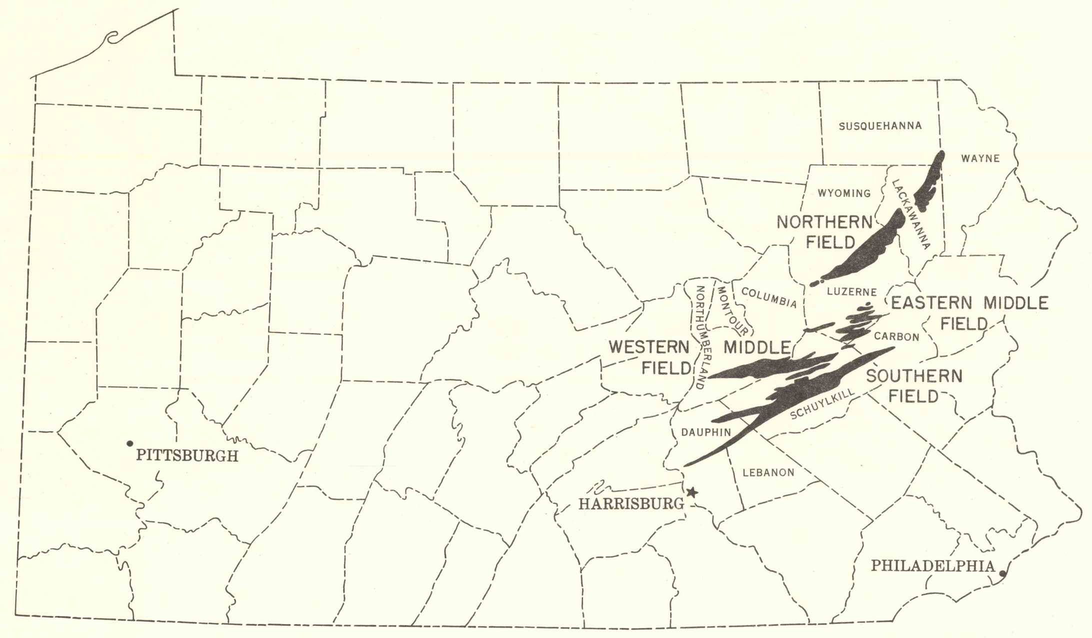
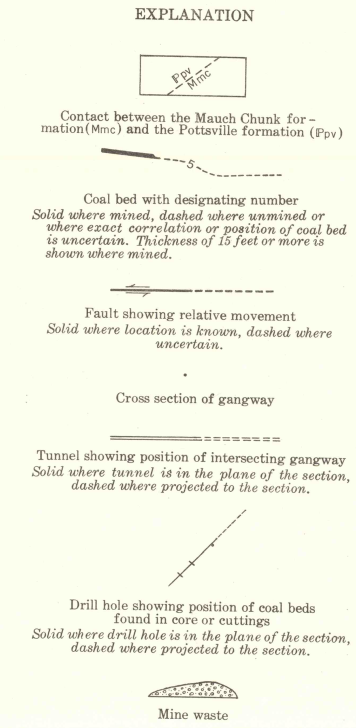
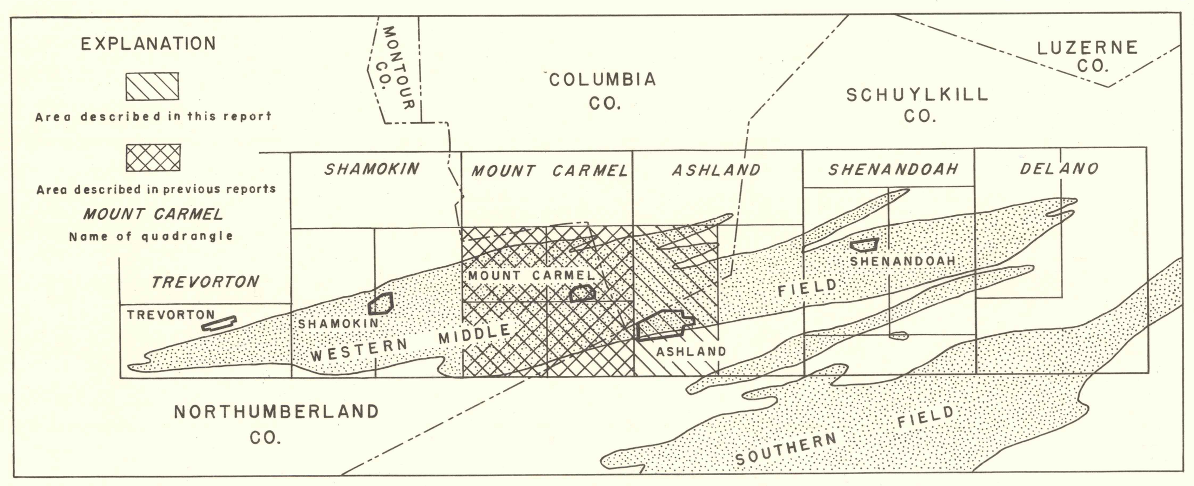
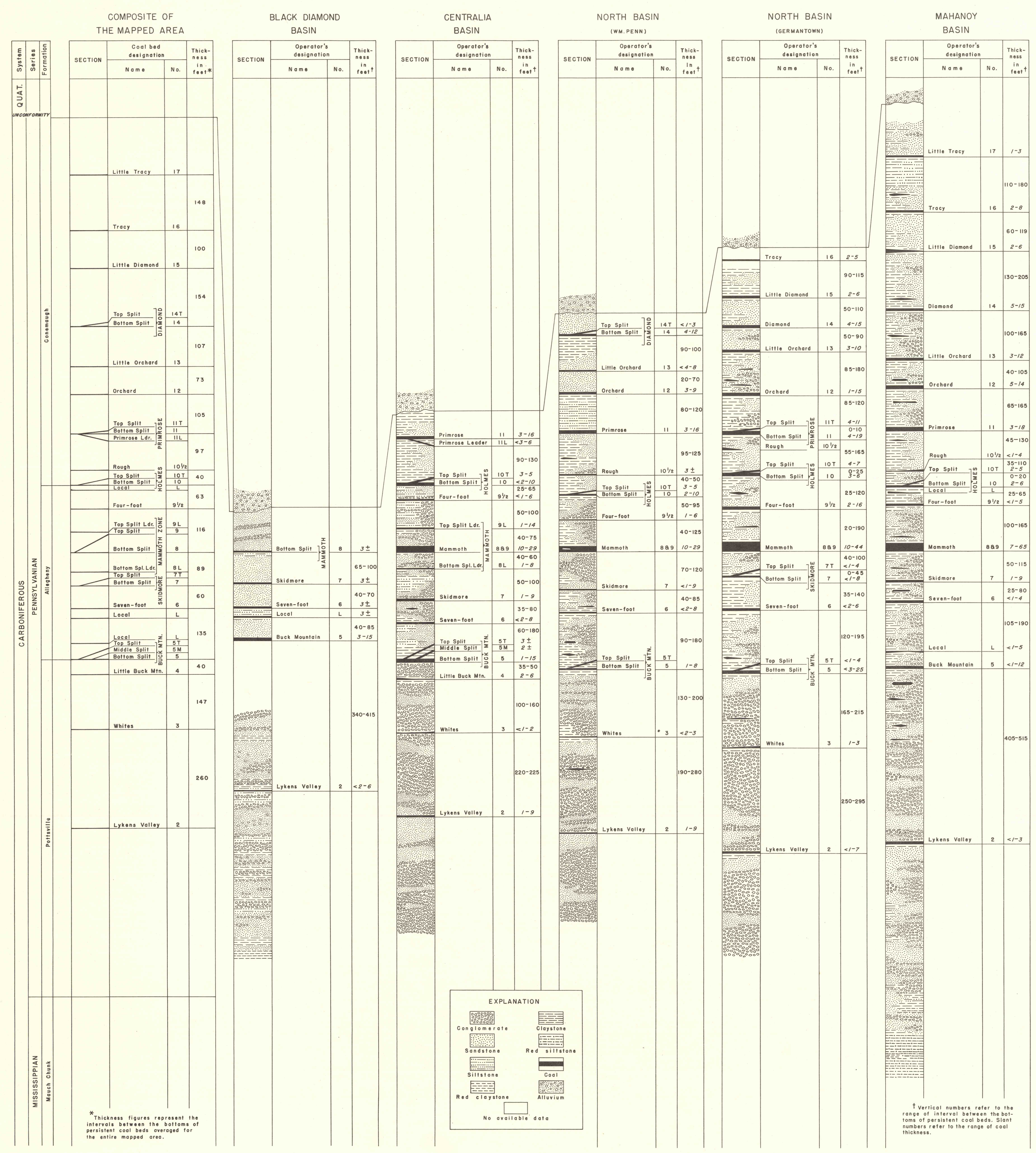


INDEX MAP OF PENNSYLVANIA SHOWING THE LOCATION OF THE ANTHRACITE FIELDS

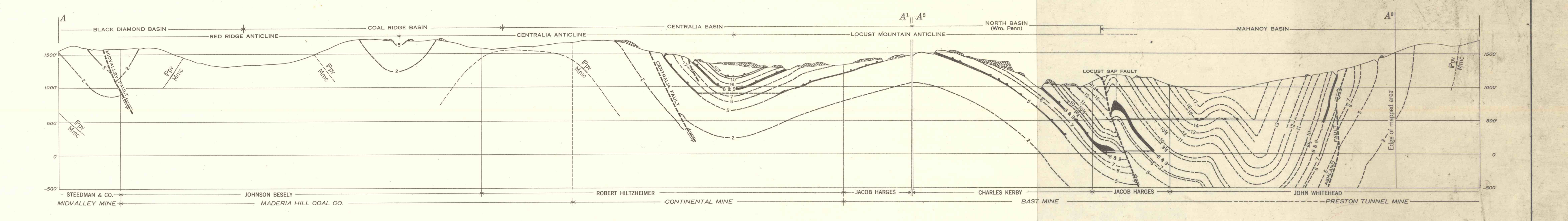


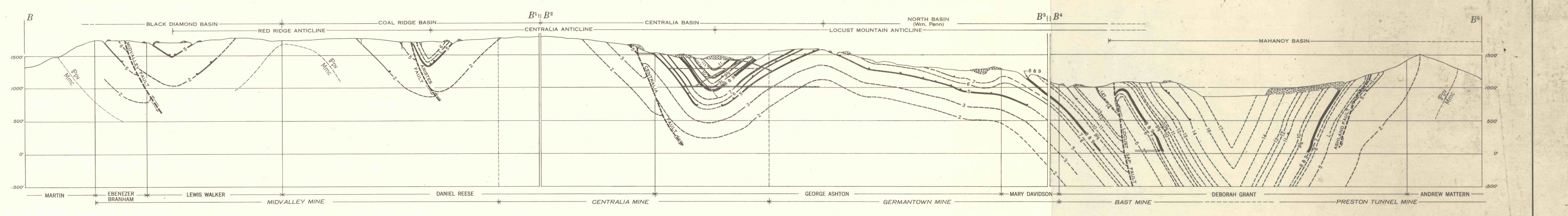


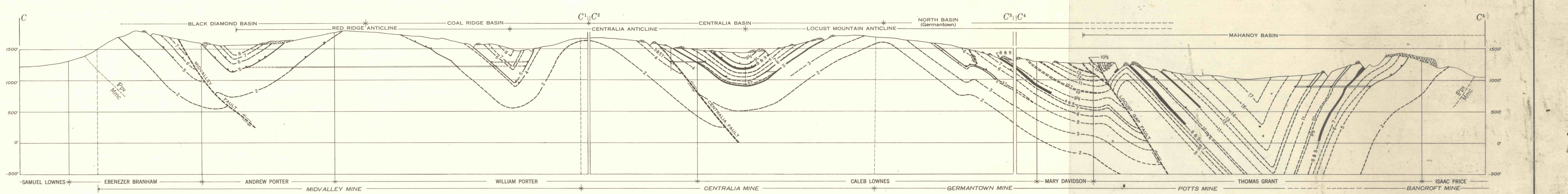
INDEX MAP OF THE WESTERN MIDDLE ANTHRACITE FIELD SHOWING THE LOCATION OF THE MAPPED AREAS

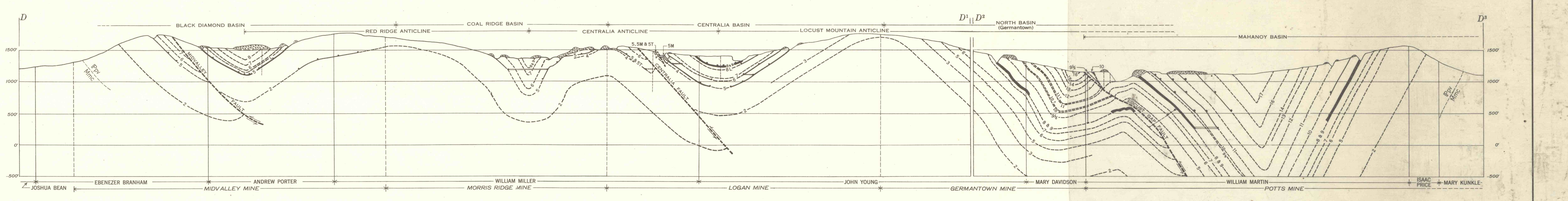


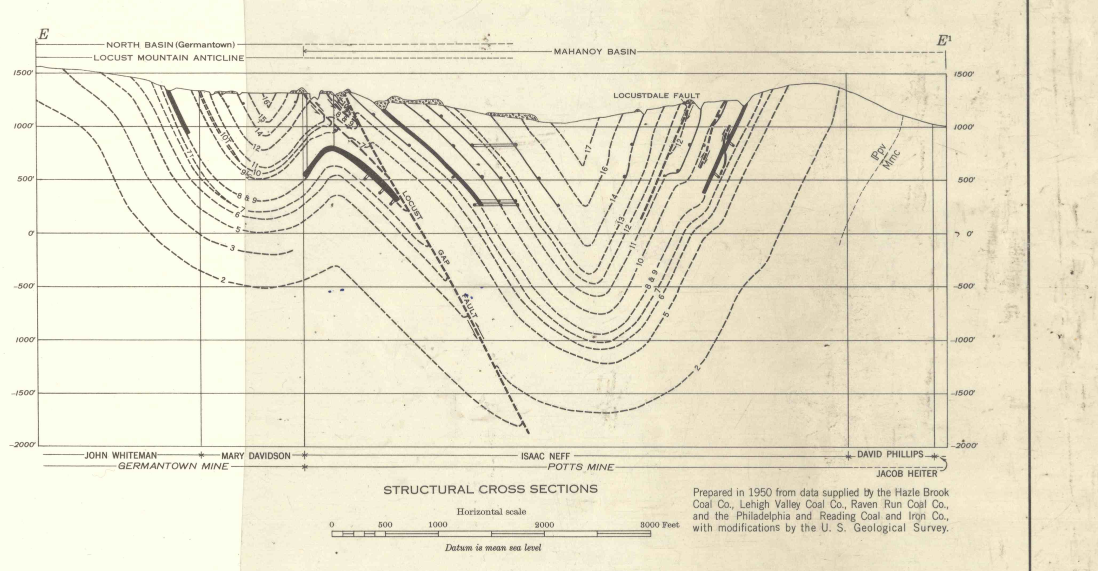
COLUMNAR SECTIONS











STRUCTURAL CROSS SECTIONS

GEOLOGY OF ANTHRACITE IN THE WESTERN PART OF THE ASHLAND QUADRANGLE, PENNSYLVANIA

INTRODUCTION

The Western Middle anthracite field is one of four structural basins containing anthracite in eastern Pennsylvania. This report describes the geology of the part of the Western Middle field that lies in the western half of the Ashland quadrangle. (See index map, sheet 2.) The mapped area covers about 19 square miles in Columbia and Schuylkill Counties. The town of Centralia is in the northern part of the area, and the town of Ashland is in the southern part.

This report has been prepared to aid in planning exploratory, developmental, and water-control operations by showing: (a) the location of all known coal outcrops (sheet 1), (b) the depth and structure of representative coal beds (sheet 1), (c) the natural and artificial barriers between mines and the structural relationships between the basins (sheets 1 and 2), (d) the stratigraphy and intervals between coal beds (sheet 2), and (e) a standard nomeclature of the coal beds.

Acknowledgments.—Information presented in this report was obtained, in part, from the actual and theoretical data shown on mine maps, cross sections, drill logs, and other records made available by the Philadelphia and Reading Coal and Iron Co., the Hazle Brook Coal Co., the Raven Run Coal Co., and the Lehigh Valley Coal Co. The cooperation of these organizations is appreciated.

Donald A. Myers, Richard E. Bergenback, and John L. Snider, of the U. S. Geological Survey, aided in the field mapping of this area.

STRATIGRAPHY

Rocks of the Carboniferous and Quaternary systems crop out in the mapped area. The Carboniferous rocks belong to the upper part of the Mauch Chunk formation of Mississippian age and to the Pottsville, Allegheny, and lower part of the Conemaugh formations of Pennsylvanian age. Unconsolidated alluvial clay, silt, sand, and gravel of Quaternary age have been deposited on the Carboniferous rocks in the stream valleys. Stream-transported mine waste, some of which contains valuable deposits of detrital coal, has also been deposited along many streams. The Quaternary alluvium has not been mapped, but the economically important deposits of mine waste are shown on the outcrop map (sheet 1).

MISSISSIPPIAN ROCKS

The Mauch Chunk formation crops out in the northern part of the mapped area north of Big Mountain and north and south of Coal Ridge, and in the southern part of the area south of Mahanoy Mountain and north of Broad Mountain. Only the upper 1,800 ft of the formation is exposed in the mapped area.

The strata in the Mauch Chunk formation consist mainly of red claystone, shale, siltstone, and fine-grained sandstone, but green siltstone and fine-grained sandstone, red or green medium- to coarse-grained sandstone, and scattered lenses of gray or green conglomerate are also present. All the beds are abruptly lenticular. The contact between the Mauch Chunk and the overlying Pottsville formation is gradational, and is mapped at that horizon below which the beds are predominantly red and above which they are predominantly gray, green, or brown.

PENNSYLVANIAN ROCKS

Rocks of Pennsylvanian age consist of lenticular beds of conglomerate, sandstone, siltstone, claystone, and shale interbedded with 12 persistent coal beds and several local coal beds. The lower part of the Pennsylvanian in the mapped area is predominantly conglomeratic, and the upper part is chiefly fine-grained. The coal beds are the most persistent of the lithologic units. The other rock units exhibit such abrupt changes in lithology that they are of little value for use as reference or key beds.

Pottsville formation.—The Pottsville formation, which includes the oldest Pennsylvanian rocks in the area, lies between the Mauch Chunk formation and the overlying Allegheny formation. It consists of resistant conglomerate and sandstone and is expressed topographically by forming all of the mountains and most of the major ridges in the mapped area. The formation is approximately 1,050 ft thick in the western and southern parts of the area but thins to approximately 860 ft in the north-central part. This thinning is due in part to a local disconformity that is apparent in the exposure of Mauch Chunk and Pottsville rocks along the Aristes-Catawissa highway. In this exposure a persistent coal bed known as the Lykens Valley (No. 2) coal bed and approximately 180 ft of strata in the upper part of the formation are missing.

The lower 100 ft of the Pottsville formation is composed of beds of gray conglomerate, gray, green, brown, and red sandstone or siltstone, and scattered lenses of gray or red claystone. The rest of the formation consists mainly of gray conglomerate, conglomeratic sandstone, coarse- to fine-grained sandstone, and scattered lenses of siltstone and claystone. The Lykens Valley (No. 2) coal is near the middle of the formation. Two nonpersistent coal beds—Whites (No. 3) and Little Buck Mountain (No. 4)—and a local coal bed are present at some places in the upper part of the formation.

Allegheny formation.—The Allegheny formation, the base of which is the Buck Mountain (No. 5) coal bed (White, 1900, p. 824), overlies the Pottsville formation and underlies the Conemaugh formation. The thickness of the Allegheny formation ranges from 390 ft to 600 ft and averages about 460 ft. It is composed of conglomerate, sandstone, siltstone, claystone, and coal. The coal beds are the only laterally persistent lithologic units. In general, conglomerate and sandstone are more abundant in the lower part of the formation than in the upper part. In the Black Diamond basin the formation consists almost entirely of sandstone.

The Allegheny formation is the source of most of the coal mined in the mapped area. Five persistent coal beds—the Buck Mountain (No. 5), Seven-foot (No. 6), Skidmore (No. 7), and two beds in the Mammoth zone (No. 8 and No. 9)—are present in the Allegheny formation. The Buck Mountain and the Mammoth zone coal beds are the most important of these.

Conemaugh formation.—The Conemaugh formation, the base of which is the Holmes (No. 10) coal (Lohman, 1937, p. 46), overlies the Allegheny formation. Erosion has removed all of the formation in the northern part of the area, but 1,200 ft of the Conemaugh remains in the Mahanoy basin. The formation is composed of gray or brown sandstone, siltstone, claystone, scattered lenses of conglomerate, and coal. This formation contains six persistent coal beds—the Holmes (No. 10), Primrose (No. 11), Orchard (No. 12), Diamond (No. 14), Tracy (No. 16), and Little Tracy (No. 17)—which are of economic value throughout most of their extent.

STRUCTURE

Each of the Pennsylvania anthracite fields is a northeast-trending composite syncline composed of several overlapping folds, some of which have been faulted. The area covered by this report is near the middle of the composite syncline that constitutes the Western Middle anthracite field. The principal component synclines and some of the truncated limbs of these synclines in this field are called basins by the miners, a practice that is followed by the authors. The miners' term "undersheet," which is the truncated limb of a syncline that extends beneath an adjacent overlying structure, is also used in this report. The undersheets in the Centralia and Black Diamond basins (sheet 1) are considered to be parts of these basins and not separate basins, as in the case of the North basin (Rothrock et al., 1951).

FOLDS

The major basins in the mapped area are, from north to south, the Black Diamond, Coal Ridge, Centralia, North, and Mahanoy basins; the major anticlines separating these basins are, from north to south, the Red Ridge, Centralia, and Locust Mountain anticlines. The largest of the synclines, and the one that contains the most coal, is the Mahanoy basin. The maximum measurable relief between the highest outcrop of the Lykens Valley (No. 2) coal and its projected position in the bottom of the Mahanoy basin is approximately 4,000 ft.

The major folds trend N. 75° E. to N. 83° E. and the dips of their axial planes range from 78° N. to 80° S. The folds are concentric, and the limbs subtend angles ranging from 65° to 115° and so include both acute (Black Diamond basin) and obtuse (Centralia basin) folding. Most of the synclines are more acutely folded than the adjacent anticlines.

FAULTS

Most faults in the mapped area are thrust faults that dip southward and are the result of compression. They generally trend northeast, paralleling the axes of the folds and cutting the bedding at angles generally less than 60° except where drag has affected the beds. The principal faults, from north to south, are the Midvalley, Centralia, and Locust Gap faults. These faults cut the northern limbs of the Black Diamond, Centralia, and Mahanoy basins, respectively, and they dip southeastward. The dips and the displacements of the principal faults increase from north to south. The Locustdale and Ashland faults in the southern part of the area are high-angle geometrically reverse faults resulting from compression of strata in the center of the folds. These faults cut the beds at angles ranging from 0° to 15° and dip northwestward.

Several faults in the mapped area cut obliquely across the folds, making angles ranging from 25° to 60° with the fold axes. These faults have relatively small displacements that range from a few feet to a few tens of feet. In many places they are associated with shear zones. Other shear zones, which have no apparent displacement, are thought to represent an arrested early stage in the development of an oblique fault. Some of these zones are linear and trend obliquely to the fold axes, but others are irregular and have no apparent orientation (see sheet 1).

An oblique fault of special interest is the Aristes fault (see sheets 1 and 2), which has cut and rotated clockwise an arcuate segment of the Coal Ridge basin. The position of the basin axis on opposite sides of the fault suggests that little vertical movement has taken place. This fault is probably the result of differential pressure applied during the formation of the major structures.

Mining is adversely affected by (1) rock faults—faults with displacements greater than the thickness of the respective coal bed, (2) pinches—areas in which the coal has been squeezed from between the roof and floor rock, (3) rolls—small folds that have sheared, thinned, or thickened the coal, and (4) shear zones—areas in which the coal is so macerated or fractured by differential movement and extreme pressure that it cannot be profitably mined.

A fault may increase or decrease the thickness of the coal bed by thrusting or dragging one part of the bed over another, or by telescoping the coal bed. The thickening of the Mammoth, as shown on cross section E²–E³ (sheet 2), is attributed to such action. In some places the thickness of the coal is decreased by squeezing as a result of differential movement of the floor and roof rocks.

COAL BEDS

In the Western Middle anthracite field the coal beds of the different mines are designated by a number, a name, or both. This nomenclature has not been standardized between the different mines because (1) coal beds in isolated mines were named before they could be correlated, (2) gaps exist between adjoining workings, (3) the structure and lithology are complex, (4) outcrops are scarce, and (5) it is difficult to change established mining records.

The names of the coal beds used in this report conform with the nomenclature used by the authors in previous reports. These names do not agree in all cases with those used in the Second Geological Survey of Pennsylvania (Ashburner, 1883, pp. 83-107), and they do not agree in all cases with the nomenclature used by the mining companies in the mapped area.

In this report a coal bed is described as persistent, nonpersistent, local, or as a leader. A persistent coal bed can be traced laterally throughout a basin and can be correlated with a bed in the same stratigraphic position in adjoining basins in the Western Middle field. A nonpersistent coal bed is recognized and correlated in several of the basins, but it is not a continuous coal bed. A local coal bed cannot be correlated across a basin or between adjoining basins, and generally cannot be traced for more than 3 or 4 miles. A leader coal bed is present in only a small area, and where first named was so near a well-known or economically important coal bed that it served as a guide or marker for that bed. It may or may not merge into the persistent coal bed and may be separated in some places from the persistent bed by a stratigraphic interval of as much as 40 ft.

Coal beds are rarely exposed in natural outcrops, owing to the cover of soil. The outcrops as shown on sheet 1 are in the position that they would occupy if the coal were projected through the soil to the surface of the ground. These positions may not agree with the blooms of weathered coal which, because of soil creep, are generally found lower on the slope than the original outcrop. Explorations for coal outcrops should start where they are shown on the map and be extended in the direction of the dip of the coal.

It was necessary to project some coal beds beyond their last known points of occurrence. This has been done to show the authors' estimate of the extent of that particular coal horizon and does not mean that the coal is of minable thickness throughout its indicated extent. Local or leader coal beds less than 18 in. thick were not mapped.

THICKNESS OF COAL BEDS

The table gives the average thickness and range in thickness of coal beds in the area covered by this report. Figures on the right side of the table show total thickness of all coal in each bed; figures on the left side of the table show total thickness of all coal and all shale partings in each bed.

Most of the coal and bed thicknesses were obtained from mine company data and were chosen to show an average of many underground observations. Measurements that may have been abnormally affected by deformation were not recorded. The maximum and minimum thicknesses shown in this table and in the columnar sections (sheet 2) are from all observed measurements along tunnels, mined coal measurements, drill cores, or sections measured by U. S. Geological Survey personnel. Thickness figures have been omitted from the table where few reliable data are available.

Average thickness and range in thickness of coal beds mined in the western part of the Ashland quadrangle

Bed number	Bed: Average Ft	Bed: Average In.	Bed: Range Ft	Bed: Range In.	Bed: Range Ft	Bed: Range In.	Coal: Average Ft	Coal: Average In.	Coal: Range Ft	Coal: Range In.	Coal: Range Ft	Coal: Range In.	Percentage of refuse
17			1	0	5	0							25.0
16	5	0	2	6	8	4	3	0	1	8	4	6	40.0
15			1	10	6	0							
14	9	1	3	10	15	1	6	4	2	4	12	2	30.3
13	7	4	2	8	11	6	4	6	0	8	8	8	38.6
12	9	1	1	0	15	0	5	10	1	0	10	11	35.8
11T	7	5	4	0	10	11	6	7	4	2	9	6	11.2
11	8	11	3	4	18	7	7	11	1	1	16	0	11.2
11L	4	8	2	6	6	2	3	8	2	6	6	2	21.4
10½	3	11	0	8	4	0							48.7
10T	5	2	3	0	7	3	4	6	2	10	7	0	12.9
10	4	8	1	8	10	4	4	5	1	8	10	0	5.4
9½	3	4	0	10	16	4	2	7	0	10	6	0	22.5
9L	5	2	1	4	14	0	4	6	1	2	14	0	12.9
9	6	1	3	0	12	6	5	2	2	6	11	10	11.0
8	8	8	3	0	14	0	8	5	3	0	14	0	2.9
8 & 9	23	4	7	8	65	5	18	5	6	8	65	2	21.1
8L	4	1	1	0	8	6	2	8	1	0	8	5	34.7
7T			0	10	4	0							
7	4	10	0	8	9	2	3	5	0	6	9	2	29.3
6	5	2	1	5	8	5	2	7	0	11	4	10	50.0
L	3												
L			0	10	5	0							
5T	3	6	1	6	13	0	2	11	1	6	13	0	17.1
5M	2	0	1	6	2	5	1	8	1	0	2	3	16.6
5	9	11	1	8	24	11	8	6	0	11	16	0	14.3
4	5	5	3	7	8	2	3	7	2	1	5	11	33.3
3	2	0	1	7	2	7	1	10	1	7	2	5	10.0
2	4	4	0	6	9	6	3	6	1	0	9	0	19.2

COAL BEDS MINED IN THE AREA

The Lykens Valley (No. 2) coal bed is the only persistent coal in the Pottsville formation. It ranges in thickness from a few inches to as much as 9 ft.

The Buck Mountain (No. 5) coal bed and the Mammoth zone coal beds are the most important coals in the Allegheny formation. The Buck Mountain coal bed overlies the resistant rocks of the Pottsville formation and underlies the less resistant rocks of the Allegheny formation. The resultant topographic bench in some areas readily identifies the Buck Mountain coal bed and allows the outcrop line to be mapped rather accurately. The persistence, quality, and thickness of this coal bed make it economically important. The Buck Mountain has been mined extensively in the mapped area, in some places as a single bed and in other places as one or two splits. The three splits are best developed in the western end of the Centralia basin (see coal outcrop map, sheet 1), where they have been exposed by strip mining and surface openings along the coal outcrop. Where these splits are too close together to be mapped separately they are shown as a single coal bed on the coal outcrop map.

The Mammoth coal zone is economically the most important group of coal beds in the Allegheny formation. It is persistent and is easily identified by its thickness, which attains a maximum of 65 ft in some parts of the mapped area. In the adjacent Mount Carmel quadrangle the Mammoth zone consists of a Bottom Split (No. 8) and a Top Split (No. 9), but in the area covered by this report these splits are generally so close together that they are mined as one bed (No. 8 and No. 9). Only the Bottom Split (No. 8) is recognized in the Black Diamond basin. In the western part of the Coal Ridge and Centralia basins the Mammoth Top Split (No. 9) is mined as a separate bed. In the western part of the Centralia basin the Mammoth zone also contains two leaders—the Mammoth Top Split Leader (No. 9L) and the Mammoth Bottom Split Leader (No. 8L).

The Holmes coal bed is the most important coal of the Conemaugh formation. Extensive mining and a rather uniform interval from the Mammoth coal zone are two factors that make the Holmes coal useful as a key bed. The Holmes coal is mined as two splits in most of the Centralia and North basins and in parts of the Mahanoy basin. The two splits merge in the western part of the mapped area and are mined as one coal bed.

The Primrose and Diamond coal beds contain two splits in some parts of the mapped area.

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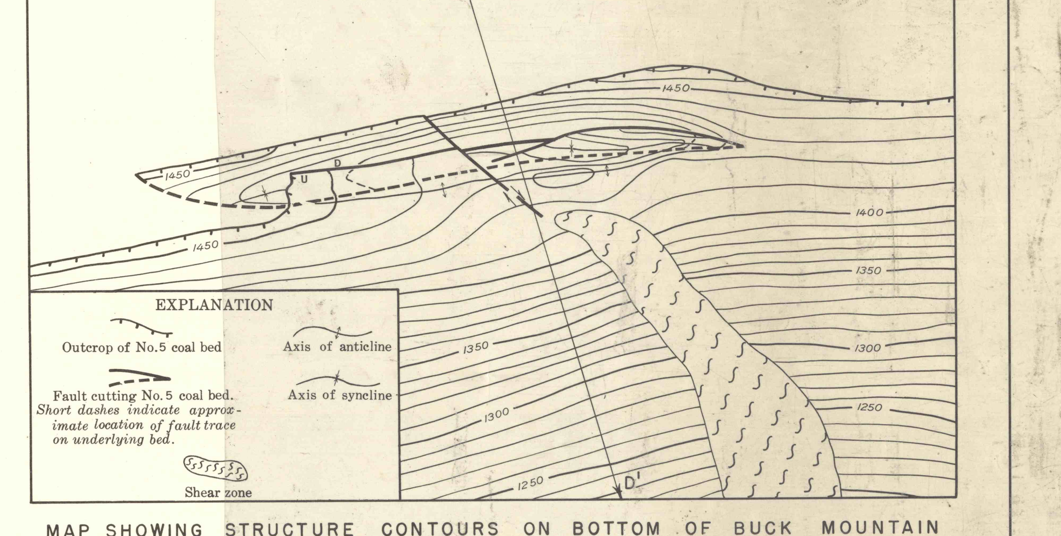
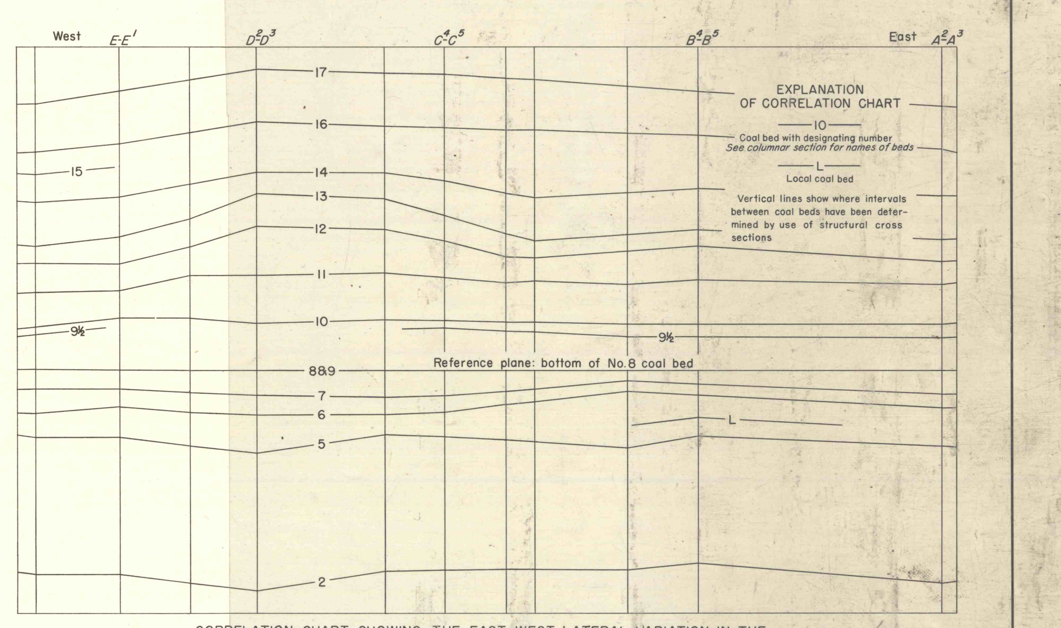


MAP SHOWING STRUCTURE CONTOURS ON BOTTOM OF BUCK MOUNTAIN (NO. 5) COAL BED ONE MILE WEST OF CENTRALIA ALONG LINE OF SECTION D-D'

CONTOUR INTERVAL IS 10 FEET



CORRELATION CHART SHOWING THE EAST-WEST LATERAL VARIATION IN THE INTERVALS BETWEEN COAL BEDS IN THE SOUTH LIMB OF THE MAHANOY BASIN

GEOLOGY OF ANTHRACITE IN THE WESTERN PART OF THE ASHLAND QUADRANGLE, PENNSYLVANIA

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

1953

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