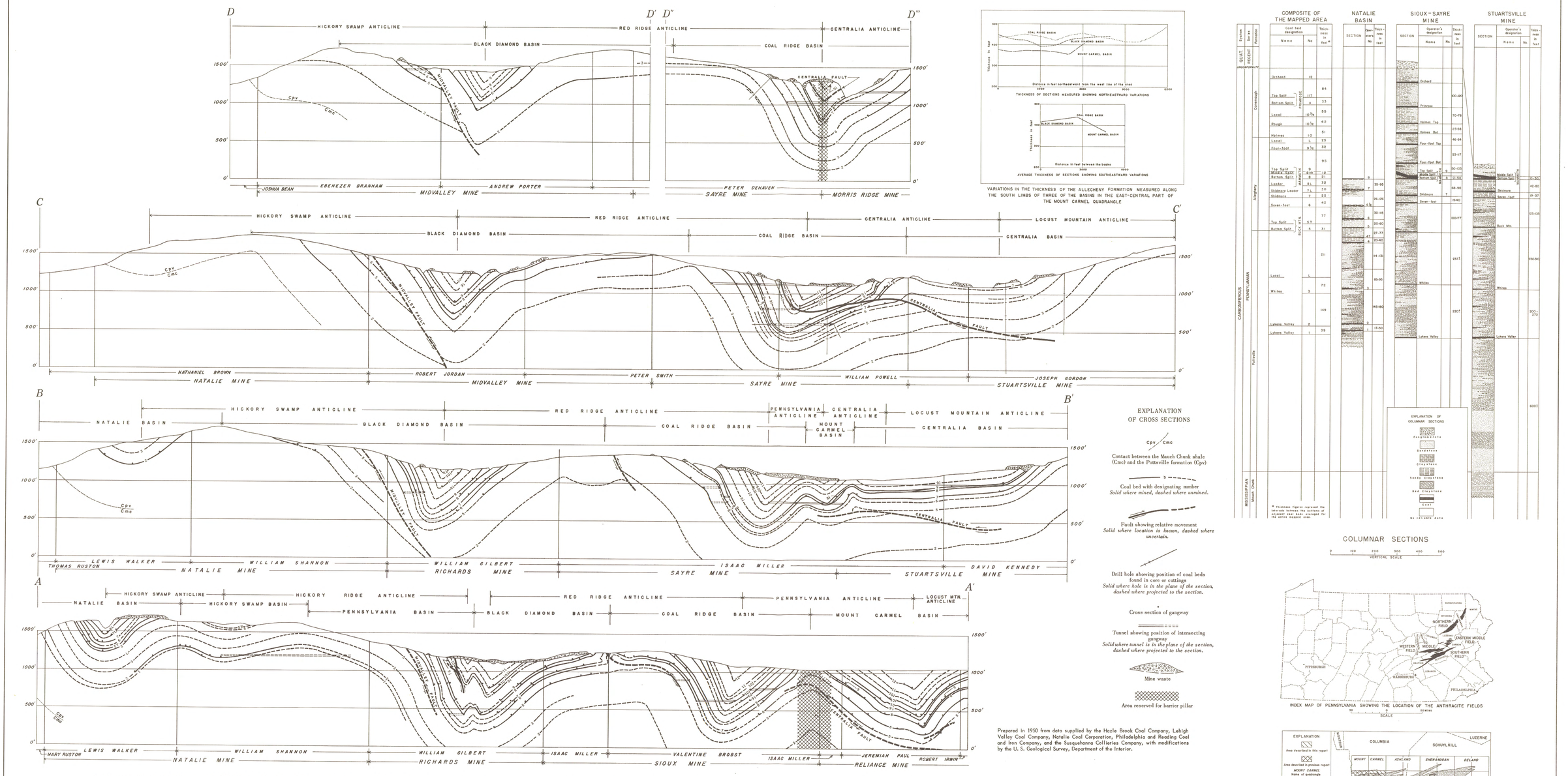


CROSS SECTIONS SHOWING THE STRUCTURE OF THE COAL BEDS IN THE EAST-CENTRAL PART OF THE MOUNT CARMEL QUADRANGLE

SCALE 1:6,000

Datum is mean sea level

VARIATIONS IN THE THICKNESS OF THE ALLEGHENY FORMATION MEASURED ALONG THE SOUTH LIMBS OF THREE OF THE BASINS IN THE EAST-CENTRAL PART OF THE MOUNT CARMEL QUADRANGLE

EXPLANATION OF CROSS SECTIONS

Cpv / Cmc — Contact between the Mauch Chunk shale (Cmc) and the Pottsville formation (Cpv)

Coal bed with designating number. *Solid where mined, dashed where unmined.*

Fault showing relative movement. *Solid where location is known, dashed where uncertain.*

Drill hole showing position of coal beds found in core or cuttings. *Solid where hole is in the plane of the section, dashed where projected to the section.*

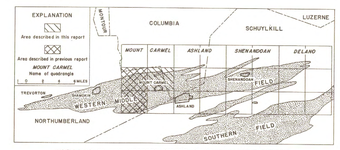
Cross section of gangway

Tunnel showing position of intersecting gangway. *Solid where tunnel is in the plane of the section, dashed where projected to the section.*

Mine waste

Area reserved for barrier pillar

INDEX MAP OF PENNSYLVANIA SHOWING THE LOCATION OF THE ANTHRACITE FIELDS



INDEX MAP OF THE WESTERN MIDDLE ANTHRACITE FIELD SHOWING THE LOCATION OF THE MAPPED AREAS

Prepared in 1950 from data supplied by the Hazle Brook Coal Company, Lehigh Valley Coal Company, Natalie Coal Corporation, Philadelphia and Reading Coal and Iron Company, and the Susquehanna Collieries Company, with modifications by the U. S. Geological Survey, Department of the Interior.

INTRODUCTION

The Pennsylvania anthracite fields, the principal source of anthracite in North America, are in the eastern half of the Pennsylvania commonwealth of Pennsylvania. (See index map of Pennsylvania, sheet 3.) The coal occurs in four elongate areas--Northern, Western Middle, Eastern Middle, and Southern fields--that trend northeastward and lie in echelon arrangement. The fields range in length from 24 to 65 miles and in width from 1 mile to 7 miles; they total, by inclusion about 484 square miles of coal-bearing land (Smith, 1935, p. 92). The area covered by this report is in the Western Middle field.

The boundaries of the coal-bearing areas that constitute the anthracite fields are considered to be the outcrops of the oldest bed of the Lykens Valley coal beds. Each of the fields has a boundary that is a single continuous line, except the Eastern Middle field, which consists of several closely spaced but disconnected coal-bearing areas. The northwest boundaries of the fields are generally indicated by outcrops of the conglomerate Pottsville Formation or of the red rocks of the Mauch Chunk shale below the Pottsville.

The mapped area here described is near the middle of the Western Middle field and consists of the east-central part of the area included in the U. S. Geological Survey's Mount Carmel quadrangle. (See index map of the Western Middle field, sheet 3.) This part of the quadrangle is between latitudes 40°45'-40°52'30" N., and longitudes 76°-76°15' W., a distance of 5.25 miles. In Northumberland and Columbia Counties, the boroughs of Mount Carmel is in the southeastern part of the area.

This report is the third of a series on the anthracite fields inaugurated by the Pennsylvania Geological Survey with the approval of the Bureau of Topographic and Hydrographic Surveys, Commonwealth of Pennsylvania. The first report of the series described the west-central part of the Mount Carmel quadrangle (Rothrock et al., 1950), and the second the southeastern part (Rothrock et al., 1951). Other parts of the series will be published as they are completed. The series will show the extent, character, and value of the coal crops (sheet 1), (2) the depth, pitch, and other structural features of representative coal beds, (3) the natural and artificial barriers and the structural relationships between the various coal beds (sheets 1, 2, and 3), (4) the stratigraphic intervals between the coal beds, (5) the physical characteristics of the beds, (6) the thickness, continuity, and other physical characteristics of the coal beds (sheet 3). The reports will bring up to date and amplify the Geol Atlas of the Anthracite Fields published by the Second Geological Survey of Pennsylvania in 1884-85, and the reports that accompany the Atlas. They will be of value to those who are in current series will and operators who are mining either on surface or underground, or who are formulating plans for centralized mine water. It is hoped that these reports will also direct attention to overlooked or neglected reserves of coal.

Acknowledgments. Much of the information comprising this report was compiled from mine maps, cross sections, surface surveys, core drill records, and other data supplied by the Hazle Brook Coal Co., Lehigh Valley Coal Co., Natalie Coal Corp., Philadelphia and Reading Coal and Iron Co., and Susquehanna Collieries Co. The cooperation of the companies' officials who made available this indispensable information and the aid given by John P. Brogan, State Mine Inspector, is deeply appreciated.

STRATIGRAPHY

The rocks that crop out in the mapped area belong to the Carboniferous and Quaternary systems. The Carboniferous rocks include the top of the Mauch Chunk shale (Mississippian), and the Pottsville, Allegheny, and lower part of the Conemaugh Formations (Pennsylvanian). The areal outcrops of these formations are covered in places with Recent and Pleistocene unconsolidated deposits. The following stratigraphic descriptions were obtained from the study of mine cross sections, core drill records, and sections taken along mine tunnels, slopes, and shafts by company engineers, and from field observations.

Mississippian rocks

Mauch Chunk shale. The Mauch Chunk shale crops out on the north ridge of Big Mountain, but no exposure of it was found because of the cover of talus. The Mauch Chunk was penetrated in a core drill hole in the Stuartsville mine penetrated a cross section of nearly 115 ft. thick of red claystone with thin interbedded sandstones. The top of this zone is considered to be the top of the Mauch Chunk shale in accordance with the practice of placing the top of the Pottsville at the base of the lowermost conglomerate predominantly red and fine grained (Mauch Chunk) and above which they predominantly weather gray or brown and are coarse grained (Pottsville).

Pennsylvanian rocks

The Pennsylvanian (Carboniferous) rocks are of continental origin and consist of lenticular deposits of cyclothemic and sigmoidal lacunous rocks, interbedded with 35 persistent beds and several local beds of workable coal. The rocks in the Pottsville rocks is predominantly conglomeratic, the upper part is predominantly fine grained. The individual beds, however, exhibit such diverse changes in lithology that the type of rock in any bed may be composed to assign indicative of a definite stratigraphic position. The coal beds are the most persistent of the rock types, most of the principal beds being found throughout the coal-bearing area.

Pottsville Formation. The Pottsville Formation, the oldest of the PENNSYLVANIAN ROCKS, overlies the Mauch Chunk shale and underlies the Allegheny Formation. The thickness of the Pottsville formation ranges from approximately 910 ft. in the adjoining area on the west to 1,200 ft. in the area covered by this report. The formation consists of resistant conglomerates and sandstones, it forms the core of Big Mountain, Locust Mountain, and the more prominent ridges in the mapped area. The base of the Pottsville is not exposed in the mapped area, but a core drill record in the Stuartsville mine indicates that the lower 175 ft. of the Formation consists chiefly of sandstone with a bed of red claystone near the middle. This claystone corresponds to a similar zone of gray and red fine grained clastics in the lower part of the Pottsville in the west-central part of the Mount Carmel quadrangle. The Pottsville Formation above the red claystone zone consists of lenticular conglomerates and sandstones, with a few thin beds of shale in the upper 400 to 500 ft., with coal beds and their associated clastics. The conglomerates, which are composed of pebbles of milky quartz and quartzite in a quartz sand matrix cemented by silica, form ridges or cliffs in many places but some form such a ridge throughout the area. The Pottsville Formation is predominantly coarse conglomerate. Crops near the middle of the formation and is overlain by the No. 2 bed of the Lykens Valley coal zone. In the eastern part of the Natalie mine area this resistant conglomerate forms a small ridge or cliff and supports only a scanty vegetation--a condition that is in marked contrast to the dense growth on the same places. In the southwestern and southeastern parts of the Mount Carmel quadrangle, however, the conglomerate above the No. 2 coal usually makes a more pronounced cliff than the one below the coal. The conglomerate at the top of the Pottsville Formation is predominantly fine grained and forms a zone of transition to the Allegheny Formation. In places the top of the Pottsville Formation (No. 5) coal, which overlies the conglomerate. The Pottsville Formation contains three coal beds that have been mined--the No. 1 and No. 2 beds of the Lykens Valley coal zone, the Whites (No. 3) coal bed, and several beds that are of little importance.

Allegheny Formation. In the mapped area the Allegheny Formation ranges from the top of the Buck Mountain (No. 5) coal bed to the base of the Holmes (No. 10) coal bed, which is the basal bed of the Conemaugh Formation. The Allegheny is 500 to 575 ft. thick. (See charts on sheet 3 showing variations in the thickness of the Allegheny formation which are made from measurements along the south limbs of the basins.) The upper chart shows no consistent trend of thickness in a longitudinal (northeastward) direction. The lower chart shows that the Allegheny thins both northward and southward from the Coal Ridge basin. The much of this thinning is depositional and how much deformational is not apparent. The following table shows the thickness, records the known facts.

Table showing the thickness of the Allegheny formation and the dip of the measured beds

Basin	Measured average thickness	Average dip of beds
		North	South
Black Diamond	417 ft.		35°
Coal Ridge	440 ft.		30°
Mount Carmel	371 ft.		36°

The Allegheny formation consists of interbedded conglomerate, sandstone, siltstone, claystone, and coal. In the lower part of the formation arenaceous rocks predominate. In the upper part claystones and siltstones occur more frequently and conglomerate becomes less abundant. Coal beds are numerous in the Allegheny. (No. 8) of the Mauch Chunk zone contains crude lenticular splits ranging from 6 inches to 3 feet in diameter. However, because of their sporadic occurrence and the occasional presence of similar concretions elsewhere in the section, the concretions are less useful as a stratigraphic marker than the Mauch Chunk zone. They are in the southeastern part of the Mount Carmel quadrangle. The Allegheny formation is the source of most of the coal mined in the area. It contains the Buck Mountain (No. 5) coal at its base, the Four-foot (No. 9) near its top, and the Seven-foot (No. 6), Skidmore (No. 7), and the Mammoth coals in the intervening zone.

Conemaugh Formation. Only the lower 450 ft. of the Conemaugh formation is exposed in the area. It includes the Holmes (No. 10) coal bed, which is the lowest bed in the Conemaugh, the Rough (No. 10) coals, and then about 200 ft. of claystone and siltstone overlying the Orchard coal. The Conemaugh is predominantly siltstone, and claystones, with lenses of conglomerate in the lower part of the formation.

Recent deposits

Recent deposits consist of boulders, gravel, sandy silt, and water-borne mine waste. These deposits, covered in many places by alluvial mine waste, are generally found in the valleys. In a previously mapped area to the southwest, deposits indicative of glacial deposits were found in the valleys. In the area of this report, glacial deposits were not noted in the area studied, it is possible that they are present but covered with subsequent alluvium.

STRUCTURE

Each of the Pennsylvania anthracite fields is a composite syncline, consisting of a group of roughly parallel overlapping synclines and anticlines. The structure of the general trend of these fields is northeastward. The synclinal parts of these fields are called basins by miners, a practice that is followed in this report. The term generally designates a complex syncline, consisting of a trough and two limbs, but in some places it is applied to the trough alone. The smaller synclines, to which the names "back" basin, "North" basin, and "underlay" are locally applied.

The mapped area includes the north end of the composite syncline that is the Western Middle field, and extends southward a little more than halfway across it. The synclines within this area become progressively deeper from north to south and their trough axes plunge southward. The area is in the northeastern part of the southeastern part of the area in the Mount Carmel basin, where the Lykens Valley (No. 2) coal is about 600 ft. below sea level. The maximum measured structural relief in the area is about 2,300 ft., as measured from the Mount Carmel basin to the highest outcrop of the Pottsville, which occurs at an altitude of about 1,700 ft. on Big Mountain.

Folds

The folds in the mapped area are concentric [parallel] and most of them are slightly asymmetric, with axial planes dipping northwest or southward at angles ranging from 65° to 90° and averaging 80°. The flattened medial parts of the limbs of major folds subtend angles that range from 70° to 130°. Minor folds include both isoclinal kinks and obtuse types of folds.

The principal synclines are the Black Diamond, Coal Ridge, and Centralia basins. The Natalie, Hickory Swamp, Pennsylvania, and Mount Carmel basins, which are smaller than the three principal basins, and southeastern parts of the Mount Carmel quadrangle, terminate up "spoon out" in the western part of the mapped area. (See sheet 2.) In most localities the troughs of the synclines are more closely compressed than the crests of the anticlines, but there are several exceptions. The Pennsylvania syncline is more compressed in the Hickory Swamp basin, which is folded to about the same degree as the adjoining anticlines. The continuation of this syncline in the west-central part of the Mount Carmel quadrangle, however, conforms to the general condition or norm. Another exception is the trough of the Coal Ridge basin, which is more compressed in the area of the moderately folded throughout its extent, a condition that is probably related to the geographic position of the basin on the northwestern edge of the field. The Centralia basin is flat-topped, a form that is due possibly to relief of compression resulting from the Centralia fault. (See sheet 2.)

Faults

Most of the faults in the area are thrust sheare and are the result of compression. Most of the faults are parallel with the strike of the folds and are called longitudinal faults. The two main faults traverse the entire area and extend for a mile or two into adjoining areas. They are the Midvalley fault on the north limb of the Black Diamond and Pennsylvania basins and the Centralia fault in the Coal Ridge basin. (See sheets 1, 2, and 3.) The Midvalley fault dips southward about 60° and represents the outcrop of the Buck Mountain (No. 5) coal bed. (No. 6), and the Skidmore (No. 7) coal beds. The Centralia fault, a warped thrust that cuts the beds at low angles, crops out in the eastern part of the area, but can be traced underground. The fault is west-central part of the Mount Carmel quadrangle.

A smaller longitudinal fault near the western end of the Red Ridge anticline illustrates a type of faulting that occurs commonly in the area. Faults at the crests of some of the anticlines in much of the Pottsville appears to be related to a late phase of folding when compressive stress was relieved by the formation of faults overlyingthe crests of adjoining anticlines. Such faults cut the beds along the axes of the anticlines but die out as bedding-plane faults on the sides of the anticlines.

Another pattern of faulting is provided by oblique faults that usually strike at an angle of about 45° with the strike of the folds. Some of them terminate in the longitudinal faults, one appears to cut these faults, and some are isolated from them. The oblique faults are associated in many places with shear zones, which are zones of crushed rock that have been formed by differential movement of the roof and floor-rock that it cement by mined profitably. Faults are indicated on the map in these shear zones where the movement has been large enough to produce measurable displacement. The true relationship of these faults, as well as that of the faults in the area, is not clearly obvious, but the oblique fault on the western end of the Red Ridge anticline (see sheet 2) apparently developed later than the longitudinal fault.

NOMENCLATURE AND CORRELATION OF THE COAL BEDS

Coal beds in the anthracite fields are generally known as veins, following very early custom. The term "vein" is used in reference to tabular mineral deposits that are foreign to, and younger than, the rocks in which they occur, and so is not applicable to deposits of coal. In this report the coal deposits are called coal beds.

The coal beds of a mine are designated by names or numbers, or by both, but this nomenclature has not been completely standardized. In the past, many beds were given different designations in different mines before correlation could be made. Subsequent mining has made it possible to correlate the beds in the different mines, but the names are in confusion still exist because of gaps between mine workings, complexity of structure and lithology, scarcity of outcrops, and the difficulty of changing established records.

The names of the coal beds used in this report were chosen to conform to the consensus of usage among operators and the nomenclature of the previous reports of this series. These names do not necessarily agree with those used in the reports of the Second Geological Survey of Pennsylvania, which conformed to local usage only (Ashburner, 1883, p. 99).

DESCRIPTION OF THE COAL BEDS

Age of the coals and location of outcrops

The coal beds in the mapped area occur in the upper half of the Pottsville Formation, throughout the Allegheny Formation, and in the lower part of the Conemaugh Formation (see columnar sections, sheet 3.) The younger coal beds that occur elsewhere in the anthracite fields have been removed by erosion from this area.

The coal beds are rarely exposed in natural outcrops because they are generally covered by talus or by soil. The beds crop out in the northwest part of the area on Big Mountain, but they are not naturally exposed because of the thick cover of talus and rubble from the adjoining conglomeratic strata.

Lykens Valley No. 1 coal bed. The Lykens Valley No. 1 coal, the oldest stratum coal in the area, crops out in the middle of the Pottsville formation. It was mined in the Natalie mine in the Hickory Swamp basin and was cut by drifts in the Red Ridge anticline. The average thickness of the bed in these areas was 3 ft. 8 in., of which 2 ft. 8 in. was coal.

Lykens Valley No. 2 coal bed. The Lykens Valley No. 2 coal is from 17 to 50 ft. above the No. 1 coal. The No. 2 bed was mined at relatively shallow depths in the Natalie and Richards mines in the northwestern part of the area and in the Midvalley mine in the southeastern part. In the southeastern part of the area, however, the bed has been mined almost to sea level in the Reliance workings. Although the bed in the principal synclines occurs at depths unfavorable for mining, it is above the plus 500-ft. level in much of the Red Ridge anticline. In the northwestern part of the area the bed is from 100 to 200 ft. below the Buck Mountain (No. 5) coal, as shown in the diagram, or the interval as interpolated between the nearest sections, by the size of the angle of dip. The length of a "rock hole" may be computed mathematically, but generally it can be more easily determined by plotting the positions of the beds and the proposed "rock hole."

The intervals between coal beds differ considerably from place to place. The interval between the bottom Split of the Mammoth coal bed and the Buck Mountain have no regular trend but the interval between the No. 8 bed and the Mammoth (No. 8) coal bed thins northward, and the one between the No. 8 and the Lykens Valley No. 2 thickens southwestward. The greatest percentage of variation is in the partings or "binders" between the splits of the Mammoth coal zone; these partings range from laminae too thin to be measured in mining to thicknesses as great as 50 ft.

Thicknesses of the coal beds

The coal thicknesses shown in this report were obtained chiefly from underground measurements made by the Bureau of Mines measurements, selected from a great many such observations, were chosen so as to reflect the normal thickness of the bed and its included rock in said areas 1,000 ft. square. Wherever possible, at least four measurements were averaged for each unit area. Measurements were made in places where the bed was free from the effects of deformation such as faulting, pinching, or swelling, were not used; hence, extreme dimensions of a bed are not included. The following table shows the averages and ranges of these unit-area thicknesses in the mapped area.

Average thicknesses and ranges in thickness of coal beds mined in the east-central part of the Mount Carmel quadrangle

Bed No.	Bed			Coal		
	Average	Range		Average	Range		Percentage of bed
	Ft.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	
12	7 8	4 4	to 10 6	5 6	2 8	to 9 0	28.2
11	5 2	2 0	to 11 10	3 11	1 0	to 11 10	24.2
10	3 6	1 11	to 6 6	2 11	1 11	to 4 6	16.6
10	4 8	2 0	to 8 0	3 4	1 4	to 8 10	7.1
10	4 8	1 0	to 12 0	3 11	1 0	to 11 0	16.0
9	4 1	1 1	to 12 0	3 4	1 1	to 12 0	18.3
9	7 6	2 0	to 15 9	6 7	1 3	to 15 4	12.2
8	7 3	3 0	to 21 0	6 10	2 0	to 21 0	9.9
8	3 6	1 0	to 16 0	3 4	1 0	to 16 0	13.5
7	3 2	1 1	to 10 6	5 0	3 1	to 10 5	5.2
7	2 5	1 2	to 4 0	2 5	1 2	to 4 0	0.0
7	6 10	1 2	to 30 6	5 10	1 2	to 30 6	14.6
6	4 4	1 0	to 14 0	3 6	0 11	to 9 0	19.2
5	2 5	1 0	to 13 0	2 5	1 0	to 9 0	29.2
5	5 6	0 11	to 14 6	4 7	1 0	to 14 0	16.6
3				2 4	1 6	to 4 0	
2	4 11	1 0	to 10 6	4 6	1 0	to 10 6	8.4
1	3 8	1 2	to 7 8	2 8	1 0	to 5 7	27.2

Coal beds less than 14 ft. (18 in.) thick are generally not recorded in this report. Exposed coal beds that have thicknesses of 18 in. or more that occur within a relatively small area, and are not branches or splits from named beds, are herein termed "local beds and are shown on sheet 2 only within the area of occurrence. Local beds that are known to occur in more than one place are given for long distances beyond the known point of occurrence. They indicate the authors' estimate of the position of the horizon of the bed in order to serve as a guide for prospecting, but they do not signify that the bed is necessarily minable throughout this extent.

Lykens Valley coal zone

In the northwestern part of the area the Lykens Valley coal zone is represented by two coal beds, called the No. 1 and No. 2 beds, which are separated by 5 to 15 ft. of shale. The beds crop out in the northwestern part of the area on Big Mountain, but they are not naturally exposed because of the thick cover of talus and rubble from the adjoining conglomeratic strata.

Lykens Valley No. 1 coal bed. The Lykens Valley No. 1 coal, the oldest stratum coal in the area, crops out in the middle of the Pottsville formation. It was mined in the Natalie mine in the Hickory Swamp basin and was cut by drifts in the Red Ridge anticline. The average thickness of the bed in these areas was 3 ft. 8 in., of which 2 ft. 8 in. was coal.

Lykens Valley No. 2 coal bed. The Lykens Valley No. 2 coal is from 17 to 50 ft. above the No. 1 coal. The No. 2 bed was mined at relatively shallow depths in the Natalie and Richards mines in the northwestern part of the area and in the Midvalley mine in the southeastern part. In the southeastern part of the area, however, the bed ranges from 12 ft. 3 in. to 25 ft. 0 in. Where two splits only are recognized the average thicknesses ranged from 7 ft. 5 in. to 20 ft. 7 in.

Mammoth Bottom Split (No. 8) coal bed. The Bottom Split of the Mammoth coal zone is used in this report as a reference or key bed because it is generally the lowermost Mammoth coal bed because it is generally present and is commonly identifiable. The average thicknesses of coal of the unit areas ranged from 4 ft. 1 in. in the southeastern part of the area to 1 ft. 11 in. in the northwest.

Mammoth Middle Split (No. 8) coal bed. The Middle Split of the Mammoth coal zone has been separately in the Richards and Stuartsville mines, where average thicknesses of coal in unit areas ranged from 1 to 3 ft.

Mammoth Top Split (No. 8) coal bed. The Top Split of the Mammoth coal zone has been mined in the Natalie and Richards mines, Midvalley, Sioux, and Reliance mines. The average thickness of the coal in the unit areas ranged from about 3 to 12 ft., with the greater thicknesses to the south.

Four-foot (No. 9) coal bed

The Four-foot (No. 9) coal bed is the most persistent of the Mammoth coal zone below by an interval that ranges between 25 to 115 ft., a range that is also characteristic of the adjacent seams to the west and southwest. The Four-foot coal bed crops out on the north limb of the Black Diamond basin and on the south limb of the Coal Ridge basin in the Pennsylvania, Reliance, Sioux, Sayre, and Richards mines. In most of the mined area the coal was 3 to 4 ft. thick but in the eastern part of the area it was 5 to 6 ft. and 7 ft. thick.

A local coal bed occurs about 30 ft. above the Four-foot coal in the Sioux mine near the west edge of the mapped area. No records of its thickness were obtained.

Holmes (No. 10) coal bed

The Holmes (No. 10) coal bed, which is the basal member of the Conemaugh Formation (Lohman, 1937, p. 90), is 120 ft. above the bottom of the Mammoth coal zone in the Mount Carmel basin and as much as 200 ft. in the southeastern portion in the Black Diamond basin. Except for the northeast and southwest ends, the interval between these horizons is relatively uniform. The Holmes coal crops out on both sides of the Black Diamond basin. The coal crops out in all of the basins except the Natalie and Hickory Swamp basins, and was mined in the Natalie, Sioux, Sayre, Reliance, and Pennsylvania mines. In most of the mined areas the average thicknesses in the unit areas ranged from 3 ft. to 5 ft. The greatest thickness of the coal in the Richards mine a maximum of 8 ft. 6 in. was recorded.

Rough (No. 10½) coal bed

The Rough (No. 10½) coal bed crops out in the Black Diamond basin and in basins to the south. It is 50 to 70 ft. above the Holmes (No. 10) coal in the southern part of the area and 40 to 50 ft. above it in the northern part of the area of its occurrence. The Rough coal is conglomeratic in the stratigraphic section occurs locally within this interval. The Rough coal is generally persistent in its area of occurrence. In these areas it was relatively uniform in thickness and contained the very low proportion of 7.7 percent of rock. This percentage is somewhat higher than with 27 and 29 percent waste in the bed in the adjoining areas to the west and southwest, respectively. The average thicknesses of the coal in the unit areas ranged from 5 ft. to 9 ft., with the greater thickness occurring in the Coal Ridge basin.

Local (No. 10¾) coal bed

A local coal bed, called the No. 10¾ in this report, occurs 20 to 60 ft. above the Rough coal in the Coal Ridge and Mount Carmel basins. It was mined as the Top Split of the Holmes bed in the Sayre mine, where the bed averages 4 ft. 4 in. thick but ranges from 2 ft. 10 in. to 17 ft.

Primrose (Nos. 11 and 11?) coal zone

The Primrose coal zone occurs in the Mount Carmel, Coal Ridge, and Black Diamond basins. It is 100 to 200 ft. above the Holmes (No. 10) coal in the Mount Carmel basin and 180 ft. above it in the Coal Ridge basin. Little information regarding its stratigraphic position in the Black Diamond basin is available. The bed crops out in the Reliance, Richards, and Sioux mines, averaged 5 ft. 2 in. in thickness, of which 3 ft. 11 in. was coal.

Orchard (No. 12) coal bed

The Orchard (No. 12) coal bed, the youngest coal mined in the area, is the highest stratigraphic member of the Allegheny in the Mount Carmel basin. It is 200 to 300 ft. above the Holmes (No. 10) bed. In the Reliance mine the average thicknesses of the coal in unit areas ranged from 3 ft. 2 in. to 8 ft. 4 in., 28 percent of which was refuse.

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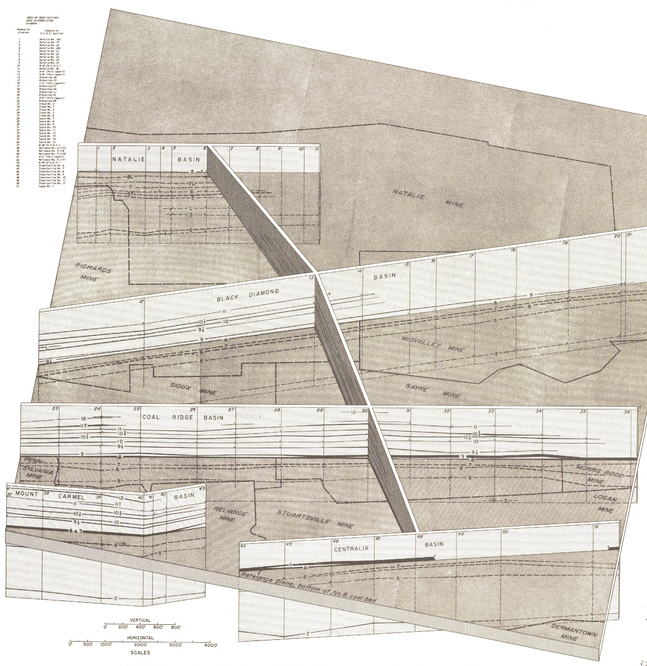

DIAGRAM SHOWING THE INTERVALS BETWEEN COAL BEDS

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.

Drafted by John T. Howells and Robert W. Banks

GEOLOGY OF ANTHRACITE IN THE EAST-CENTRAL PART OF THE MOUNT CARMEL QUADRANGLE, PENNSYLVANIA

By
Howard E. Rothrock, Holly C. Wagner, Boyd R. Haley and Harold H. Arndt

1951

Pennsylvania. (Mount Carmel quad., E.C.) Coal. 1:6,000. 1951.
Sheet 3, Report.

COAL INVESTIGATIONS
MAP C 10 (IN 3 SHEETS) SHEET 3

For sale by U. S. Geological Survey, price $1.50 per set

M(6000)
C
no.10
sheet 3
c.1