrows.
 - 3.0 Covered.
 - 42.0 Tan to white, cross-bedded, medium- to coarse-grained, well-sorted, flaggy sandstone.

Locality 17

Section in Gaylord Fuel Company quarry 2 miles southeast of McHenry, Garrett County, Longitude 79°23'05"; Latitude 39°33'15". Base of section is in the Loyalhanna Member of the Greenbrier Formation.

Thickness (feet)

Greenbrier Formation

Loyalhanna Member

- 15.0 Light-gray, dense limestone with a few thin layers of tan dolomite at top.

Deer Valley Member

- 12.0 Greenish-gray, thin-bedded, shaly limestone.
- 2.0 Light-gray, ripple-laminated, sandy limestone.

Savage Dam Member

- 6.0 Reddish-brown mudstone.
- 5.0 Light-gray, cross-bedded, medium- to coarse-grained, calcareous sandstone containing corals and brachiopods, and exhibiting herringbone cross-bedding. Grades up into tan, dolomitic siltstone.
- 6.0 Greenish-gray, calcareous, platy siltstone.
- 5.0 Greenish-gray mudstone.
- 2.0 Tan, calcareous, fine-grained sandstone.
- 3.0 Red-brown siltstone.
- 1.0 Red-brown claystone.
- 1.0 Red-brown siltstone.
- 2.0 Red-brown mudstone.
- 1.0 Reddish-brown claystone with carbonate nodules.
- 7.0 Red-brown mudstone.
- 8.0 Reddish-brown, silty, argillaceous sandstone.
- 5.0 Red-brown mudstone.
- 2.0 Interbedded, white, medium-grained sandstone and green-gray and red shale.
- 1.0 Reddish-brown, argillaceous sandstone.
- 0.8 Red-brown, silty mudstones.
- 2.0 Light-gray-green, shaly, sandy limestone.
- 0.3 Greenish-gray shale.

Wymps Gap Member

- 2.0 Greenish-gray, nodular-bedded, sandy limestone.
- 0.35 Red and green mottled shale.
- 3.0 Thinly interbedded, light-gray limestone and tan shale.
- 0.5 Greenish-gray claystone.
- 3.0 Thinly-bedded, dark-gray, fetid limestone with shaly laminae. Contains *Composita*, *Anthracospirifer*, and bryozoans.
- 4.0 Medium- to dark-gray, medium-bedded, fetid limestone containing *Anthracospirifer*, *Composita*, and *Diaphragmus*.
- 2.0 Greenish-gray claystone with thin beds of argillaceous limestone.
- 4.0 Dark-gray, thick-bedded, argillaceous lime wackestone, containing *Anthracospirifer*, *Martinia*, bryozoans, crinoids, and pyrite.

Locality 18

Section in quarry located where Sang Run Road crosses the Youghiogheny River 0.45 mile west of Sang Run, Garrett County, Longitude 79°25'50"; Latitude 39°34'05". Base of the section is at the base of the Wymps Gap Member of the Greenbrier Formation.

Thickness (feet)

Greenbrier Formation

Wymps Gap Member

- 1.5 Greenish-gray, rippled, fine-grained sandstone.
- 3.0 Light-gray, calcareous claystone.
- 4.5 Interbedded, light-gray to gray-green, shaly limestone and gray shale.
- 0.8 Light-greenish-gray, calcareous shale containing *Composita* and *Straparolus*.
- 2.5 Thinly interbedded, light-gray limestone and shale. Some of the limestone beds are graded.
- 3.5 Nodular-bedded, light-gray limestone.
- 2.0 Thinly interbedded, light-gray limestone and shale.
- 1.5 Medium-gray lime grainstone with shaly partings.
- 2.0 Interbedded, gray lime grainstone and shale with rippled upper surface.
- 4.5 Very-dark-gray, fetid, argillaceous, pyritic, medium-bedded limestone.
- 0.8 Medium-gray lime grainstone which grades up into 0.1 foot thick shale.
- 5.0 Dark-gray, fetid, thick-bedded, argillaceous limestone containing crinoids and brachiopods.
- 1.0 Black, calcareous shale.
- 2.0 Very-dark-gray, argillaceous limestone containing brachiopods, bryozoans, and crinoids.
- 0.8 Black, calcareous shale.
- 5.0 Very-dark-gray, argillaceous, fetid limestone.
- 2.0 Interbedded, green-gray, fossiliferous shale and limestone.
- 2.0 Light-gray lime mudstone containing abundant brachiopod and bryozoan remains.
- 3.0 Interlaminated, fossiliferous limestone and shale containing abundant brachiopods.
- 2.0 Light-greenish-gray, bioturbated argillaceous limestone, laminated at the top.

Mauch Chunk Formation

- 3.0 Reddish-brown, silty shale with siltstone interbeds.
- 2.0 Reddish-brown siltstone.

Locality 19

Section in abandoned quarry 1.8 miles northeast of Swanton, Garrett County, Longitude 79°12'00"; Latitude 39°28'00". Base of the section is in the upper Purslane Formation.

Thickness (feet)

Purslane Formation

- 10.0 Reddish-brown, cross-bedded, medium-grained, flaggy sandstone.

Greenbrier Formation

Loyalhanna Member

- 5.0 Tan, sandy, ripple-laminated limestone.
- 0.8 Light-gray, lime mudstone.
- 15.0 Light-gray, cross-bedded, sandy limestone.
- 0.25 Light-gray, shaly siltstone.
- 5.0 Dark-gray, massive, sandy, fetid limestone.
- 1.0 Light-grayish-green to tan siltstone.

Deer Valley Member

- 6.0 Dark-gray, thinly-bedded, argillaceous, fetid limestone, becoming light-gray at top with tan, dolomitic siltstone at the top.
- 9.0 Light-gray to gray-green, thinly-bedded limestone with silty laminations.
- 4.0 Light-gray, cross-bedded, sandy lime grainstone.

Locality 20

Section along road 1.5 miles east of Swanton, Garrett County, Longitude 79°12'35"; Latitude 39°27'30". Base of section is in the Mauch Chunk Formation.

Thickness (feet)

Mauch Chunk Formation

- 7.0 Olive-gray siltstone.
- 17.0 Greenish-gray, argillaceous, cross-bedded, medium-grained sandstone with erosional base, fines upward into overlying unit.
- 3.0 Greenish-gray and reddish-brown, sandy siltstone.

5.0	Red-brown to variegated mudstone.
3.0	Greenish-gray siltstone with a layer of carbonate nodules.
+ 2.0	Red-brown siltstone.
22.0	Red-brown mudstone to siltstone with a few mottled layers.
2.0	Greenish-gray, platy siltstone.
1.0	Red-brown, silty mudstone.
2.0	Gray-green, platy, micaceous siltstone.
13.0	Red-brown mudstone interbedded with layers of mottled siltstone.
7.0	Greenish-gray, argillaceous, cross-bedded, medium-grained sandstone with shale pebbles at the base and erosional base.
3.0	Green-gray shale.
6.0	Green-gray, shaly siltstone.
9.0	Red-brown, silty shale.
11.0	Covered.
12.0	Greenish-gray, cross-bedded, argillaceous sandstone. Fines upward into overlying unit.
12.0	Greenish-gray and red-brown, silty shale.

Locality 21

Section along railroad tracks at Altamont, Garrett County, Longitude 79°17'00"; Latitude 39°25'40". Base of section is in the Hampshire Formation.

Thickness (feet)

Hampshire Formation

2.0	Reddish-brown, cross-bedded, coarse-grained sandstone.
5.0	Reddish, platy, micaceous siltstone.
2.0	Covered.
3.5	Reddish-brown, shaly siltstone.
6.0	Covered.

Rockwell Formation

Finzel Marine Tongue

2.0	Greenish-gray and tan, mottled, argillaceous, fine-grained sandstone with <i>Skolithos</i> burrows.
1.0	Green-gray claystone.
12.0	Covered.
1.0	Red-brown and green-gray, mottled, argillaceous, fine-grained sandstone.
1.0	Covered.
1.0	Greenish-gray to tan, mottled sandstone.
16.0	Covered.
3.5	Greenish-gray, fine-grained, argillaceous sandstone with <i>Skolithos</i> burrows.

4.0	Covered.
2.0	Greenish-gray, shaly, fine-grained sandstone.
1.0	Green-gray shale.
3.5	Tan to light-gray, mottled, fine-grained, medium-bedded sandstone with <i>Skolithos</i> burrows.
0.8	Green-gray shale.
2.0	Tan to greenish-gray, medium-grained sandstone with <i>Skolithos</i> burrows.
1.0	Covered.
2.0	Tan, argillaceous, fine-grained sandstone.
5.0	Covered.
10.0	Tan to greenish-gray, fine- to medium-grained sandstone with thin layers of calcareous shale. Sandstones contain abundant <i>Skolithos</i> burrows.
2.0	Greenish-gray, argillaceous, shaly, friable sandstone.
6.0	Tan, fine-grained, medium-bedded sandstones with <i>Skolithos</i> burrows.
3.0	Covered.
0.75	Tan, slabby, fine-grained sandstone.
7.0	Covered.
15.0	Tan, medium- to coarse-grained, medium-bedded sandstone, weathers to spheroids.

Riddlesburg Member

4.0	Tan to light-gray, silty shale with orbiculoid brachiopods.
3.0	Red and tan shale with a few black shale layers. Contains bivalves and scattered brachiopods.
10.0	Covered.
25.0	Tan, flaggy, medium- to coarse-grained, micaceous sandstone.

Locality 22

Section in abandoned quarry approximately 500 yards north of Underwood Church and Underwood Road, Garrett County, Longitude 79°27'35"; Latitude 39°22'10". Base of section is in the Wymps Gap Member of the Greenbrier Formation.

Thickness (feet)

Greenbrier Formation

Wymps Gap Member

7.0	Covered.
5.0	Dark-gray, argillaceous, fetid, lime wackestone with crinoids and <i>Martinia</i> .
0.5	Dark-gray, calcareous shale.

- 6.0 Very-dark-gray, fetid, argillaceous, medium-bedded lime wackestone with crinoids, corals, and brachiopods (*Diaphragmus*, *Composita*, *Anthracospirifer*, and *Phrycodothyris*).
- 3.5 Dark-gray, argillaceous limestone, grading upward into greenish-gray calcareous shale with thin (0.25 to 0.5 inches) packstone beds, containing *Diaphragmus*, *Composita*, *Anthracospirifer*, and crinoids.
- 2.0 Medium- to light-gray, lime wackestone, shaly at base.
- 1.5 Greenish-gray, calcareous shale to shaly limestone with a few beds of packstone. Abundant bryozoans and brachiopods.
- 2.5 Thin-bedded, greenish-gray, wackestone with calcareous shale laminae.

Mauch Chunk Formation

- 23.0 Reddish-brown siltstone and shale (mostly covered).

Reynolds Member

- 1.0 Greenish-gray, argillaceous limestone.
- 6.0 Red-brown shale (mostly covered).

Locality 23

Section in abandoned quarry and along Silver Knob Road, 1.5 miles south of Underwood Church, Garrett County, Longitude 79°28'15"; Latitude 39°21'00". Base of the section is in the Hampshire Formation.

Thickness (feet)

Hampshire Formation

- 5.0 Red, silty mudstone.
- 25.0 Covered.

Purslane Formation

- 15.0 Reddish-brown to tan, poorly indurated conglomerate with white quartz pebbles.
- 30.0 Tan to white, hematite-rich, cross-bedded, quartz-pebble conglomerate with layers of granule-size and very coarse-grained sand. Poorly cemented with quartz pebbles averaging 0.5 inches or less, but up to 2.0 inches in diameter.
- 5.5 Reddish-brown, quartz-pebble conglomerate, with pebbles averaging 0.5 to 1.0 inches in diameter.
- 4.0 Tan, conglomeratic, very coarse-grained sandstone, poorly indurated with layers of cross-bedded, quartz-

pebble conglomerate.

- 3.0 Tan, quartz-pebble conglomerate with faint cross-bedding.
- 2.0 Tan, very-coarse-grained, poorly indurated, conglomeratic, cross-bedded sandstone.
- 5.0 White, cross-bedded, pebbly conglomerate.
- 33.0 White, cross-bedded, poorly indurated, conglomerate composed of well-rounded quartz pebbles, and exhibiting abundant scour surfaces.
- 10.0 White, well-sorted, cross-bedded, poorly indurated, very coarse-grained sandstone with a few layers of quartz pebbles.

Locality 24

Section in abandoned quarry 150 yards west of U.S. Route 219 at Deep Creek Lake, 0.75 miles north of Thayerville, Garrett County, Longitude 79°19'35"; Latitude 39°30'40". Base of section is at the top of the Savage Dam Member of the Greenbrier Formation.

Thickness (feet)

Greenbrier Formation

Wymys Gap Member

- 4.75 Interbedded, medium-gray, lime mudstone and calcareous shale. Limestones fine upward and exhibit rippled upper surfaces. Fauna include *Straparollus*, *Diaphragmus*, *Composita*, bryozoans, and crinoids.
- 3.0 Dark-gray lime wackestone to lime mudstone with a few tan, argillaceous laminae. Contains *Anthracospirifer*, *Composita*, and *Straparollus*.
- 6.0 Thinly interbedded, medium-gray, lime packstone to wackestone and calcareous shale. Limestone beds contain *Straparollus*, *Composita*, *Anthracospirifer*, and *Orthis*, and are graded upward.
- 11.0 Dark-gray to black, argillaceous, fetid lime wackestone with a few shaly beds. Contains *Wilkingia*, *Orthis*, *Martinia*, *Anthracospirifer*, and crinoids.
- 2.0 Black, calcareous shale.
- 4.5 Black, massive, fetid lime wackestone containing crinoids, *Orthis*, *Phrycodothyris*, and *Wilkingia*.
- 2.0 Greenish-gray, interlaminated, shaly limestone and calcareous shale. Highly fossiliferous, with *Orthis* and

- Composita*, which are often current imbricated.
- 2.5 Light-gray, argillaceous, bioturbated lime mudstone with shaly burrows.
 - 1.5 Covered.
 - 3.5 Greenish-gray, bioturbated, argillaceous limestone containing *Composita* and becoming shaly at top.

Mauch Chunk Formation

- 3.0 Reddish-brown and greenish-gray shale.
- 0.15 Tan to gray, rippled limestone.
- 0.5 Reddish-brown, shaly limestone.
- 16.0 Reddish-brown, silty mudstone and shale.
- 0.25 Green gray claystone.

Reynolds Member

- 3.0 Tan, calcareous claystone with abundant bivalve fragments.
- 25.0 Interbedded, red-brown mudstone and siltstone.

Locality 25

Section in abandoned quarry 75 yards northwest of New Germany Road, 1.0 mile south of New Germany State Park, Garrett County, Longitude 79°08'20"; Latitude 39°37'25". Entire section is probably in the Savage Dam Member of the Greenbrier Formation. Quarry is likely in one of the limestone interbeds of the upper Savage Dam Member.

Thickness (feet)

Greenbrier Formation

Savage Dam Member

- 3.5 Reddish-brown mudstone with green-gray mottling.
- 6.0 Variegated red and green, sandy siltstone.
- 2.0 Red-brown, silty shale.
- 0.5 Variegated red and green, silty sandstone.
- 1.5 Red-brown, silty shale.
- 1.0 Gray, calcareous, medium-grained, cross-bedded sandstone.
- 3.0 Covered.
- 1.0 Red-brown siltstone, green at top.
- 1.5 Greenish-gray, calcareous siltstone.
- 2.0 Interbedded, nodular-bedded, limestone and reddish-brown shale, containing bryozoans, bivalves, crinoids, *Composita*, and *Anthracospirifer*.
- 5.0 Greenish-gray, argillaceous, sandy lime wackestone with crinoids, bryo-

zoans, trilobites, and *Composita*.

- 6.0 Red-brown, silty shale.
- 0.25 Red-brown, sandy siltstone.
- 1.0 Red-brown, silty sandstone.
- 1.5 Red-brown, silty shale.
- 1.0 Red-brown, silty sandstone.

Locality 26

Section along U.S. Route 40 at the Maryland-Pennsylvania State line, near the intersection with Pigs Ear Road, Somerset County, Pennsylvania, Longitude 79°18'10"; Latitude 39°43'15". Section is in the Mauch Chunk Formation.

Thickness (feet)

Mauch Chunk Formation

- 12.0 Greenish-gray, argillaceous, medium-grained, cross-bedded sandstone, fining upward into splintery siltstone at top.
- 3.0 Variegated red and green mudstone.
- 2.0 Reddish-brown claystone with carbonate nodules.
- 4.0 Reddish-brown shale.
- 4.0 Covered.
- 3.5 Greenish-gray, thin-bedded, cross-bedded, medium-grained sandstone.
- 10.0 Covered.
- 1.0 Greenish-gray, fine-grained sandstone.
- 2.0 Greenish-gray, argillaceous, silty sandstone.
- 11.0 Covered.
- 4.0 Greenish-gray to tan, fine- to medium-grained, cross-bedded sandstone.
- 4.0 Covered.
- 7.0 Greenish-gray, cross-bedded, medium-grained sandstone with erosional base, fines upsection.
- 3.0 Covered.
- 22.0 Medium-gray-green, cross-bedded, medium to coarse-grained, flaggy sandstone with erosional base, fines upsection.
- 20.0 Covered (abundant green-gray sandstone float).
- 7.0 Red-brown, silty mudstone.

Locality 27

Section along B&O railroad tracks 1.0 mile west of Rowlesburg, Preston County, West Virginia. Data from Bjerstedt, 1986, Reger, 1924, and Brezinski 1984, p. 110.

Locality 28

Section along Conrail tracks in Casselman River Gorge 2.0 miles west of Garrett, Somerset County, Pennsylvania. Data from Brezinski (1984, p. 106).

Locality 29

Composite section in Keystone Lime Company Inc. quarries at Savage, Somerset County, Pennsylvania. Data from Hoque (1965), Flint (1965), and Brezinski (1984, p. 100).

Locality 30

Discontinuous section along Wills Creek 0.6 mile east of Fairhope, Somerset County, Pennsylvania. Data from Brezinski (1984, p. 107, revised and modified).

Locality 31

Section on Little Savage Mountain along Pennsylvania Route 160 0.7 mile west of Pleasant Union, Somerset County, Pennsylvania. Data from Beuthin (1986, p. 70-73).

Locality 32

Section along West Virginia Route 46 2.0 miles east of Piedmont, Mineral County, West Virginia. Data from Hoque (1965).

Locality 33

Section along Interstate 70 0.2 mile west of Crystal Spring, in road cut through Rays Hill, Fulton County, Pennsylvania. Data from Brezinski (1989, Figure 4).

Locality 34

Composite section along Little Piney Creek and in abandoned quarries on hillside above creek, 2.0 miles southeast of Salisbury, Somerset County, Pennsylvania, and 0.5 mile north of the Maryland-Pennsylvania State line. Data from Brezinski (1984, p. 102).

Locality 35

Section along railroad tracks 0.7 mile east of Glade City, Somerset County, Pennsylvania. Data from Brezinski (1984, p. 104).

APPENDIX II — MISSISSIPPIAN FOSSILS OF MARYLAND

Fossil specimens illustrated in the following plates are repositied at the Section of Invertebrate Paleontology of The Carnegie Museum of Natural History (CMNH) in Pittsburgh, Pennsylvania.

PLATE 1

A, B, G, H, *Rugosochonetes* sp., Riddlesburg Shale Member of the Rockwell Formation, Sideling Hill road cut (locality 1). CMNH 35565-35568, x2.0.

C, E, *Macropotamorhyncus* sp., Riddlesburg Shale Member of the Rockwell Formation, Sideling Hill road cut (locality 1). CMNH 35569, 35570, x3.0.

K, *Schuchertella* sp., Riddlesburg Member of the Rockwell Formation at locality 11A. CMNH 35571, x0.75.

D, Indeterminate bivalve, Riddlesburg Shale Member of the Rockwell Formation, Sideling Hill road cut (locality 1). CMNH 35572, x3.0.

F, I, *Phestia* sp., Riddlesburg Shale Member of the Rockwell Formation, Sideling Hill road cut. CMNH 35573, 35574, x2.0 and 3.0 respectively.

J, *Verkhotomia* sp., marine sandstone member of the Riddlesburg Member at locality 11A. CMNH 35575, x1.0.

L, Undetermined orbiculoid, Riddlesburg Shale Member of the Rockwell Formation at locality 21. CMNH 35576, x3.0.

M, N., *Adiantites* sp., Riddlesburg Shale Member of the Rockwell Formation, Sideling Hill road cut (locality 1). CMNH 35577, x2.0.

O, *Lepidodendropsis* sp., Upper Purslane Formation at Sideling Hill road cut (locality 1). CMNH 35578, x1.0.



A



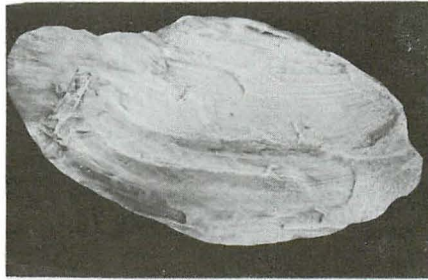
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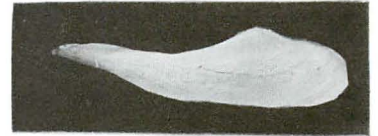
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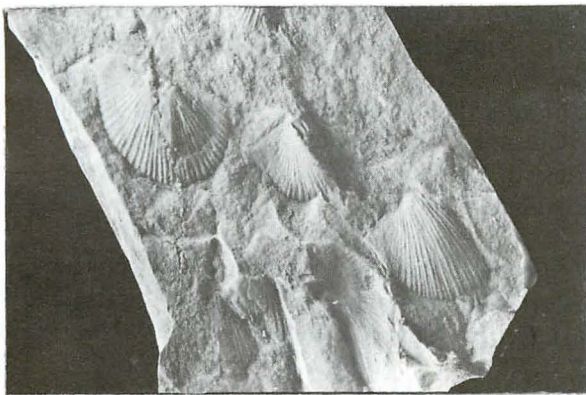
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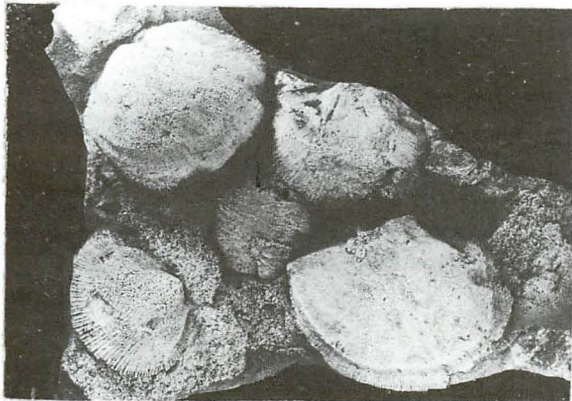
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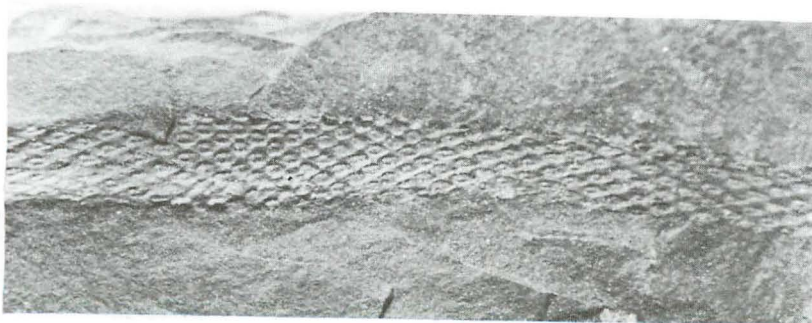
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L



M



O



N

PLATE 2

A, B, *Ovatia* cf. *O. pileiformis*, Wymps Gap Member of the Greenbrier Formation at Sang Run quarry (locality 18). CMNH 35579, x2.5.

C, D, *Diaphragmus elegans*, Wymps Gap Member of the Greenbrier Formation at Sang Run quarry (locality 18). CMNH 35580, x2.0.

E, *Cleiothyridina sublamelosa*, Wymps Gap Member of the Greenbrier Formation at Sang Run quarry (locality 18). CMNH 35581, x1.5.

F, G., *Martinia contracta*, Wymps Gap Member of the Greenbrier Formation at Sang Run quarry (locality 18). CMNH 35582, 35583, x1.0 and x0.75 respectively.

H, L, *Anthracospirifer* cf. *A. pellaensis*, Wymps Gap Member of the Greenbrier Formation at the Thompson quarry near Chalkhill, Fayette County, Pennsylvania. CMNH 35584, 35585, both x1.5.

I, *Orthotetes* sp., Wymps Gap Member of the Greenbrier Formation at Sang Run quarry (locality 18). CMNH 35586, x1.0.

J, *Composita* sp., Wymps Gap Member of the Greenbrier Formation at Sang Run quarry (locality 18). CMNH 35587, x1.5.

K, *Composita subquadrata*, Savage Dam Member of the Greenbrier Formation at locality 9. CMNH 35588, x1.5.

M, *Phrycodothyris* sp., Wymps Gap Member of the Greenbrier Formation at Sang Run quarry (locality 18). CMNH 35589, x2.0.

N, *Girtyella* sp., Wymps Gap Member of the Greenbrier Formation at Sang Run quarry (locality 18). CMNH 35590, x1.5.

O, *Composita* encrusted by three orbiculoid specimens, from the Wymps Gap Member of the Greenbrier Formation at the Thompson quarry near Chalkhill, Fayette County, Pennsylvania. CMNH 34600, x4.0.

P, Q, *Endothyra* sp. from the Wymps Gap Member of the Greenbrier Formation at locality 24 (photos courtesy of D. Weible). Enlargement times not known, approximately x30.

R, *Fenestella*?, from the Wymps Gap Member of the Greenbrier Formation at the Thompson quarry, Chalkhill, Fayette County, Pennsylvania. CMNH 35591, x2.5.

S, *Archimedes* sp., Wymps Gap Member of the Greenbrier Formation at Sang Run quarry (locality 18). CMNH 35592, x0.5.

T, *Eridopora* sp. encrusting a specimen of *Fenestella*, Wymps Gap Member of the Greenbrier Formation at the Thompson quarry near Chalkhill, Pennsylvania. x7.

U, *Rhombopora* sp., Wymps Gap Member of the Greenbrier Formation at Sang Run quarry (locality 18). CMNH 35593, x5.



A



C



E



G



B



D



F



H



I



J



K



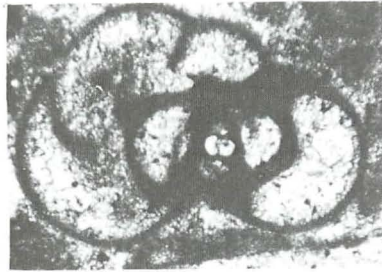
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M



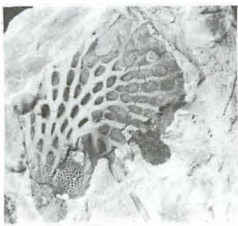
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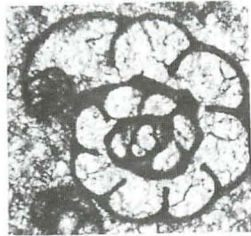
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R



P



S



T



U

PLATE 3

A, Indeterminate pinnid? bivalve, Wymps Gap Member of the Greenbrier Formation from the Thompson quarry near Chalkhill, Fayette County, Pennsylvania. CMNH 35594, x0.5.

B, *Septimyalina* sp., Wymps Gap Member of the Greenbrier Formation from the Thompson quarry near Chalkhill, Fayette County, Pennsylvania. CMNH 35595, x1.5.

C, *Paleoyoldia* sp. internal mold, from the Savage Dam Member of the Greenbrier Formation at locality 34. CMNH 35596, x2.5.

D, *Edmondia*? sp., Savage Dam Member of the Greenbrier Formation at locality 9. CMNH 35597, x1.5.

E, *Goniophera*? sp., from the Savage Dam Member of the Greenbrier Formation at locality 34. CMNH 35598, x2.0.

F, Indeterminate mytilid bivalve sp., from the Savage Dam Member of the Greenbrier Formation at locality 9. CMNH 35599, x2.0.

G, Indeterminate nuculid bivalve sp., Savage Dam Member of the Greenbrier Formation at locality 9. CMNH 35600, x1.5.

H, *Niadites* sp., Savage Dam Member of the Greenbrier Formation at locality 9. CMNH 35601, x2.0.

I, *Bellerophon* sp., Savage Dam Member of the Greenbrier Formation at locality 9. CMNH 35602, x2.0.

J, *Bulimorpha* sp., Savage Dam Member of the Greenbrier Formation at locality 9. CMNH 35603, x3.0.

K, *Wilkingia* sp., Mauch Chunk Formation (Savage Dam Member equivalent in Pennsylvania) at Bolivar, Westmoreland County Pennsylvania. CMNH 35604, x0.75.

L, *Platyceras* sp., Wymps Gap Member of the Greenbrier Formation from the Thompson quarry near Chalkhill, Fayette County, Pennsylvania. x5.0.

M, *Straparollus* cf. *S. similis*, Wymps Gap Member of the Greenbrier Formation at Sang Run quarry (locality 18). CMNH 35605, x1.5.

N, Undetermined rugosan coral, Savage Dam Member of the Greenbrier Formation at locality 9. CMNH 35606, x1.5.

O, S, *Platycrinites* sp., Wymps Gap Member of the Greenbrier Formation from the Thompson quarry near Chalkhill, Fayette County, Pennsylvania. CMNH 35607, 35608, x2.5.

P, *Agassizocrinus* sp., Wymps Gap Member of the Greenbrier Formation at Sang Run quarry (locality 18). CMNH 35609, x3.0.

Q, R, *Paladin chesterensis*, Wymps Gap Member of the Greenbrier Formation at Sang Run quarry (locality 18). CMNH 35610, x2.5.

T, *Pentremites* sp., Wymps Gap Member of the Greenbrier Formation from the Thompson quarry near Chalkhill, Fayette County, Pennsylvania. CMNH 35611, x2.0.

U, *Paraconularia chesterensis*, Wymps Gap Member of the Greenbrier Formation from the Thompson quarry near Chalkhill, Fayette County, Pennsylvania. CMNH 35612, x1.5.

V, *Cornulites* encrusting a brachial valve of *Composita*, Wymps Gap Member of the Greenbrier Formation from the Thompson quarry near Chalkhill, Fayette County, Pennsylvania. x10.0.



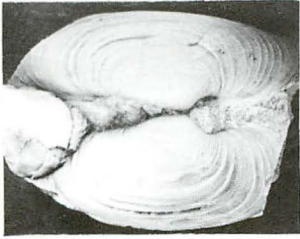
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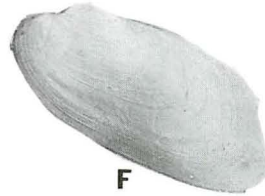
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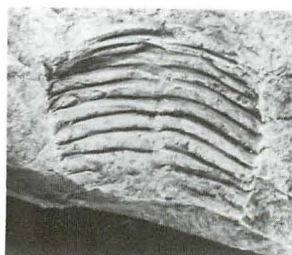
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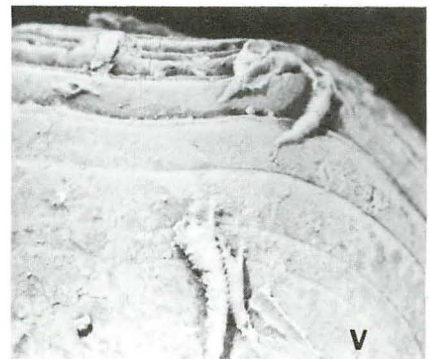
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V

