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UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, DIRECTOR

GEOLOGIC ATLAS

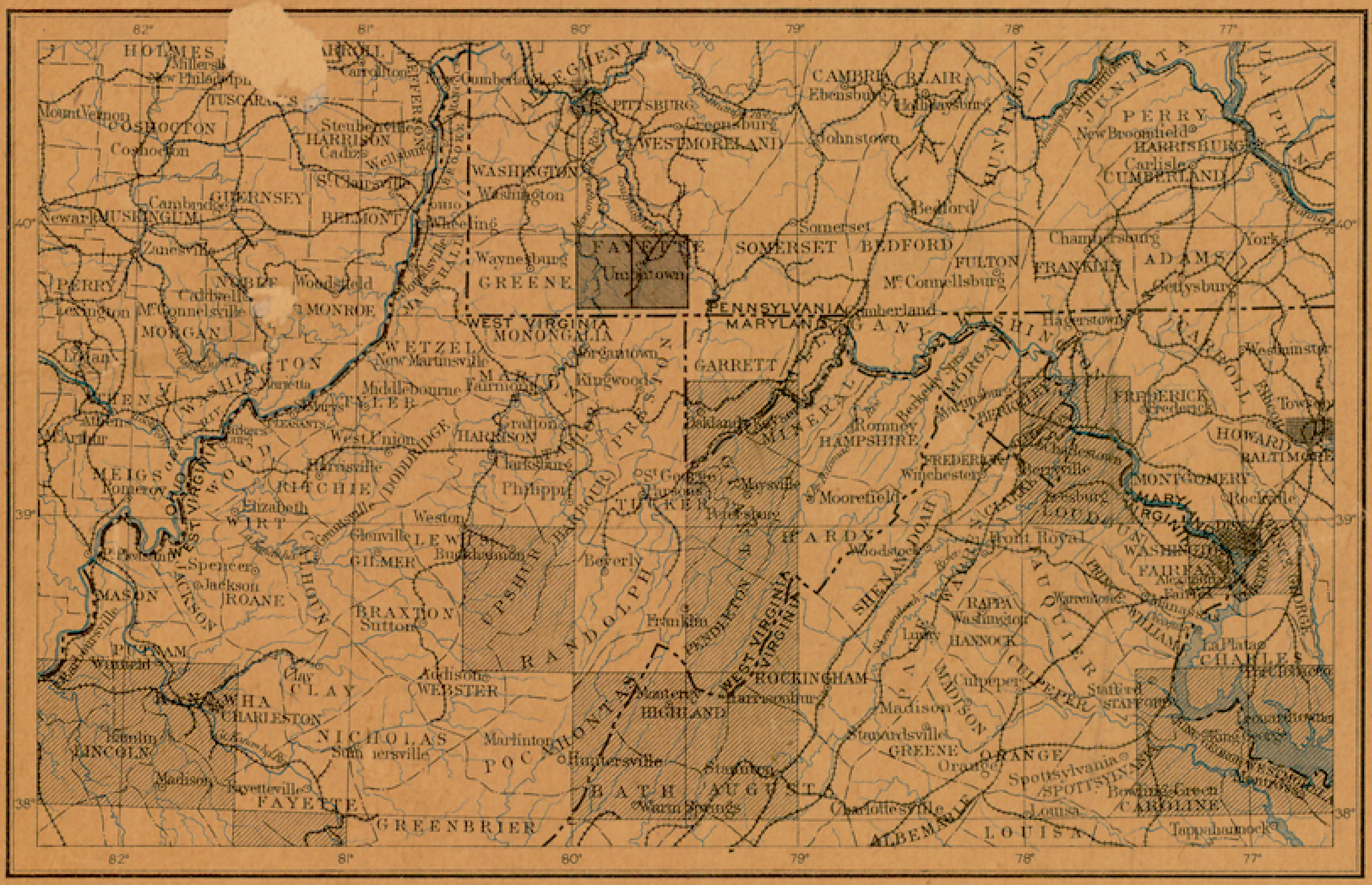
OF THE

UNITED STATES

MASONTOWN-UNIONTOWN FOLIO

PENNSYLVANIA

INDEX MAP



SCALE: 40 MILES - 1 INCH

AREA OF THE MASONTOWN-UNIONTOWN FOLIO

AREA OF OTHER PUBLISHED FOLIOS

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LIBRARY EDITION

MASONTOWN-UNIONTOWN FOLIO
NO. 82

WASHINGTON, D. C.

ENGRAVED AND PRINTED BY THE U. S. GEOLOGICAL SURVEY

GEORGE W. STOSE, EDITOR OF GEOLOGIC MAPS   S. J. KUBEL, CHIEF ENGRAVER

EXPLANATION.

The Geological Survey is making a geologic map of the United States, which necessitates the preparation of a topographic base map. The two are being issued together in the form of an atlas, the parts of which are called folios. Each folio consists of a topographic base map and geologic maps of a small area of country, together with explanatory and descriptive texts.

THE TOPOGRAPHIC MAP.

The features represented on the topographic map are of three distinct kinds: (1) inequalities of surface, called *relief*, as plains, plateaus, valleys, hills, and mountains; (2) distribution of water, called *drainage*, as streams, lakes, and swamps; (3) the works of man, called *culture*, as roads, railroads, boundaries, villages, and cities.

Relief.—All elevations are measured from mean sea level. The heights of many points are accurately determined, and those which are most important are given on the map in figures. It is desirable, however, to give the elevation of all parts of the area mapped, to delineate the horizontal outline, or contour, of all slopes, and to indicate their grade or degree of steepness. This is done by lines connecting points of equal elevation above mean sea level, the lines being drawn at regular vertical intervals. These lines are called *contours*, and the uniform vertical space between each two contours is called the *contour interval*. Contours and elevations are printed in brown.

The manner in which contours express elevation, form, and grade is shown in the following sketch and corresponding contour map:

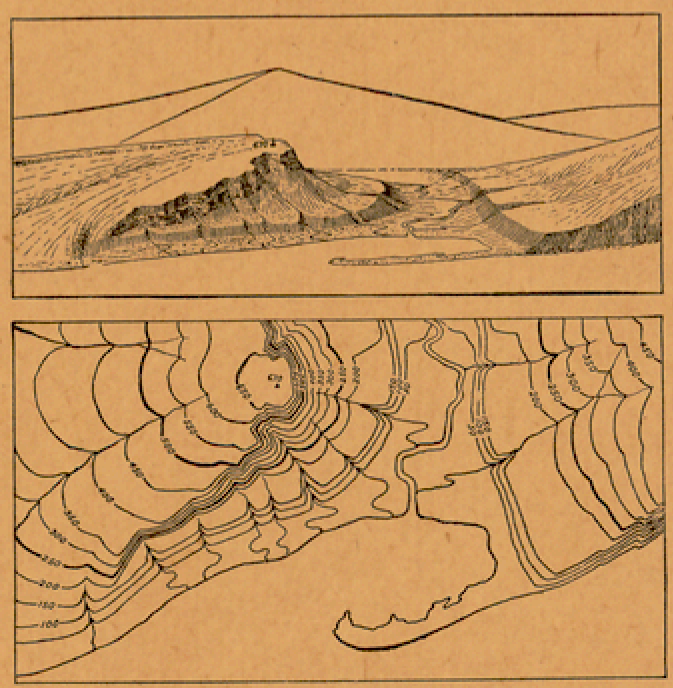


Fig. 1.—Ideal sketch and corresponding contour map.

The sketch represents a river valley between two hills. In the foreground is the sea, with a bay which is partly closed by a hooked sand bar. On each side of the valley is a terrace. From the terrace on the right a hill rises gradually, while from that on the left the ground ascends steeply in a precipice. Contrasted with this precipice is the gentle descent of the slope at the left. In the map each of these features is indicated, directly beneath its position in the sketch, by contours. The following explanation may make clearer the manner in which contours delineate elevation, form, and grade:

1. A contour indicates approximately a certain height above sea level. In this illustration the contour interval is 50 feet; therefore the contours are drawn at 50, 100, 150, 200 feet, and so on, above sea level. Along the contour at 250 feet lie all points of the surface 250 feet above sea; and similarly with any other contour. In the space between any two contours are found all elevations above the lower and below the higher contour. Thus the contour at 150 feet falls just below the edge of the terrace, while that at 200 feet lies above the terrace; therefore all points on the terrace are shown to be more than 150 but less than 200 feet above sea. The summit of the higher hill is stated to be 670 feet above sea; accordingly the contour at 650 feet surrounds it. In this illustration nearly all the contours are numbered. Where this is not possible, certain contours—say every fifth one—are accentuated and numbered; the heights of others may then be ascertained by counting up or down from a numbered contour.

2. Contours define the forms of slopes. Since contours are continuous horizontal lines conforming to the surface of the ground, they wind smoothly about smooth surfaces, recede into all reentrant angles of ravines, and project in passing about prominences. The relations of contour curves and angles to forms of the landscape can be traced in the map and sketch.

3. Contours show the approximate grade of any slope. The vertical space between two contours is the same, whether they lie along a cliff or on a gentle slope; but to rise a given height on a gentle slope one must go farther than on a steep slope, and therefore contours are far apart on gentle slopes and near together on steep ones.

For a flat or gently undulating country a small contour interval is used; for a steep or mountainous country a large interval is necessary. The smallest interval used on the atlas sheets of the Geological Survey is 5 feet. This is used for regions like the Mississippi delta and the Dismal Swamp. In mapping great mountain masses, like those in Colorado, the interval may be 250 feet. For intermediate relief contour intervals of 10, 20, 25, 50, and 100 feet are used.

Drainage.—Water courses are indicated by blue lines. If the streams flow the year round the line is drawn unbroken, but if the channel is dry a part of the year the line is broken or dotted. Where a stream sinks and reappears at the surface, the supposed underground course is shown by a broken blue line. Lakes, marshes, and other bodies of water are also shown in blue, by appropriate conventional signs.

Culture.—The works of man, such as roads, railroads, and towns, together with boundaries of townships, counties, and States, and artificial details, are printed in black.

Scales.—The area of the United States (excluding Alaska) is about 3,025,000 square miles. On a map with the scale of 1 mile to the inch this would cover 3,025,000 square inches, and to accommodate it the paper dimensions would need to be about 240 by 180 feet. Each square mile of ground surface would be represented by a square inch of map surface, and one linear mile on the ground would be represented by a linear inch on the map. This relation between distance in nature and corresponding distance on the map is called the scale of the map. In this case it is "1 mile to an inch." The scale may be expressed also by a fraction, of which the numerator is a length on the map and the denominator the corresponding length in nature expressed in the same unit. Thus, as there are 63,360 inches in a mile, the scale of "1 mile to an inch" is expressed by $\frac{1}{63,360}$. Both of these methods are used on the maps of the Geological Survey.

Three scales are used on the atlas sheets of the Geological Survey; the smallest is $\frac{1}{250,000}$, the intermediate $\frac{1}{125,000}$, and the largest $\frac{1}{62,500}$. These correspond approximately to 4 miles, 2 miles, and 1 mile on the ground to an inch on the map. On the scale $\frac{1}{62,500}$ a square inch of map surface represents and corresponds nearly to 1 square mile; on the scale $\frac{1}{125,000}$, to about 4 square miles; and on the scale $\frac{1}{250,000}$, to about 16 square miles. At the bottom of each atlas sheet the scale is expressed in three different ways, one being a graduated line representing miles and parts of miles in English inches, another indicating distance in the metric system, and a third giving the fractional scale.

Atlas sheets and quadrangles.—The map is being published in atlas sheets of convenient size, which are bounded by parallels and meridians. The corresponding four-cornered portions of territory are called *quadrangles*. Each sheet on the scale of $\frac{1}{250,000}$ contains one square degree, i. e., a degree of latitude by a degree of longitude; each sheet on the scale of $\frac{1}{125,000}$ contains one-quarter of a square degree; each sheet on a scale of $\frac{1}{62,500}$ contains one-sixteenth of a square degree. The areas of the corresponding quadrangles are about 4000, 1000, and 250 square miles, respectively.

The atlas sheets, being only parts of one map of the United States, are laid out without regard to the boundary lines of the States, counties, or townships. To each sheet, and to the quadrangle it represents, is given the name of some well-known town or natural feature within its limits, and at the sides and corners of each sheet the names of adjacent sheets, if published, are printed.

Uses of the topographic sheet.—Within the limits of scale the topographic sheet is an accurate and characteristic delineation of the relief, drainage, and culture of the district represented. Viewing the landscape, map in hand, every characteristic feature of sufficient magnitude should be recognizable. It should guide the traveler; serve the investor or owner who desires to ascertain the position and surroundings of property to be bought or sold; save the engineer preliminary surveys in locating roads, railways, and irrigation ditches; provide educational material for schools and homes; and serve many of the purposes of a map for local reference.

THE GEOLOGIC MAP.

The maps representing areal geology show by colors and conventional signs, on the topographic base map, the distribution of rock formations on the surface of the earth, and the structure-section map shows their underground relations, as far as known and in such detail as the scale permits.

KINDS OF ROCKS.

Rocks are of many kinds. The original crust of the earth was probably composed of *igneous rocks*, and all other rocks have been derived from them in one way or another.

Atmospheric agencies gradually break up igneous rocks, forming superficial, or *surficial*, deposits of clay, sand, and gravel. Deposits of this class have been formed on land surfaces since the earliest geologic time. Through the transporting agencies of streams the surficial materials of all ages and origins are carried to the sea, where, along with material derived from the land by the action of the waves on the coast, they form *sedimentary rocks*. These are usually hardened into conglomerate, sandstone, shale, and limestone, but they may remain unconsolidated and still be called "rocks" by the geologist, though popularly known as gravel, sand, and clay.

From time to time in geologic history igneous and sedimentary rocks have been deeply buried, consolidated, and raised again above the surface of the water. In these processes, through the agencies of pressure, movement, and chemical action, they are often greatly altered, and in this condition they are called *metamorphic rocks*.

Igneous rocks.—These are rocks which have cooled and consolidated from a liquid state. As has been explained, sedimentary rocks were deposited on the original igneous rocks. Through the igneous and sedimentary rocks of all ages molten material has from time to time been forced upward to or near the surface, and there consolidated. When the channels or vents into which this molten material is forced do not reach the surface, it may consolidate in cracks or fissures crossing the bedding planes, thus forming dikes, or spread out between the strata in large bodies, called sheets or laccoliths, or form large irregular cross-cutting masses, called stocks. Such rocks are called *intrusive*. Within their rock inclosures they cool slowly, and hence are generally of crystalline texture. When the channels reach the surface the lavas often flow out and build up volcanoes. These lavas cool rapidly in the air, acquiring a glassy or, more often, a partially crystalline condition. They are usually more or less porous. The igneous rocks thus formed upon the surface are called *extrusive*. Explosive action often accompanies volcanic eruptions, causing ejections of dust or ash and larger fragments. These materials when consolidated constitute breccias, agglomerates, and tuffs. The ash when carried into lakes or seas may become stratified, so as to have the structure of sedimentary rocks.

The age of an igneous rock is often difficult or impossible to determine. When it cuts across a sedimentary rock it is younger than that rock, and when a sedimentary rock is deposited over it the igneous rock is the older.

Under the influence of dynamic and chemical forces an igneous rock may be metamorphosed. The alteration may involve only a rearrangement of its minute particles or it may be accompanied by a change in chemical and mineralogic composition. Further, the structure of the rock may be changed by the development of planes of division, so that it splits in one direction more easily than in others. Thus a granite may pass into a gneiss, and from that into a mica-schist.

Sedimentary rocks.—These comprise all rocks which have been deposited under water, whether in sea, lake, or stream. They form a very large part of the dry land.

When the materials of which sedimentary rocks are composed are carried as solid particles by water and deposited as gravel, sand, or mud, the deposit is called a mechanical sediment. These may become hardened into conglomerate, sandstone, or shale. When the material is carried in solution by the water and is deposited without the aid of life, it is called a chemical sediment; if deposited with the aid of life, it is called an organic sediment. The more important rocks formed from chemical and organic deposits are limestone, chert, gypsum, salt, iron ore, peat, lignite, and coal. Any one of the above sedimentary deposits may be separately formed, or the different materials may be intermingled in many ways, producing a great variety of rocks.

Sedimentary rocks are usually made up of layers or beds which can be easily separated. These layers are called *strata*. Rocks deposited in successive layers are said to be stratified.

The surface of the earth is not fixed, as it seems to be; it very slowly rises or sinks over wide expanses, and as it rises or subsides the shore lines of the ocean are changed; areas of deposition may rise above the water and become land areas, and land areas may sink below the water and become areas of deposition. If North America were gradually to sink a thousand feet the sea would flow over the Atlantic coast and the Mississippi and Ohio valleys from the Gulf of Mexico to the Great Lakes; the Appalachian Mountains would become an archipelago, and the ocean's shore would traverse Wisconsin, Iowa, and Kansas, and extend thence to Texas. More extensive changes than this have repeatedly occurred in the past.

The character of the original sediments may be changed by chemical and dynamic action so as to produce metamorphic rocks. In the metamorphism of a sedimentary rock, just as in the metamorphism of an igneous rock, the substances of which it is composed may enter into new combinations, or new substances may be added. When these processes are complete the sedimentary rock becomes crystalline. Such changes transform sandstone to quartzite, limestone to marble, and modify other rocks according to their composition. A system of parallel division planes is often produced, which may cross the original beds or strata at any angle. Rocks divided by such planes are called slates or schists.

Rocks of any period of the earth's history may be more or less altered, but the younger formations have generally escaped marked metamorphism, and the oldest sediments known, though generally the most altered, in some localities remain essentially unchanged.

Surficial rocks.—These embrace the soils, clays, sands, gravels, and bowlders that cover the surface, whether derived from the breaking up or disintegration of the underlying rocks by atmospheric agencies or from glacial action. Surficial rocks that are due to disintegration are produced chiefly by the action of air, water, frost, animals, and plants. They consist mainly of the least soluble parts of the rocks, which remain after the more soluble parts have been leached out, and hence are known as residual products. Soils and subsoils are the most important. Residual accumulations are often washed or blown into valleys or other depressions, where they lodge and form deposits that grade into the sedimentary class. Surficial rocks that are due to glacial action are formed of the products of disintegration, together with bowlders and fragments of rock rubbed from the surface and ground together. These are spread irregularly over the territory occupied by the ice, and form a mixture of clay, pebbles, and bowlders which is known as till. It may occur as a sheet or be bunched into hills and ridges, forming moraines, drumlins, and other special forms. Much of this mixed material was washed away from the ice, assorted by water, and

DESCRIPTION OF THE MASONTOWN AND UNIONTOWN QUADRANGLES.

By Marius R. Campbell.

GEOGRAPHY.

LOCATION OF THE QUADRANGLES.

By reference to the key map on the cover of the folio, it will be seen that the Masontown and Uniontown quadrangles are adjacent and are located in the southwestern part of Pennsylvania. They extend from latitude 39° 45′ on the south to 40° on the north, and from longitude 79° 30′ on the east to 80° on the west. Each includes one-sixteenth of a square degree of the earth's surface, and they cover an aggregate area of 458 square miles.

Area and political divisions included.

The quadrangles lie entirely within the State of Pennsylvania, their southern boundary extending to within 2 miles of the West Virginia line. The major portion of the territory belongs to Fayette County, but the Masontown quadrangle extends west across Monongahela River and includes a part of Greene County and the extreme southeast corner of Washington County. The quadrangles are named from the most important towns within their boundaries.

TRIANGULATION POINTS.

The exact location of these quadrangles with reference to latitude and longitude is determined from certain points the position of which has been ascertained accurately by triangulation. The survey of the two quadrangles is controlled by five triangulation stations located within their boundaries and eight other stations situated in close proximity thereto. For the convenience of engineers the following descriptions of these stations are given, together with the triangulation data from which their positions have been determined:

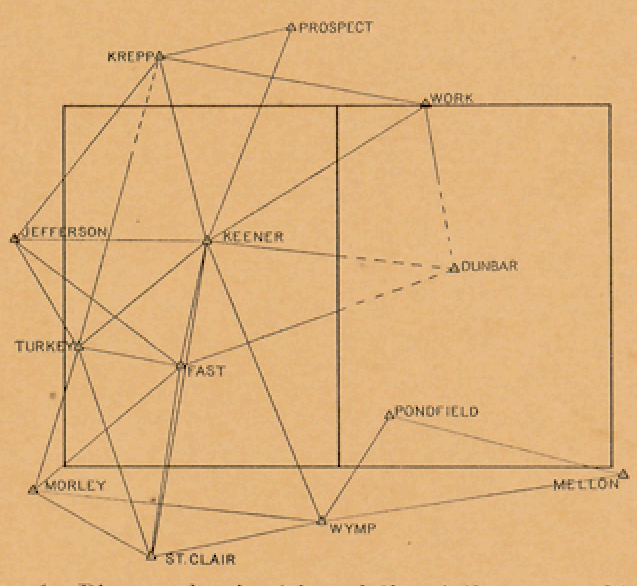


FIG. 1.—Diagram showing triangulation stations upon which the survey of the quadrangles is based.

PONDFIELD, FAYETTE COUNTY.

On a high timbered summit of Chestnut Ridge, about 4 miles air-line distance south of Fairchance and one-half mile north of Robert Rankin's house. Theodolite was elevated 25 feet and lines of sight were cut through timber toward other stations.

Station mark: A stone post 36 by 12 by 12 inches, set flush with surface of ground, in the center of top of which is cemented a copper bolt; 3 feet south of stump.

[Latitude 39° 46′ 57.92″. Longitude 79° 42′ 07.17″.]

To station—	Azimuth.	Back azimuth.	Log. distance.
	° ′ ″	° ′ ″	*Meters.*
Wymp	34 25 25.2	214 23 09.0	3.9532404
Mellon	282 48 22.5	102 56 31.1	4.2706993

DUNBAR, FAYETTE COUNTY.

On a bald summit of Chestnut Ridge, one-fourth mile east of State Orphan School and about 5 miles by wagon road southeast of Uniontown.

Station mark: A stone post 42 by 8 by 8 inches, set 36 inches in the ground, in the center of which is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania."

[Latitude 39° 53′ 15.11″. Longitude 79° 38′ 38.67″.]

To station—	Azimuth.	Back azimuth.	Log. distance.
	° ′ ″	° ′ ″	*Meters.*
Keener	97 12 12.7	277 03 28.5	4.2915497
Work	170 44 31.3	350 43 35.0	4.1119491

KEENER, FAYETTE COUNTY.

About 8 miles west of Uniontown, 1½ miles north of McClellandtown, and 23.3 feet west of a lone locust tree on a bare knob owned by Ben Keener, who lives 300 yards south of station.

Station mark: A stone post 40 by 8 by 8 inches, set 36 inches in the ground, in the center of top of which is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania."

Reference mark: A stone post 36 by 12 by 12 inches, set 34 inches in the ground, in the center of top of which is cemented an aluminum bolt; azimuth from station, 275° 27′; distance, 20 feet.

[Latitude 39° 54′ 33.86″. Longitude 79° 52′ 16.00″.]

To station—	Azimuth.	Back azimuth.	Log. distance.
	° ′ ″	° ′ ″	*Meters.*
Fast	10 45 03.1	190 44 15.0	3.9804006
Turkey	51 08 33.2	231 04 02.8	4.1097964
Jefferson	93 07 26.3	273 01 04.2	4.1512351
Krepp	166 57 58.6	346 56 35.3	4.1346730
Prospect	203 35 01.7	23 38 12.3	4.2448865
Work	239 05 15.9	59 13 04.4	4.3047205
Dunbar	277 03 28.5	97 12 12.7	4.2915497

FAST, FAYETTE COUNTY.

About 2 miles southeast of Masontown, on road to Smithfield, 8 feet north of an east-west fence on land owned by Mr. Fast, who lives about 300 yards south of station.

Station mark: A stone post 36 by 10 by 10 inches, set 36 inches in the ground, in the center of top of which is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania."

[Latitude 39° 49′ 29.36″. Longitude 79° 53′ 30.97″.]

To station—	Azimuth.	Back azimuth.	Log. distance.
	° ′ ″	° ′ ″	*Meters.*
St. Clair	10 01 47.4	190 00 37.0	4.1777734
Morley	47 17 02.2	227 11 58.5	4.1871165
Turkey	99 01 56.6	278 58 14.5	3.9215699
Jefferson	129 24 42.4	309 19 08.7	4.2041975
Keener	190 44 15.0	10 45 03.1	3.9804006

TURKEY, GREENE COUNTY.

About 1 mile north of Sigsbee and 4 miles south of Carmichaels, on Turkey Knob, in a cultivated field owned by Leroy Hartley.

Station mark: A stone post 42 by 10 by 10 inches, set flush with surface of ground, in the center of top of which is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania."

[Latitude 39° 50′ 11.72″. Longitude 79° 59′ 17.60″.]

To station—	Azimuth.	Back azimuth.	Log. distance.
	° ′ ″	° ′ ″	*Meters.*
Morley	14 32 17.4	194 30 55.5	4.0842057
Jefferson	154 58 31.5	334 56 40.0	3.9895121
Krepp	197 57 02.7	18 00 10.1	4.3515150
Keener	231 04 02.8	51 08 33.2	4.1097964
Fast	278 58 14.5	99 01 56.6	3.9215699
St. Clair	340 43 59.6	160 46 31.0	4.2327348

MELLON, FAYETTE COUNTY.

About 2 miles north of Markleysburg and 600 feet north of Mellon's store, on hill covered with timber. Theodolite raised 18 feet on stump of tree and lines of sight cut out to other stations.

Station mark: A stone post 36 by 12 by 12 inches, set flush with surface of ground, in the center of top of which is cemented a copper bolt.

[Latitude 39° 44′ 43.18″. Longitude 79° 29′ 23.30″.]

To station—	Azimuth.	Back azimuth.	Log. distance.
	° ′ ″	° ′ ″	*Meters.*
Wymp	82 07 39.3	261 57 14.8	4.3709214
Pondfield	102 56 31.1	282 48 22.5	4.2706993

WYMP, MONONGALIA COUNTY, W. VA.

On high summit 1 mile southwest of Wymp Gap, in Chestnut Ridge, about 9 miles air-line distance northeast of Morgantown, W. Va., and 16 miles south of Uniontown, Pa.

Station mark: A stone post 36 by 12 by 12 inches, set flush with surface of ground, in the center of top of which is cemented a copper bolt.

[Latitude 39° 42′ 57.71″. Longitude 79° 45′ 40.28″.]

To station—	Azimuth.	Back azimuth.	Log. distance.
	° ′ ″	° ′ ″	*Meters.*
St. Clair	78 48 54.2	258 42 43.2	4.1494319
Morley	94 13 55.6	274 03 51.4	4.3536430
Pondfield	214 23 09.0	34 25 25.3	3.9532404
Mellon	261 57 14.8	82 07 39.3	4.3709214

ST. CLAIR, MONONGALIA COUNTY, W. VA.

In a pasture on a bald hill owned by Mr. E. H. St. Clair, about 4 miles northeast of Morgantown and 1½ miles south of Stewartstown.

Station mark: A bronze tablet countersunk and cemented in a dressed stone 42 by 12 by 12 inches, set flush with surface of ground.

[Latitude 39° 41′ 28.58″. Longitude 70° 55′ 21.04″.]

To station—	Azimuth.	Back azimuth.	Log. distance.
	° ′ ″	° ′ ″	*Meters.*
Morley	116 48 34.2	296 44 41.3	3.9880410
Turkey	160 46 31.0	340 43 59.6	4.2327348
Fast	190 00 37.0	10 01 47.4	4.1777734
Wymp	258 42 43.2	78 48 54.2	4.1494319

MORLEY, GREENE COUNTY.

On a flat, bald ridge owned by D. W. Morley, 1 mile southeast of Bald Hill and one-half mile north of Pennsylvania–West Virginia line. There are few trees under brow of hill on east side.

Station mark: A stone post 42 by 12 by 12 inches, set flush with surface of ground, in the center of top of which is cemented a copper bolt.

[Latitude 39° 43′ 50.65″. Longitude 80° 01′ 25.65″.]

To station—	Azimuth.	Back azimuth.	Log. distance.
	° ′ ″	° ′ ″	*Meters.*
Turkey	194 30 55.5	14 32 17.4	4.0842057
Fast	227 11 58.5	47 17 02.2	4.1871165
Wymp	274 03 51.4	94 13 55.6	4.3536192
St. Clair	296 44 41.3	116 48 34.2	3.9880410

JEFFERSON, GREENE COUNTY.

About 1 mile southeast of Jefferson, on a high, bald knob owned by Lawrence Kraft.

Station mark: A stone post 36 by 8 by 8 inches, set 36 inches in the ground, in the center of which is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania."

[Latitude 39° 54′ 58 46″. Longitude 80° 02′ 11.35″.]

To station—	Azimuth.	Back azimuth.	Log. distance.
	° ′ ″	° ′ ″	*Meters.*
Krepp	221 23 32.6	41 28 31.9	4.2228713
Keener	273 01 04.2	93 07 26.3	4.1512351
Fast	309 19 08.7	129 24 42.4	4.2041975
Turkey	334 56 40.0	154 58 31.5	3.9895121

KREPP, WASHINGTON COUNTY.

About 1½ miles northwest of Brownsville, on a prominent and well-known bald knob owned by James Nickson.

Station mark: A sandstone post 40 by 8 by 8 inches, set 36 inches in the ground, in the center of top of which is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania."

[Latitude 40° 01′ 44.55″. Longitude 79° 54′ 25.69″.]

To station—	Azimuth.	Back azimuth.	Log. distance.
	° ′ ″	° ′ ″	*Meters.*
Jefferson	41 28 31.9	221 23 32.6	4.2228714
Prospect	254 22 24.1	74 26 58.4	4.0209121
Work	278 08 09.5	98 17 22.0	4.3136372
Keener	346 56 35.3	98 17 22.0	4.1346730
Turkey	18 00 10.1	197 57 02.7	4.3515150

PROSPECT, FAYETTE COUNTY.

About 1¾ miles southeast of Redstone and 7 miles northeast of Brownsville, on a flat, bald hill having a large apple tree on summit. The land is owned by the heirs of Thomas Murphy and is occupied by J. C. Murphy, of Redstone.

Station mark: A stone post 40 by 8 by 8 inches, set 36 inches in the ground, in the center of top of which is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania."

[Latitude 40° 03′ 15.98″. Longitude 79° 47′ 19.34″.]

To station—	Azimuth.	Back azimuth.	Log. distance.
	° ′ ″	° ′ ″	*Meters.*
Keener	23 38 12.3	203 35 01.7	4.2448965
Krepp	74 26 58.4	254 22 24.1	4.0209121

WORK, FAYETTE COUNTY.

On land owned by John Work, about 5 miles west of Connellsville and 9 miles north of Uniontown. A row of locust trees crosses top of hill along a north-south fence.

Station mark: A stone post 36 by 8 by 8 inches, set 30 inches in the ground, in the center of top of which is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania."

Reference mark: A nail driven at foot of locust tree 25½ feet distant, magnetic bearing of which is N. 30° E.

[Latitude 40° 00′ 09.20″. Longitude 79° 40′ 06.44″.]

To station—	Azimuth.	Back azimuth.	Log. distance.
	° ′ ″	° ′ ″	*Meters.*
Keener	59 13 04.4	239 05 15.9	4.3047205
Krepp	98 17 22.0	278 08 09.5	4 3136372
Dunbar	350 43 35.0	170 44 31.3	4.1119491

PHYSIOGRAPHIC AND GEOLOGIC RELATIONS.

In their physiographic and geologic relations these quadrangles form a part of the Appalachian province, which extends from the Atlantic Coastal Plain on the east to the Mississippi lowlands on the west, and from central Alabama to Canada.

THE APPALACHIAN PROVINCE.

With respect to the topography and the attitude of the rocks, the Appalachian province may be divided into two nearly equal parts by a line which follows the Allegheny Front throughout Pennsylvania, Maryland, and West Virginia and the eastern escarpment of the Cumberland Plateau across Virginia, Tennessee, Georgia, and Alabama.

Differences of geologic structure and topography which distinguish subdivisions.

East of this line the rocks are greatly disturbed by faults and folds and in many places they are so metamorphosed that the determination of their original character is difficult. West of the line the rocks are less disturbed; they lie nearly flat, and the few folds which break the regularity of the structure are so broad that they are scarcely appreciable.

The general topographic features of the northern part of the province are well illustrated by fig. 27, Illustration sheet. East of the dividing line the topography consists of alternating ridges and valleys, designated the Greater Appalachian Valley, and of a slightly dissected upland, like the Piedmont Plain of eastern North Carolina and Virginia. West of the line the surface is composed of more or less elevated plateaus, broken by a few ridges, where minor folds have affected the rocks, and is greatly dissected by streams. In contradistinction from the lowlands of the Mississippi Valley west of the province and the regularly alternating ridges and valleys on the east, this part of the province has been called by Powell the Allegheny Plateaus. The Masontown and Uniontown quadrangles are entirely within the western division of the province.

ALLEGHENY PLATEAUS.

The Allegheny Plateaus are characterized by distinctive types of geologic structure, of surface features, and of drainage arrangement, which are described below.

Geologic structure of Allegheny Plateaus.—The structure of the Allegheny Plateaus is comparatively simple. The strata lie nearly flat and their regularity is broken only by small faults and low, broad folds which usually have little effect upon the general structural features of the region.

The two great coal basins and the intervening arch.

The most pronounced fold is a low, broad arch, known as the Cincinnati anticline. The main axis of the fold enters the Allegheny Plateaus from the direction of Chicago, but a minor fold from the western end of Lake Erie joins the major axis near the type locality. From Cincinnati the axis of the anticline passes due south to Lexington, Ky., and there curves to the southwest, parallel with the Appalachian Valley, as far as Nashville, Tenn. Its maximum development is in the vicinity of Lexington, where the Trenton limestone is exposed at the surface at an altitude of 1000 feet above sea level. In Tennessee it again swells out into a dome-like structure which is represented topographically by the Central Basin of Tennessee.

This anticline separates the Allegheny Plateaus into two structural basins, which are best known from the coal fields which they contain. The western basin extends far beyond the limit of the province, and contains the Eastern Interior coal field of Illinois, Indiana, and Kentucky. The eastern basin lies entirely within the limits of the Allegheny Plateaus, and is generally known as the Appalachian coal field.

By reference to the map (fig. 28) showing the northern extremity of the coal basin, it will be seen that the Uniontown and Masontown quadrangles are situated well within the boundaries of the latter field, hence a somewhat detailed description is necessary in order to present a clear idea of the geologic features of the quadrangles.

Structural features of the Appalachian coal field, especially in Pennsylvania and West Virginia.

Since the Appalachian coal field lies in a canoe-shaped basin, the strata around its margin dip generally toward the center of the field. This is particularly noticeable on the two sides of the basin, the rocks on the northwestern side dipping gently but regularly to the southeast, and those on the southeastern side dipping more strongly to the northwest.

In Pennsylvania and West Virginia the regularity of the dip near the southeastern margin of the trough is interrupted by parallel folds, which in many cases give rise to anticlinal ridges and synclinal valleys. These undulations are similar to the great folds east of the Allegheny Front, except that they are developed on a very much smaller scale and they have not been broken by faults, as have many of the great folds farther east. These minor folds are a constant feature along the southeastern margin of the basin from central West Virginia to southern New York. Across the northern extremity of the basin the minor folds are developed in large number, extending at least halfway across Pennsylvania near its northern boundary. In the southern part of the State there are only six pronounced anticlines, and two of these disappear near the West Virginia line. Farther south the number is less, until on Kanawha River the regular westward dip is interrupted by only one fold of small proportions.

Drainage of Allegheny Plateaus.—The drainage of the Allegheny Plateaus is almost entirely into Mississippi River, but the northeastern end of the region drains either into the Great Lakes on the northwest or through the Susquehanna, Delaware, or Hudson into the Atlantic Ocean on the southeast.

Present arrangement of streams contrasts with former systems.

In the northern part of the province the arrangement of the drainage is largely due to the advance of the ice sheet from the north during the Glacial epoch. Before that time it is supposed that all of the streams north of central Kentucky flowed to the northwest and discharged their waters through the St. Lawrence system. The encroachment of the great ice sheet closed this northern outlet and new drainage lines were established along the present courses of the streams.

In the southern half of the province the westward-flowing streams not only drain the Allegheny Plateaus, but many of them have their sources upon the summit of the Blue Ridge and cross the Greater Appalachian Valley as well as the Allegheny Plateaus. It is probable that this drainage has been readjusted also, but the changes occurred much farther back in geologic time than the change which has taken place in the northern part of the province. The original divide between some of the streams flowing into Mississippi River and those draining southward into the Gulf was probably along the eastern margin of the Allegheny Plateaus, but through some crustal movement the westward-flowing streams secured an advantage over those flowing to the south and the drainage from the southern part of the Greater Appalachian Valley was directed to the Mississippi Basin.

The high plateau: its former extent and existing remnants.

Surface relief of Allegheny Plateaus.—As the name Allegheny Plateaus implies, the surface of this division of the province is composed of a number of plateaus. The highest and most extensive plateau lies along the southeastern margin of the division and extends throughout its length. This feature is very old and consequently is so greatly dissected that its plateau character is not always apparent. Its surface rises from beneath the Cretaceous cover in central Alabama at a height of 500 feet above sea level. From this altitude it ascends to 1700 feet at Chattanooga, 2400 feet at Cumberland Gap, 3500 feet at New River, and probably 4000 feet at its culminating point in central West Virginia. From this point it descends to about 2800 feet on the southern line of Pennsylvania, and 2300 to 2400 feet in the central part of the State. North of this point the plateau is widely developed in the northern counties of Pennsylvania and throughout southern New York, and it ranges in altitude from 2000 to 2400 feet.

The surface of this topographic feature is best preserved in Alabama and Tennessee, where it constitutes the Cumberland Plateau. North of Tennessee it doubtless was once well developed, but now is difficult to identify. In northern West Virginia and northern Pennsylvania occur a few remnants of high-level land which appear to be parts of the original surface of this plateau, but it is generally so dissected that only the hilltops mark its former position.

Throughout most of the province there are knobs and ridges which rise to a greater height than the surface of the high plateau, but generally they may be distinguished by the fact that they stand above the general level of the surrounding hills.

Western escarpment of the high plateau.

The surface of the high plateau slopes to the west, but it is generally separated from the next lower plateau by a more or less regular westward-facing escarpment. This escarpment is most pronounced in Tennessee, where it has a height of 1000 feet and separates the Cumberland Plateau on the east from the Highland Plateau on the west. Toward the north the height of the escarpment diminishes to 500 feet in central Kentucky, and north of Ohio River it is so indistinctly developed that it has not been recognized. In southern Pennsylvania it becomes more pronounced where the hard rocks of Chestnut Ridge rise abruptly above the plain formed on the soft rocks of the Monongahela Valley, but the surface of the uppermost plateau is so greatly dissected that it can be recognized only with difficulty. Toward the central part of the State the plateau surfaces that are usually separated by this escarpment seem to approach each other and the escarpment is merged in a mass of irregular hills which represent all that remains of the higher plateau.

A lower plateau—the Highland or Lexington Plateau.

A second plateau surface is well developed as a distinct feature in Tennessee and Kentucky. It is known in the former State by the name of the Highland Plateau and in the latter by the name of the Lexington Plain. It slopes to the west, but along its eastern margin it holds throughout these States a constant altitude of 1000 feet above sea level. In the territory north of Ohio River this plateau was developed on harder rocks than in Kentucky and Tennessee, and the result is that the surface is less regular and its exact position is more difficult to determine. It appears to rise from an altitude of 700 or 800 feet in Indiana to 1000 feet in Ohio, 1200 to 1300 feet in southwestern Pennsylvania, and probably 1600 to 1800 feet throughout the northern part of the State and the southern part of New York.

The surface features of this plateau are variable, but there is not so much diversity as in the higher plateau. In Kentucky and Tennessee it is preserved in large areas as a nearly featureless plain, but in other States it was less perfectly developed and has suffered greatly from dissection since it was elevated.

West of the Highland Plateau there is a third plain which is developed in the Central Basin of Tennessee and in the western portion of Kentucky and Indiana.

TOPOGRAPHY OF THE QUADRANGLES.

DRAINAGE.

The size and arrangement of the streams which drain a region are prominent factors in both its topographic development and its usefulness to man. The part which the streams have played in shaping the surface features of these quadrangles is important, but it will be discussed in a section devoted to that subject. The effect of main drainage lines upon human affairs is readily seen in the industrial development that generally marks the river valleys of western Pennsylvania.

Monongahela River; navigation and development along it.

Monongahela River is the principal stream in the Uniontown and Masontown quadrangles. Its upper valley is not marked by so much mining and manufacturing as characterize the lower course of the stream, but the time will come when mines will be opened and manufacturing plants established along the river in this territory.

During ordinary stages of water the stream is not navigable, but by means of a series of locks and dams steamboats and coal barges can make the passage from Pittsburg, Pa., to Morgantown, W. Va., at any season of the year, except when prevented by ice.

The construction of these dams was begun by private enterprise at Pittsburg about 1840, and by 1854 dams Nos. 5 and 6 had been built near the northern boundary of the Masontown quadrangle. Since that time the system has been extended, until slack-water navigation is secured to beyond the West Virginia line.

The altitude of the surface of the water in the various pools is as follows:

Altitudes of water surface of Monongahela River between Pittsburg and Morgantown.

	Feet above tide.
Pool of Davis Island dam, Pittsburg	703.00
Pool No. 1	707.40
Pool No. 2	715.10
Pool No. 3	723.10
Pool No. 4	733.48
Pool No. 5	746.41
Pool No. 6	760.15
Pool No. 7	769.99
Pool No. 8	780.80
Pool No. 9	793.40

Most of the territory west of Laurel Ridge is drained by tributaries of Monongahela River. The principal streams are Redstone, Dunlap, and George creeks and Browns Run. On the west side of the river the principal tributaries are Dunkard Creek, near the southern border of this territory; Whiteley Creek, a little farther north, and Muddy Run, in the vicinity of Carmichaels. Most of the drainage basins of these streams lie outside of these quadrangles, only their lower courses crossing that part of the Masontown quadrangle which is west of Monongahela River.

Youghiogheny River.

Youghiogheny River crosses the northeast corner of the Uniontown quadrangle. It drains that part of Ligonier Valley which lies north of the National Pike and a small area west of Laurel Ridge. Its principal tributaries are Indian and Dunbar creeks and Meadow Run.

South of the National Pike is Big Sandy Creek, which discharges into Cheat River a few miles south of this territory.

SURFACE RELIEF.

According to surface relief, this territory is naturally divided into two parts by a line along the western base of Laurel Ridge. East of this line is the so-called mountain region of western Pennsylvania. In the southern part of the State the most westerly mountain ridge bears several names. North of Youghiogheny River it is known as Chestnut Ridge, and south of that stream it is usually called Laurel Ridge.

The mountain region of southwestern Pennsylvania: the Chestnut-Laurel ridge, Laurel Hill, and Ligonier Valley.

Parallel with the Chestnut–Laurel ridge and distant about 12 miles to the southeast is Laurel Hill, one of the most pronounced mountain ridges of this region. This ridge does not occur in the Uniontown quadrangle, but the high land along the National Pike in the southeast corner of the quadrangle lies upon its flank.

Both ridges are deeply trenched by Youghiogheny River, which cuts through the Chestnut-Laurel ridge above Connellsville in the northeast corner of the Uniontown quadrangle and through Laurel Hill above Ohiopyle, which is located east of the eastern edge of the territory. Cheat River also has cut a deep, narrow gorge through the Chestnut–Laurel ridge a few miles south of this territory in West Virginia.

The altitude of the Chestnut–Laurel ridge varies from about 1900 feet above sea level on the edge of the Youghiogheny gap to 2778 feet at Pondfield triangulation station, near the head of Hector Hollow, in the southern part of the Uniontown quadrangle. From this high point the altitude of the summit decreases southward to the gorge of Cheat River. Laurel Hill is low near the southern margin of this quadrangle, but it increases in altitude toward the north, so that north of Youghiogheny River it rises to as great a height as the Chestnut–Laurel ridge.

Between these two ridges is a strip of country that is a few hundred feet lower in altitude than the summits of the ridges on either side. It is generally spoken of as the Ligonier Valley, from the town of this name in Westmoreland County. Across this broad valley, as well as the adjacent ridges, Youghiogheny River has cut a gorge from 600 to 1300 feet in depth. The tributary streams both of this system and of Cheat River have also cut deep V-shaped valleys, leaving the upland much dissected by the numerous small streams of the region.

Physiographic relations of the ridges and Ligonier Valley.

Generally it has been assumed that the even-crested summits of these ridges are the sole surviving remnants of an extensive peneplain that once existed over much of the Appalachian region. In these quadrangles there is not much evidence in favor of the existence of such a plain. The summit of Laurel Ridge appears to be too irregular to suit such a hypothesis, and accurate maps of the other ridge are not available to show its form and altitude. It is possible that some part of the present surface coincides with the surface of such a peneplain, but from the topography of this quadrangle it is not apparent.

A close examination of the altitude of the surface of Ligonier Valley about Farmington and Fayette Springs shows that there is a large area of the surface at about 2000 feet above sea level; also that many divides between principal streams are at about the same level. It is true that two of the principal divides, one near Mount Washington and one south of Farmington, are cut below the 1900-foot contour, but these appear to be exceptions to the general rule. The existence of so much surface at 2000 feet above tide and the reduction of so many divides to about the same level seems to indicate that at the stage of uplift in the region when Fayette Springs (Chalk Hill) was near sea level the movement of the land ceased long enough for erosion to broaden the valleys and reduce much territory nearly to drainage level. If this period of quiescence had been of great duration, most of the land would have been reduced approximately to this level and a peneplain would have been formed, but the period was evidently short and served simply to record one stage of the uplift and erosion of the region. So far as the writer is aware, this stage has not been recognized in adjacent regions and hence its age is problematical.

Viewed from the Chestnut–Laurel ridge the country to the west appears like a nearly featureless plain. Slight irregularities in detail may be noted, but the summits of the hills fall into line with remarkable uniformity. In such a view the valleys are lost from sight, and the surface probably appears in much the same condition as it did before these valleys were cut. When examined in detail the surface is found to be far from regular, being decidedly hilly in almost all parts of the quadrangles. From the contoured maps it will be observed that the altitudes of these hills range generally from 1200 to 1300 feet above sea level. Along the major streams where erosion has been most active the summits rise but little over 1200 feet above tide. This may be seen in the high land west of Morris Crossroads, on the ridge between Old Frame and New Geneva, and also on the ridge north of Jacobs Creek. North of Masontown the land rises somewhat higher, but in the immediate vicinity of the river the spurs generally have an altitude of about 1200 feet. This is particularly true in Luzerne Township, which lies in the great bend of the river between East Riverside and Brownsville. On this projecting point erosion has been very effective and the surface is reduced to an altitude of about 1200 feet. On the west side of the river the 1200-foot level is not so striking, but it may be seen in the high land north of Carmichaels and also in the elevated region east of that village. South of Little Whiteley Creek the 1200-foot level is not well developed; in fact, the surface is eroded to a lower level, which will be described in a subsequent paragraph.

Aspects of the surface west of the Chestnut-Laurel ridge.

The 1200-foot level is well developed along the western front of Laurel Ridge. The rocks outcropping in this locality are prevailingly soft, and the surface is worn down into a broad, nearly level valley, the altitude of which on the summit south of Uniontown is about 1170 feet. This divide is slightly lower than the one which separates Redstone Creek from the drainage that unites with the Youghiogheny River at Connellsville. The latter divide has an altitude of approximately 1200 feet, as has also much of the high land in the drainage basin of Redstone Creek.

In this region there are certain areas which are marked by summits that rise above the 1200-foot level. These may be observed west of Uniontown and in the region about Juniataville and Elm Grove. The presence of high summits along this line is explained by the fact that they are located on a pronounced arch of the strata, which brings to the surface harder rocks than those which outcrop on either side. These hard beds have resisted erosion more successfully than those in adjacent areas, and consequently they form a low ridge along the anticlinal fold. High land also occurs in Greene County on the west side of the river. In this case it is not due to geologic structure, but to the fact that the rocks in the upper part of the series are more arenaceous than those lower down, and consequently they are more resistant to the action of erosion than the softer rocks to the east.

If the sharply cut valleys were filled to an altitude of about 1200 feet the country would have a gently undulating surface bearing so close a resemblance to a uniform plain that it might be classed as a peneplain. Such a surface may be produced either by the cutting action of waves or by subaereal erosion. There is no evidence that the sea has occupied this region since Paleozoic time; hence the first explanation is not applicable. The second is generally accepted, and it seems to satisfy all of the conditions. When the peneplain was produced the land in this region stood nearly 1200 feet lower than at the present time. On that land rains and running streams operated until it was reduced to a gently undulating plain. It was subsequently uplifted to its present position and dissected by the very streams which had been instrumental in producing it. To-day we see only the remnants here and there of the original surface; the rest is washed away, and its place is occupied by the deep valleys which the streams have cut.

The physiographic history of the region west of the Chestnut-Laurel ridge.

This peneplain records an important epoch in the physiographic development of this region. It carries us back to a time when the land did not move up or down appreciably during an epoch which was so long that the hills wasted away, except where the rocks were hard. If the period of quiescence had been extended indefinitely the entire surface, including the Chestnut-Laurel ridge, would have been reduced to a common level, but the existence of this ridge of hard rock, as well as of other areas of high land already described, shows that the period was limited in its duration and that the time was sufficient only to reduce such areas as were located near the major draining streams and those in which the surface was composed of soft rocks.

The geologic age of this peneplain has not been definitely ascertained. It has been correlated with a peneplain in the eastern part of the State that is regarded as of early Tertiary age, but the evidence is not conclusive. Nevertheless, the assumption that it was formed during the Eocene period is in harmony with the facts observed in these quadrangles, and it is here provisionally accepted.

A careful study of the topographic maps shows that there is a second stage, or substage, of Tertiary erosion recorded in this region. West of Monongahela River it may be seen in the upland at an altitude of 1100 feet. East of the river this level is not so pronounced, but it may be recognized on the headwaters of George Creek and on many of the principal divides of the region. It is most apparent on the ridge separating Dunlap Creek from Monongahela River, but it is also noticeable on several other dividing ridges.

It is possible that the agreement in altitude between these various features is simply a coincidence, but it seems probable that it marks a substage in the erosion of the region. It may easily be accounted for on the assumption of a regional uplift of about 100 feet, and then a cessation of movement which permitted the reduction of many of the divides, and also of large areas in the immediate vicinity of the rivers, nearly to drainage level. This substage of supposed late Tertiary erosion has not been generally recognized, and it is possible that it is a feature due to local conditions.

ABANDONED CHANNELS OF MONONGAHELA RIVER.

Below the 1100-foot level just described the streams have cut sharp valleys, but the slopes are interrupted by a system of rock terraces and abandoned channels along the main stream, which mark a second substage of late Tertiary or Pleistocene erosion. These terraces and abandoned channels are from 140 to 150 feet above water level, and they are of frequent occurrence from Pittsburg, Pa., to Morgantown, W. Va. Several notable cases occur in this territory; in fact, from Dunkard Creek to East Riverside the river has deserted its original, broadly meandering channel for a direct course through the upland and across the broad meanders of its former course.

Generally the channels have been silted up to depths ranging from zero to 100 feet, but in many cases the filling has been removed by the small streams, which not only have carried off the soft silt of the valley but have cut deep channels in the rock floor beneath. The partial filling and erosion has destroyed many of the original characteristics of the valleys, leaving them with much more irregular floors and outlines than they originally possessed.

The valley filling is composed of various materials, ranging from the finest clay to bowlders having a diameter of 4 to 5 feet. Usually the rock floor is overlain by a thin deposit of sand and well-rounded gravel, evidently the material transported by an active stream before the channel was abandoned. Resting upon this basement gravel is a varied assortment of material, some coarse, some fine, apparently deposited without much system of arrangement or distribution. The bulk of the material is composed of clay and sand rudely stratified, like flood-plain deposits of an active stream. Conditions of sedimentation varied greatly from place to place, giving to the deposits local characteristics. Thus in the sand pits at Bellevernon, a few miles north of this territory, large subangular bowlders are found in the midst of fine deposits, where apparently they had been dropped from floating ice, while in the bend at Carmichaels beautifully laminated clay shows that quiet conditions prevailed which permitted undisturbed sedimentation to take place.

Descriptions of the abandoned channels.—The most southerly abandoned channel in the Masontown quadrangle extends from Dam No. 8 to New Geneva. On leaving this channel the river chose a more circuitous route, although the new course differs only a little from that which the stream formerly maintained. The new channel, however, is distinct from the old and is separated from it by a small hill composed of rock in place. Owing to the existence of this hill, the river could not have reached its present position by swinging to the left. It is apparent that the stream has been transferred bodily from one course to the other, but the reason for pursuing a more circuitous route than formerly is not apparent.

In comparing the two valleys, ancient and modern, it is interesting to note that the abandoned channel is much wider than the one now occupied by the stream, and also that the slopes leading into the upper valley are low and much less precipitous than those which border the present stream. The abandoned valley has the appearance of maturity, while the modern channel is so youthful that its bounding walls are extremely steep and the river itself is flowing on a rock bottom. In the abandoned channel the main body of clay and sand extends from the rock floor, which has an altitude of about 920 feet, up to an altitude of about 1000 feet above sea level. Deposits of gravel occur at higher altitudes, but they are probably isolated exposures and not parts of a continuous sheet. Professor Stevenson observed them on the road from New Geneva to Point Marion at an altitude of about 1060 feet.

From New Geneva to Jacobs Creek the stream follows its original channel, but a part of the old floor of the upper channel is still to be seen as a rock shelf on the west side of the river. Since traces of a similar shelf may be observed on the east side in the village of New Geneva and at the mouth of Jacobs Creek, it seems probable that the old valley had a breadth of about one-half mile and that the present channel occupies only a part of the floor of the older valley.

In the vicinity of Grays Landing the old channels are rather complicated. From Jacobs Creek to the mouth of Whiteley Creek the original course lay in a curve to the west near Mapletown and along the lower course of Whiteley Creek. An old channel also leaves the present course at Grays Landing and returns with a sharp bend by Masontown to the present stream at Hatfields Ferry. Instead of following the present course of the river below Hatfields Ferry, the old channel pursued a westerly course up Little Whiteley Creek for 3 miles and then in a broad sweep by Carmichaels reached the present course at East Riverside.

The valley near Mapletown is excellently developed, with a breadth on its rock floor of about one-half mile. It is separated from the present river valley by a group of hills a mile in width and rudely triangular in shape, with the longest side of the triangle facing the present channel of the stream. The hills reach an altitude of 1150 feet, and since they are composed of rock in place it is manifestly impossible for the river to have reached its present position by lateral swing.

In the Masontown bend it is not so apparent that the cut-off is not due to lateral corrasion by the stream near the mouth of Whiteley Creek. If the change was produced by lateral corrasion at the base of the promontory on the inside of the curve, the ridge north of Cats Creek should narrow to a point at its western extremity, but this ridge, as shown on the map, is square-ended next the river and gives no indication of having been cut through by the river as it swung in against its base in the sharp turn from the Whiteley Creek channel to its course up Cats Creek. From the amount of erosion noticeable on the slopes bordering the Masontown bend, and from the great reduction which the point of land on the inside of the bend has suffered, it seems probable that this valley marks the original course of the stream. The same is true of the Mapletown valley, consequently the river in late Tertiary time presumably flowed from Dam No. 8 direct to New Geneva, thence in a broad gentle curve by Dam No. 7 into the present valley of Whiteley Creek. Instead of continuing to the north along the present course of the river the stream probably swung sharply to the east, by Grays Landing and up Cats Creek, to Masontown, where it bent in a sharp return curve and crossed the present channel of the river at Hatfields Ferry. The channel cut by the river when it followed this course would have an abrupt bend at the mouth of Whiteley Creek, but on a stream of this size the curve presumably would not have been much sharper than that which shows at the end of the Masontown bend. It certainly could not have produced the angle now visible at that point, which is made by the bluff north of the river and that which borders the old valley west of the mouth of Whiteley Creek. The only adequate explanation of the straight bluff west of the mouth of Whiteley Creek is that it was formed when the course of the stream was down Whiteley Creek and along the present river valley to Hatfields Ferry. This means that the Masontown channel was abandoned first and that the stream flowed through the Mapletown valley and along the present course of the river to Hatfields Ferry, and thence into the great Carmichaels valley to the west. The last change appears to have been the abandonment of the Mapletown valley by the cutting of a new channel across the bend from Dam No. 7 to Grays Landing.

The Mapletown and Masontown bends are deeply filled with clay, sand, and gravel. In the former the main body of the filling rises to an altitude of about 1000 feet above sea level; in the latter it has a thickness of 100 feet, and rises to an altitude of 1020 feet. Above the principal deposits which cover the rocky floors a thin veneer of sand and pebbles is frequently found on the valley slopes at a considerably greater altitude. In the Mapletown bend such deposits were noted at the forks of the road on the hill between the abandoned channel and the river at an altitude of 1050 feet, and at the same altitude in the vicinity of Mapletown.

The best example of abandoned channels is the Carmichaels bend, now occupied in part by Muddy Run and Little Whiteley Creek. The Masontown channel formerly crossed the present river valley at Hatfields Ferry; it extended west about 3 miles and then swung to the north by Carmichaels in a broad curve and reached the present channel at East Riverside. Near Arensburg Ferry the old valley again swings to the left and makes a short detour on Pumpkin Run, but the channel is not clearly outlined.

The central part of the Carmichaels channel is filled to a depth of 70 feet with alternating beds of clay and quicksands, and scattering gravels have been traced to an altitude of 1080 feet. In the upper end of the valley the filling has been largely removed by Little Whiteley Creek, but in every sheltered place clay is found above the gravel pavement at the bottom, showing that originally the floor was well covered with fine material. In the lower end of the valley the rock floor has been considerably dissected by Muddy Run, but for about a mile from the river a wide shelf is preserved on the east side of the stream. This shelf is covered by a thin coating of sand and gravel, evidently belonging to the gravel pavement which was deposited by the stream before the heavy masses of clay and sand in the vicinity of Carmichaels accumulated. Along Whiteley and Little Whiteley creeks, where the conditions of erosion have been essentially the same as along the lower course of Muddy Run, clay is found in every protected locality overlying the gravel pavement on the rock floor. This shows that the abandoned valleys above Carmichaels were originally silted up and that the streams have succeeded in removing only a part of the filling. The absence of clay on Muddy Run is due to lack of deposition, and indicates that the conditions in this part of the valley were different from those which prevailed at the same time either above or below this locality. This fact is important, since it affords a clue to the conditions which then prevailed and which were responsible for the abandonment of the well-established channels of the region.

Cause of abandonment of channels.—These abandoned channels constitute the most striking topographic feature of the region. They have been recognized as abandoned valleys by Stevenson, White, Lesley, Wright, and Chamberlin, but no adequate explanation of their origin has been offered. They have been described as "oxbows" or "abandoned channels," as though it were the most natural thing in the world for a stream to abandon its channel. If western Pennsylvania were a country of low relief, it might be possible for a stream during its normal development to cut off oxbows, as the Mississippi does on its low flood plain below Cairo, Ill.; but western Pennsylvania is a rugged region, with a general upland rising 500 feet above the water level of the principal stream. In such a region it is an extremely difficult and slow process for a stream to cut off any of its meander, and it is manifestly impossible for it to establish a totally new course unless the conditions under which it operates are very different from those which normally affect the development of a stream.

Prof. I. C. White has recognized the anomalous character of the deposits and physical features of the region, and in a vague way he has attributed them to ponding of the northward-flowing waters by the advance of the Glacial ice sheet in Beaver Valley. If the valley were silted up to an altitude of about 1050 feet the change in the course of the stream might be accounted for by superposition, but the absence of silt in a part of the Carmichaels channel shows clearly that the valley was not silted up in all its parts, and consequently the present drainage can not be regarded as superposed.

In attempting to account for these abandoned valleys it is necessary to go outside of the territory under consideration and briefly describe similar phenomena in other parts of the province, in order to determine the general conditions under which they were formed.

Outside of the glaciated region, abandoned river channels of the character here described do not occur, except in the Ohio Valley. So far as the writer's knowledge goes, they are limited to the following streams: Allegheny, Kiskiminitas, Youghiogheny, Monongahela, Kanawha, Guyandot, Big Sandy, Kentucky, and Ohio. These streams are located a short distance south of the limit of glaciation, therefore the abandonment of the channels seems to be due to some condition induced by the presence of the ice sheet. The contemporaneity of the two phenomena is evidenced by the occurrence of fossil leaves in an abandoned channel near Morgantown, W. Va., which, according to Dr. F. H. Knowlton, have an arctic facies and probably were deposited during the Glacial epoch. In studying the problem still further it will be noted that abandoned channels are most abundant on streams that flow northward, or directly toward the ice front. The streams flowing in that direction are Monongahela, Youghiogheny, Kanawha, Guyandot, Big Sandy, and Kentucky, and along all, except the last, abandoned channels are abundant.

In this connection it must be noted that the drainage of the Upper Ohio Basin has suffered decided changes through the advance of the Glacial ice sheet. It is now fairly well established that the present Allegheny River system was formerly divided into three parts, all of which drained into the St. Lawrence Basin. The waters of Monongahela River also found a northern outlet through Beaver River into the same system. Kanawha River with its tributaries, Guyandot and Big Sandy rivers, flowed north through the present Scioto Valley and probably constituted a branch of the river system which occupied the basin of Lake Erie. The advancing ice is supposed to have dammed these northward-flowing streams and forced the water to seek another outlet, which it found along the present course of the Allegheny and the Ohio. In the ponds which ensued from this ice blockade the silts found along the abandoned channels of Monongahela River were formerly supposed to have been deposited, and to the cutting down of the new outlet and the draining of this immense pond has been attributed the origin of the abandoned valleys. While it must be admitted that ponding to a certain extent took place during these changes of drainage, and that probably silt was deposited in the lake so formed, it is plainly apparent, as shown on another page, that general ponding can not account for the irregularities of deposition that are shown in the sediments. It is possible that the scattering gravel which occurs in many places up to altitudes of 1050 to 1070 feet was deposited in the ponded waters at the time of the formation of the Allegheny–Ohio river. In fact, Monongahela Valley may have been filled by these gravel deposits to a depth of 1050 feet, but if so they were almost completely removed before the Carmichaels valley was abandoned.

The irregularities of the principal deposits indicate that local conditions controlled the deposition of material and also that they were responsible for the change in the alignment of the river. The question now presents itself, what local conditions could produce such profound changes in the drainage of the region? The changes evidently occurred during the prevalence of an arctic climate, and if so, it seems probable that ice was the instrument by which the abandonment of these stream courses was accomplished. The Glacial ice sheet did not reach so far south, and hence it could not have been directly instrumental in producing them. In rivers which flowed north, or toward the ice front, it seems probable that during the short summers which must have prevailed at that time the ice in the stream would break first near the head of the river. This broken ice, on being swept down, would tend to form jams or gorges, as the ice to-day is gorged in almost all northern rivers during the break-up in the spring. With the topographic environment and under the arctic conditions then existing, it seems possible that immense dams may have been built by floating ice, and that the shortness of the summer season did not permit their being melted before the rigors of the ensuing winter fixed them firmly in position. During the second summer they may have been increased in the same manner in which they were originally built, and it seems possible that the result may have been a dam so strong as to persist for a great many seasons, and so high as to force the water to seek a new outlet in some more favorable locality. In the pond produced by such dams immense quantities of silt would accumulate, but the character and arrangement of the material would depend largely upon the shape of the channel and upon the location of the outlet. If the outlet occurred near the dam, strong currents would doubtless sweep through the entire pond and the finest material would be carried on, leaving only the coarser sediments in the bottom of the pond; but if the outlet occurred at some distance from the point where the dam was built, as in the Carmichaels channel, then there was a large body of water nearly free from movement, and in such places finely laminated clay would be deposited. The most striking example of such deposition is in the great Teays Valley of southern West Virginia, which was vacated by Kanawha River, under similar conditions. In this valley laminated clay of the finest character accumulated to a depth of 60 feet. The outlet was 14 miles above the dam, and sedimentation in the lake was quiet and undisturbed. Below such a dam little or no deposition would occur and the channel would be left in the same condition as when it was occupied by the active stream before the formation of the dam. It may be urged that it would be impossible for such a dam to persist long enough to permit the stream to intrench itself in a new course, but it must be remembered that during the cutting of the new channel the old one is being silted up, and that the amount of work necessary is only enough to lower the grade of the stream below the top of the silt in the old valley This, presumably, would be less than 100 feet in all cases, and with the volume of water that doubtless then prevailed, it may have been accomplished during the life of the dam.

If this hypothesis is correct many such dams may have been formed, and each of the abandoned channels in this territory was probably produced by an independent ice jam. The results are frequently masked by later dams farther down the stream, for behind each dam there must have been an extended pond of water in which silts were deposited. Thus it is that in most of the cases in this territory there is no direct evidence of the position of these ice barriers, but in the Carmichaels bend, which presumably was the last to be abandoned, almost the exact position of the dam is indicated by the termination of the silt $1\frac{1}{2}$ miles northeast of the town.

Sequence of events on Monongahela River.—The general sequence of events has been roughly outlined. The river's old course appears to have extended from its present course at Dam No. 8 directly northwestward to New Geneva. From Dam No. 7 it followed the Mapletown channel to the mouth of Whiteley Creek, where it turned eastward to Masontown and crossed the present course to Carmichaels. The first change is hypothetical, but it seems probable that an ice gorge was formed in the Masontown channel either below Grays Landing or between Masontown and Hatfields Ferry. The height of the dam is also problematical, but it probably had a height of nearly 100 feet, reaching to the summit of the ridge on the concave side of the bend. The water found an outlet south of Hatfields Ferry and a new course was established along this line. A second dam was formed in the vicinity of Mapletown and the water was forced over a low divide at Grays Landing and the present course of the river was established from Dam No. 7 to Hatfields Ferry.

About the same time an ice gorge was formed across the old channel near Dam No. 8. An outlet was found near and to the left of the dam and the present course was established, which avoids the old channel only where the ice blockade barred its way.

The last change was produced by gorging of the ice $1\frac{1}{2}$ miles below Carmichaels. Since in this case the actual location of the dam can be determined it is interesting to speculate regarding the height necessary to force the river to assume its present course. It is impossible to determine this with accuracy, but there are some facts which throw light on the subject. Since the new channel was established at the lowest point in the rim of the basin, its altitude must have been less than that of any existing divide. In undertaking to solve this problem, it is necessary to determine, if possible, the original arrangement of the minor drainage in the vicinity of the new channel. In the case of the Carmichaels channel this is particularly difficult, since the minor drainage shows an apparently abnormal arrangement. Thus Middle Run and Antram Run flow in parallel courses toward the southwest, at nearly right angles to the general drainage lines of the region. Browns Run is nearly at right angles to the new course of the river, but inclines slightly in the direction of flow. It is probable that these minor drainage lines were originally united, but did they then flow to the north and unite with the river at East Riverside, or turn south and enter the river near Hatfields Ferry? The courses of Middle and Antram runs appear to have been determined by the geologic structure; they are in harmony with most of the minor drainage lines in the northeast quarter of the Masontown quadrangle. For this reason the southwest courses of these streams are not necessarily indicative of an outlet in a southerly direction. It seems therefore, more probable that Browns Run was the main stream and that Middle and Antram runs were tributary to it. If that was the case the dividing ridge between Browns Run and the river extended from north of Masontown to the high land east of Carmichaels and terminated in the angle between the two streams above East Riverside. The lowest divide at present in this ridge is east of McCanns Ferry, and its altitude is about 1000 feet. The gap across which the water found an outlet must have been lower than the one east of the ferry, hence it was probably just below 1000 feet. This altitude is close to that of the top of the silt south of Carmichaels, and indicates that the channel was here filled to the level of the water surface.

The divide below McCanns Ferry was soon cut below the level of the silt above the dam, and the new channel by Parkers Bar and Adah was established. The ice composing the dam finally melted, leaving no trace of its existence except the new channel and the absence of sediment below the point where the dam was formed. No dam formed below this point after the abandonment of the Carmichaels channel, and consequently the Carmichaels valley remains in the condition in which it was left by the river, with the exception of the changes which have been produced by normal erosion since that time.

Abandoned channels along Youghiogheny River.—Similar conditions prevailed on Youghiogheny River, and its course is marked by a number of abandoned channels of the same character and at approximately the same altitude as those previously described. None of the channels of Youghiogheny River occur in this territory, but a small one is to be seen at Ohiopyle, just east of the eastern margin of the Uniontown quadrangle. Youghiogheny River enters the village of Ohiopyle from the east, but instead of turning to the north in a simple curve it turns to the south and forms a loop about 2 miles in length and returns to within a few hundred yards of its course at the falls. The promontory around which it flows is high and rocky, except at its base, where it is but 15 to 20 feet higher than the channel of the river above the falls. This low neck of land is covered with a thick deposit of well-rounded river bowlders resting upon a rock floor only a little higher than that upon which the stream is flowing above the town. It is obvious that at one time the stream flowed across the neck of the peninsula along the line of the Baltimore and Ohio Railroad, but it has abandoned this direct course and cut a new and circuitous channel. It is evident that the direct course must have been blockaded, and the presumption is that a gorge of river ice caused the blockade. The altitude of Ohiopyle is 1238 feet, hence the hypothesis of a general pond due to glacial ice does not apply to this case, unless there has been differential crustal movement since the diversion occurred. There is no evidence of such movement, and the character of the material filling the abandoned channel at Ohiopyle indicates that at the time the change occurred the stream was still active and had not begun to grade its valley. This is to some extent corroborated by the occurrence of an abandoned channel on Dunbar Creek at Sitka at an altitude of about 970 feet. This shows the grade of the old valley to be 260 feet between Ohiopyle and Sitka, while the present stream descends 330 feet between the same points.

Uplift of western Pennsylvania in Glacial time.—From the foregoing description of abandoned channels it is apparent that during their formation the surface of western Pennsylvania was nearer sea level than it is to-day and that it had remained stationary long enough for the streams in the region west of the Chestnut–Laurel ridge to reach grade and to broaden their channels to a small extent, but not sufficiently long to allow Youghiogheny River to produce a similar channel in the hard rocks of the mountainous region. As the abandonment of the channels occurred in early Pleistocene time the partial cycle of erosion in which they were produced began in late Tertiary time and was terminated by an uplift of the region, presumably at the close of the Kansan stage of the Glacial epoch. The amount of this movement has not been definitely determined, but it must have been greater than the depth of the present channel below the abandoned valleys. This difference is about 150 feet, but the grade of the old stream was less than that of the present river, consequently a small amount may be added to this measure. Also another addition may be made for the reason that the pre-Pleistocene drainage was into the St. Lawrence system and presumably reached sea level in a much shorter distance than the present drainage by way of Mississippi River. Thus it seems that the post-Kansan (?) elevation may have ranged from 200 to 500 feet.

The latest or Wisconsin stage of glaciation does not appear to have affected the streams of this region. Either the climate was not so severe or the streams were too deeply intrenched in their modern canyons to be diverted. The Wisconsin epoch is recorded in the lower Allegheny Valley by a terrace of drift material about 20 feet above the present flood plain of the river. Such material was not available in Monongahela Valley, and consequently no one has yet been able to differentiate the low terraces of this stream.

RELATION OF TOPOGRAPHY TO MAN'S ACTIVITIES.

In this territory it is clearly apparent that man's activities have been largely controlled by the character of the surface, but a modifying condition has recently appeared that may change this to a considerable extent. Originally surface features were all-powerful in shaping the growth of the community, but now the presence of good coal is largely the determining factor in development.

In the early settlement of this region the valleys were avoided for the reason that the slopes were too precipitous for farming purposes and the streams were too small for navigation, except by the smallest type of boats. The most promising location for a town was in the broad, shallow valley at the western base of the Chestnut-Laurel ridge, and here Uniontown was established, on the line of Braddock's trail from Potomac River to the junction of Monongahela and Allegheny rivers. Before the days of railroads the National Pike was built by the Government through this region from Cumberland to Wheeling. For a long time this was a great national thoroughfare and Uniontown was one of the thriving towns along its course.

In later years the settlement of the country extended to the river valleys, but, even to the present day, the valleys are of slight importance compared with the more open and accessible upland. For many years the principal artery of traffic through this territory has been the Baltimore and Ohio Railroad, which utilizes the valley of Youghiogheny River for its line between Pittsburg on the west and Washington and Baltimore on the east. A few towns have been established along this line, but they owe their location as much to the mineral deposits there available as to the presence of the railroad. The stage roads have fallen into disuse, but Uniontown has thriven, for it is situated in the very heart of one of the best coal basins in the country.

The development of the coking plants in the Uniontown region has increased the population of this valley by thousands, but at present the activities are shifting, and recent improvements west of Uniontown give indications of great development in Monongahela Valley in the near future. Although slack-water navigation has been carried on for nearly a score of years, the physical features of the valley are so forbidding that no new developments have been undertaken. Under the stimulus of coal mining on a large scale and railroad connections, doubtless this valley, despite the natural disadvantages, will be thickly populated and manufactories will abound.

GEOLOGY.

STRUCTURE.

The lay of the Appalachian coal basin in general.

Structure of the Appalachian coal field.—The geologic structure of the Appalachian coal field is very simple, consisting, in a general way, of a broad, flat, canoe-shaped trough. This is particularly true of the northern extremity, a generalized map of which is shown in fig. 28. The deepest part of this trough lies along a line extending southwest from Pittsburg across West Virginia to Huntington on Ohio River. Toward this line the rocks dip from both sides of the trough. On the southeastern side they dip to the northwest and on the northwestern side they dip to the southeast. About the canoe-shaped northern end the rocks show in a rudely semicircular line of outcrop and at all points dip toward the lowest part of the trough.

In Pennsylvania the deepest part of the trough is situated in the southwest corner of the State, and the inclination of the rocks is generally toward that point.

Although the general structure of the region is of this simple character, the eastern limb of the trough is crumpled into a number of parallel wrinkles or folds that make the detailed structure somewhat complicated and break up the regular westward dip of the rocks, so that at first sight it is not apparent. Close examination, however, shows that from the Allegheny Front westward each succeeding trough is deeper than the one on the east, and the successive arches become lower, until the rocks which are over 2000 feet above sea at the Allegheny Front extend below sea level in the central part of the basin.

Definitions.

In describing these folds the upward-bending arch is called an *anticline* and the downward-bending trough is called a *syncline*. The *axis* of a fold is that line which at every point occupies the highest part of the anticline or the lowest part of the syncline, and from which the strata dip in an anticline and toward which they dip in a syncline.

Contour and altitude of a selected stratum or datum surface.

Method of representing structure.—In previous reports the underground relations, or structure, of the rocks have been illustrated by cross sections such as the one herewith given on the Uniontown Geologic Structure sheet. Another method of representing the basins and arches is employed in these maps, as follows: The upper or lower surface of a particular stratum of rock is selected as a reference surface. The form of the reference surface is ascertained, first, from the outcrop of the chosen stratum; second, from the depth of that stratum beneath beds above it; and third, from the height of that stratum above beds beneath it. In the first case the stratum outcrops and is observed. In the second case it is underground, and the outcrop of some higher bed is observed. The thickness of rocks between the two being known, the depth of the reference surface can be estimated. In the third case the reference surface is in the air—that is, the chosen stratum has been eroded—and the outcrop of an underlying bed is observed. The thickness of the intervening rocks being known, the height of the reference surface can be determined.

By reference to the topographic map the altitude of any outcrop can be ascertained and thus the height above sea for a corresponding point of the reference surface can be determined. This is done for hundreds of points along a very large number of sections taken in various directions. Points which have the same altitude are then connected by a line, which gives the form of the reference surface at that elevation. Many such lines are drawn at regular vertical intervals. They are contour lines, and as printed on the Geologic Structure sheet they show: First, the horizontal contour of the troughs and arches; second, the relative and also the actual dip of the beds; and third, the height of the reference surface above the sea at any point. The depth of the reference horizon may be determined by subtracting the elevation of the reference horizon from that of the surface of the ground.

As a rule these structure contours are generalized and are only approximately correct. Where mines have been opened on the chosen stratum, as on the Pittsburg coal, the contours are precise and detailed, but in other cases they are liable to error from several conditions. Being estimated on the assumption that over small areas the rocks maintain a uniform thickness, the position of a contour will be out by the amount by which the actual thickness varies from the calculated thickness. Being measured from the altitude of observed outcrops, the position of the contour is uncertain to the degree that that altitude is approximate, and while in many instances topographic altitudes are determined by spirit level, in most cases geologic observations are located by aneroid barometers. The aneroids are constantly checked against precise bench marks, and the instrumental error is probably slight, but it may be appreciable. And finally the observations of structure at the surface can be extended to buried or eroded strata only in a general way. The details probably escape determination. These sources of error may combine or may compensate one another, but in any case it is believed that their sum is probably less than the amount of one contour interval; that is to say, the absolute altitude of the reference surface will not vary more than 100 feet from that indicated in the mountainous region east of Uniontown and not more than 50 feet in the other part of the quadrangles; and the relative altitudes for successive contours may be taken as very closely approximate to the facts.

DETAILED GEOLOGIC STRUCTURE.

In the Uniontown and Masontown quadrangles the most pronounced structural features are in the mountainous country southeast of Uniontown. The parallel ridges which are so conspicuous in this region owe their existence to anticlines of hard rock that have withstood erosion better than the softer rocks of the adjacent synclines.

In order to bring out the details of the structure of this mountainous belt the top of the Pottsville sandstone is selected as a reference surface and it is represented on the Geologic Structure sheet by contour lines, with a vertical interval of 100 feet, printed in orange color. Where this horizon is below the surface its position has been calculated from the beds in sight, on the assumption that intervals between formations are fairly constant over small areas. Where the Pottsville has been eroded from the tops of the arches its restoration likewise has been determined from the rocks showing at the surface.

Arches represented by the Pottsville datum surface.

In the report on the geology of this region Professor Stevenson recognized the fact that the Chestnut Ridge anticline north of Youghiogheny River did not quite coincide with the arch of Laurel Ridge south of that stream. He speaks of it as an offset of some kind, but he did not determine the exact nature of the complication. From the contour lines it is apparent that these folds, although very closely related and connected, are really distinct and have separate axes. That which attains its greatest development in Chestnut Ridge north of Youghiogheny River is here designated the Chestnut Ridge anticline, while the axis of the westernmost fold south of the river, for want of a better name, is called the Dulany anticline, from the well-known cave on Laurel Ridge.

If the Pottsville sandstone were restored across the Dulany anticline it would reach an altitude, as shown by the contours, of 3300 feet above sea level. From this maximum the sandstone bed descends beneath the western face of the ridge until it is below the level of the sea, but in this region it is so deeply buried that it is useless as a reference stratum and the contours have been carried only to a depth of about 500 feet below the surface. On the eastern side the descent is not so great, and the Pottsville in the vicinity of Elliotsville reaches the bottom of a local syncline in Ligonier Valley at an altitude of 1300 feet above sea level. The Dulany anticline attains its maximum development on the National Pike, but it continues southward at nearly the same altitude to within a mile or two of the southern margin of the quadrangle. South of the latter point it plunges rapidly, and it is only a moderate fold where it is cut by Cheat River, a few miles south of the Pennsylvania line. North of the National Pike the fold diminishes until the Pottsville attains an altitude of about 2100 feet on the axis back of Mount Braddock. At this point the fold loses its distinctive character, and soon dies out on the western flank of the Chestnut Ridge anticline.

The Chestnut Ridge anticline makes its first appearance as a low fold south of the National Pike, and it increases slowly northward until the Pottsville sandstone attains an altitude of 2300 feet at Elk Rocks. From this point to the northern line of the quadrangle the fold maintains a constant altitude, and presumably it does not change much across the Connellsville quadrangle. The axis swings approximately into line with that of the Dulany fold, and the only perceptible difference is a low place in the arch along Dunbar Creek and a slight flattening of the dips in the vicinity of Youghiogheny River.

The axis of the Laurel Hill anticline lies just east of the southeast corner of the Uniontown quadrangle. It plunges rapidly to the southwest, and the effect of the plunge is seen in the direction of the contours on its western slope. Along the National Pike the Pottsville rises from an altitude of about 1500 feet in the vicinity of Farmington to a little over 2200 feet on the axis of the fold, and then it dips rapidly into the deep syncline in the vicinity of Confluence.

Basins represented by the Pottsville datum surface.

The Laurel Hill and Chestnut Ridge anticlines are separated by an irregular basin which is here designated the Ohiopyle syncline. It is a part of the great Ligonier Valley syncline, but it has been given a distinct name because it has local characteristics and as a separate and distinct synclinal axis it probably does not extend throughout the full length of Ligonier Valley.

A minor syncline also exists between the Chestnut Ridge and Dulany anticlines. It is connected with the Ohiopyle syncline, but it has a separate and distinct axis, and it is called the Elliottsville syncline.

The Pittsburg coal as a datum surface.

West of Laurel Ridge the structural features are not so pronounced as they are east of that line, but there are several more or less distinct folds crossing these quadrangles. In the territory west of the Chestnut–Laurel ridge the Pottsville sandstone does not outcrop and another reference surface gives more reliable results. The best known horizon in this field is the Pittsburg coal, and the contours printed in brown color on the Geologic Structure sheet are represented as being drawn upon the floor of this bed with a vertical interval of 50 feet.

Form of the Connellsville basin.

The synclinal basin along the western foot of the Chestnut–Laurel ridge is the best known structural feature of western Pennsylvania. It is the celebrated Connellsville basin, in which is produced the major portion of the coke used in this country. The term Connellsville basin applies to a general synclinal trough extending from the West Virginia line on the south to Conemaugh River on the north. In reality the basin is made up of two separate and distinct synclines which abut against each other with a slight offset north of the city of Connellsville. They are here described as the Uniontown and Latrobe synclines.

Form of the Uniontown syncline on the Pittsburg coal.

The southern syncline has its greatest development near Uniontown, and hence it is proposed to designate it the Uniontown syncline. In the deepest part of this basin the Pittsburg coal is at an altitude of about 550 feet above sea level, or about 600 feet below the tops of the highest hills. As shown on the map, the bottom of the syncline is rather flat, having an area about a mile and a half in width and 3 or 4 miles in length. From this relatively level bottom the coal bed rises sharply and with great regularity to the surface along the eastern side of the basin. On the west, dips are lower, and that side of the basin is correspondingly wider. The axis rises toward the south, so that the coal is exposed at the surface near Fairchance, but it continues to occupy the hilltops to beyond the margin of the quadrangle.

The data upon which these contours are based are very much more accurate than the data for the contours of the Pottsville sandstone. In the areas covered by large mines the contours are located from actual levels within the mines, and are therefore accurate so far as the scale of the map will permit. Between and beyond the areas occupied by mines the contours are extended on geologic evidence secured at the surface and from drill records, where such are available. The structure of the basin is remarkably regular and free from minor variations. So far as known, the minor irregularities are limited to the center of the basin, where the dips are slight, and to the extreme ends, where the flatness of the coal tends to exaggerate slight inequalities of its floor.

Form and altitude of the Fayette anticline on the Pittsburg coal.

West of the Uniontown syncline lies an anticlinal fold, which is only slightly pronounced on the southern margin of this territory, but which increases irregularly northward and reaches its greatest development north of Youghiogheny River. This fold has been called by Stevenson the Fayette anticline, and the name will be retained, although the fold is equally well developed in Westmoreland County. South of the National Pike the Pittsburg coal is preserved in many of the hilltops even along the axis, and from this fact the size and form of the fold were easily and accurately determined. North of the pike the anticline is of greater magnitude and the coal has been eroded from a wide belt on both sides of the axial line. In this part of the territory the data for drawing structural contour lines are meager and the shape of the fold is to some extent hypothetical. The evidence of the former position of the Pittsburg coal where the axis crosses Redstone Creek is derived from the records of a deep well drilled a number of years ago at Upper Middletown. In this well the Pottsville formation is identifiable and affords a clue to the position not only of the Pittsburg coal but of the Upper Freeport coal as well. The record of the deep well at Smithfield shows the interval between the Pottsville sandstone and Pittsburg coal to be 910 feet. If this measure is added to the altitude of the Pottsville in the Upper

Middletown well it gives the former position of the Pittsburg coal at this point as 1400 feet. This is apparently on the axis, and therefore gives us fairly reliable data concerning the height of the fold. In the vicinity of Youghiogheny River there is abundant evidence for determining the shape and size of the fold, but between this stream and Redstone Creek the evidence is scanty and the fold is determined simply by connecting contour lines. The magnitude of these folds may be seen by comparing the altitude of the coal at Upper Middletown with the same bed in the bottom of the Uniontown syncline. Thus it is seen that the coal rises at least 950 feet from the axis of the syncline to the axis of the anticline.

Extent and depth of the Lambert syncline on the Pittsburg coal.

On the west the coal dips again into a basin which is somewhat deeper than the Uniontown syncline and which is more irregular in direction and outline. Its greatest development is in the vicinity of Dunlap Creek, and it is called the Lambert syncline, from a mining town which has lately been established at the head of Middle Run. The axis of the syncline enters this territory from the north, crossing Redstone Creek at the mouth of Washwater Run. From this point it extends southwestward and crosses Monongahela River near the mouth of Middle Run. After pursuing a westerly course for nearly a mile beyond the river, the axis turns almost due south, through Paisley, and terminates somewhat indefinitely near Willow Tree, in Greene County. At its deepest point the coal is supposed to reach an altitude of less than 450 feet above sea level. From the deepest part of the basin it rises in all directions, and at the southern extremity reaches an altitude of over 700 feet. Toward the north the syncline extends only a short distance beyond Redstone Creek, where it merges with another syncline on the west, forming the deep basin which crosses Youghiogheny River at Port Royal and extends northward to Irwin, on the Pennsylvania Railroad.

Irregular folds represented in the Masontown quadrangle on the Pittsburg coal.

In the Masontown quadrangle the coal rises westward from the Lambert syncline in an irregular arch, which is called the Brownsville anticline. The axis of this fold passes just east of the town of Brownsville and crosses Monongahela River at East Riverside. From this point southward the fold is very poorly defined, but there appears to be a slight undulation in the rocks, which may be traced beyond Turkey Knob. This is a minor wrinkle in a large synclinal basin, the eastern limb of which rises to the Fayette anticline and the western limb to the Bellevernon or Waynesburg anticline, which lies beyond the limits of the territory. West of the Brownsville anticline the rocks appear to be gently warped, but with no pronounced synclinal fold. In the extreme northwest corner of the territory the contours show slopes leading up to the Belvernon axis.

All of the structures in the western part of the Masontown quadrangle are poorly defined, and from the data at hand there is great difficulty in expressing the structure by means of contour lines. In many places well-marked geologic horizons could not be found, and hence the position of the Pittsburg coal could not be determined with great accuracy. In this portion of the map the contour lines should be taken as the expression of structure in a very broad way only, and considerable allowance should be made for inaccuracies of observation and for variation in thickness of formations.

After the structure contours were engraved on the Masontown map a possible error was discovered in the vicinity of Ceylon due to unsuspected variation in the interval between the Pittsburg and Waynesburg coals. The actual position of the Pittsburg coal was determined by drill records at Willow Tree, on Whiteley Creek southeast of Sigsbee, at Hatfields Ferry, and by the Gates shaft at the mouth of Middle Run. At all of these points the interval between the two coal beds is about 380 feet. As these determined points nearly encircle Ceylon, it was assumed that the interval remained constant in this region, and the contour lines were drawn accordingly. Since then it has been discovered that Professor Stevenson reports that a well was drilled years ago at Ceylon, and that the Pittsburg coal is only 324 feet below the Waynesburg coal. If this reported record is correct the structure contours are too low in this locality by about 50 feet.

Structure sections drawn for Uniontown quadrangle only.

West of Laurel Ridge the folds are so slight that they do not show in structure sections drawn to the scale of the maps, therefore none have been prepared for the Masontown quadrangle. In the Uniontown quadrangle, however, the structural features are more pronounced, and they are illustrated by a section which follows in a general way the course of the National Pike. This is engraved on the Structure Section sheet, and it represents the strata as they would appear in the side of a deep trench cut across the quadrangle along the line A—B. The vertical and horizontal scales are the same, hence the actual form and slope of the land and the dips of the strata are shown. On this section the rocks may be seen rising on the east to the Laurel Hill anticline, and in the middle arching over the Dulany anticline. The minor irregularities of structure in the broad valley between these ridges are not apparent on the section. The slight dip of the rock under the Uniontown syncline is shown on the left, but the basin is too shallow to show to advantage on this scale.

STRATIGRAPHY.

General statement.—The rocks exposed at the surface in these quadrangles are prevailingly of Carboniferous age, but in the Dulany anticline lower rocks are brought to light in the ravines that have been eroded on the flanks of Laurel Ridge and in the gorge of Youghiogheny River where it cuts across the anticline in the northern part of the Uniontown quadrangle. These belong to the Devonian system, and they are the oldest rocks exposed in the territory.

DEVONIAN ROCKS.

Olive-green shales and sandstones with red shales.

Catskill formation.—The upper part of this formation is well exposed on the National Pike between Hopwood and Summit. The rocks showing in this exposure consist almost entirely of olive-green shale with occasional beds of argillaceous or muddy sandstone. The upper limit of the formation is marked by the sandy Pocono beds which overlie it, and the plane of contact is usually characterized by the presence of a thin, irregularly bedded conglomerate.

In the exposures along Youghiogheny River the Catskill formation appears to be more sandy, but even in this locality the shaly material preponderates. The apparent character of the beds depends largely upon the nature of the outcrop and the amount of weathering which the rocks have undergone. Where the beds are freshly cut, as along the National Pike or in deep drill holes, they have a decidedly shaly aspect, but where the weathering has been severe the shales are worn back, leaving the beds of sandstone well exposed along the bluffs and giving the impression that they predominate.

The full thickness of the formation can not be determined. That part which is exposed at the surface has a thickness of not over 400 feet, but in the deep oil and gas wells which have been drilled west of Laurel Ridge the drill has penetrated beds of this character to a depth of 1200 or 1300 feet without apparently reaching the lower limit of the formation. In the surface exposures the rocks are prevailingly dark and usually green in color. But the records of the deep wells previously mentioned show at a depth of about 700 feet below the Pocono sandstone an extensive deposit of red shale, sometimes attaining a thickness of 150 feet.

On purely lithologic grounds it is difficult to correlate these beds with rocks of probably the same age in the eastern part of the State. In the report on Ligonier Valley, Professor Stevenson, under the direction of Professor Lesley, classed these rocks as doubtfully belonging to the Catskill formation, but in a later publication (Am. Jour. Sci., 3d series, Vol. XV, 1878, pp. 423–430) he stated that he regarded them as equivalent to the Chemung of New York, the Catskill phase of sedimentation being absent in this locality. In the same paper it is stated that the gray Catskill, or Pocono, recognized in the eastern part of the State, is probably represented in Laurel Ridge by the group of sandstones which is here called the Pocono formation, but that the red Catskill is entirely wanting. This statement is correct so far as surface exposures are concerned, but, as shown by the drill, the red beds are present at some depth.

Chemung fossils in the Catskill beds.

During the present survey fossils were collected on the National Pike about 50 feet below the base of the Pocono sandstone which, according to George H. Girty, are of Chemung age, and Professor Stevenson, in the paper cited, states that he found a number of species which, according to Professor Hall, are typical Chemung forms. These were found within 18 inches of the base of the Pocono sandstone, and clearly show that, from a paleontologic standpoint, no formation can be present between the Chemung shales and the Pocono sandstone.

It is now clearly established that the so-called Catskill formation is merely a shore or brackish-water phase of certain Devonian formations. In the vicinity of Delaware Water Gap this phase made its appearance in Hamilton time, and from that point it progressed upward and westward until somewhere in western Pennsylvania and New York the brackish-water, or Catskill, phase thinned to a feather edge and disappeared about the close of Devonian time. The rocks of Laurel Ridge appear to have been deposited almost wholly in the open sea and entirely west of the area in which brackish-water conditions prevailed.

When the accompanying geologic map was prepared the writer was inclined to consider these beds as equivalent to the true Catskill of New York, but further consideration convinced him that they are more nearly related to the Chemung of the type locality, and consequently should bear that name. In the meantime the name Catskill had been engraved and printed and could not be changed.

CARBONIFEROUS ROCKS.

MISSISSIPPIAN SERIES.

Flaggy sandstone, conglomerate, and arenaceous limestone.

Pocono sandstone.—This sandstone, named from Pocono Mountain, in the northeastern part of the State, is well exposed in the Uniontown quadrangle. It outcrops on the flanks of Laurel Ridge at the southern margin of the quadrangle, but toward the north the arch increases in magnitude and the sandstone is carried to the summit of the ridge. At the point where it is crossed by the National Pike the Pocono sandstone is eroded, but it appears in the high summits on either side of the gap. The arch decreases in size toward the north and the outcrop disappears from the summit, and is found almost entirely on the eastern flank of the ridge in the deep ravine cut by Dunbar Creek. It is well shown also in the gorge of the Youghiogheny, rising from river level a short distance above the waterworks in South Connellsville, and sinking from view on the other side of the arch near the eastern margin of the quadrangle. The thickness of the formation is approximately 300 feet. It is composed almost entirely of sandstone, which varies from thin-bedded, flaggy rocks to massive conglomerate. Its base is usually characterized by a thin conglomerate, which is well shown on the National Pike about halfway up the mountain and along the main line of the Baltimore and Ohio Railroad about 3 miles above Gibson Junction. The upper part of the formation is usually more massive than the lower, and on this account it is a more prominent feature in the topography of the region. Toward the top the sandstone gives way to a strongly arenaceous limestone which is here regarded as constituting the top of the formation. At the top the limestone is blue and sandy and it would not for a moment be confused with the sandstone underneath, but in passing downward the limestone is found to become more sandy, until from an arenaceous limestone it grades into a calcareous sandstone, and presumably changes gradually to the nearly pure siliceous beds of the well-known Pocono section.

On Youghiogheny River the calcareous upper bed is quarried extensively and crushed for ballast. At this point it has a thickness of over 60 feet, and very little of it can be classed as limestone. It is overlain by bright-red shale of the Mauch Chunk formation. Under the shale occurs very arenaceous limestone, and below this the bulk of the bed is essentially a greenish-gray sandstone that, presumably, is calcareous in its upper portion. Near the southern margin of the quadrangle the bed is evidently much more strongly calcareous, for Dulany Cave has been formed in it on the western side of Laurel Ridge. In this locality it is a blue sandy limestone which grades down into the coarse sandstone of the true Pocono formation. In many places this bed appears to be a relatively pure limestone, but no fossils have been found in it. In previous surveys the limestone portion has been classed as a part of the Greenbrier formation, but Professor Stevenson, in his report on Bedford and Fulton counties, recognized the close relationship between the siliceous limestone and the underlying sandstone, and remarked that "this bed is much more closely related to the Pocono sandstone than to the Mauch Chunk shales," so that in all probability it should be classed with the former.

The Pocono sandstone is remarkably persistent and regular in thickness in the southwestern part of the State. It has probably been encountered in every deep well that has been drilled in this section of the country, but to the driller it is known only by the name of the Big Injun sand. In the records of wells drilled at Upper Middletown and Haddenville the Pocono sandstone has a thickness of 290 feet. At Smithfield its apparent thickness is only 151 feet, but it is possible that some shaly beds occurring lower in the well should be included in this formation.

Red and green sandy shales with interbedded limestone.

Mauch Chunk shale and Greenbrier limestone lentil.—Above the arenaceous limestone last described occur red and green shales with interstratified limestone and sandstone beds, the whole having a thickness of about 250 feet. This is the representative of the great Mauch Chunk red shale of the eastern part of the State, and it takes its name from the city of Mauch Chunk, in the region of its greatest development.

In the type locality the formation is composed almost entirely of red and brown shales and brown sandstone, and no limestones are recognized in it. In passing to the south and west, a limestone appears, which at first is an extremely thin bed, but which thickens until far to the southwest it replaces in large measure the Mauch Chunk formation. This bed is the great Greenbrier limestone of central Virginia, and in its greatly expanded development constitutes most of the Mississippian series farther west. In its greatest development in Mississippi Valley it is not only of sufficient magnitude to be classed as one formation, but it is complex, and has been divided into several formations which have been identified over a wide range of territory. In no part of the State of Pennsylvania does it attain on its outcrop a greater thickness that 30 feet. It occurs about 50 feet above the base of the Mauch Chunk formation, and throughout the southwestern portion of the State it is always underlain by beds of typical Mauch Chunk red shale. Since in Pennsylvania the Greenbrier limestone occurs in the midst of typical Mauch Chunk shales, to treat it as a lentil is more satisfactory than to regard it as an independent formation.

In its best development the Greenbrier limestone lentil has a thickness of about 30 feet. The larger part of the formation is composed of thin beds of pure blue limestone, but toward the top they become shaly and the formation changes to olive-green shale through gradations of shaly limestone and calcareous shale. It is extremely fossiliferous, but during this survey no collections were made. Professor Stevenson, however, recently (Mauch Chunk of Pennsylvania: Am. Geologist, Vol. XXIX, 1902, pp. 242–249) collected fossils from this limestone at a quarry on the National Pike east of Laurel Ridge. Stuart Weller pronounced the fossils to be of Genevieve age and to be identical with those occurring in the Maxville limestone of Ohio. From these fossils it seems probable that the Greenbrier limestone lentil may be correlated with the base of the Chester beds, or the top of the St. Louis limestone.

The outcrop of the limestone is easily determined in the field by the many quarries which have been opened upon it. The stone is hauled to adjacent farms and burned in open ricks to supply fertilizer.

The Mauch Chunk shale can be identified in every well-kept drill record throughout the region west of Laurel Ridge, but the reports of the drillers vary greatly in their description of its character. In the Upper Middletown well it has a thickness of 145 feet and is noted as red rock and slate. In the Haddenville well it is reported as consisting of 5 feet of shale underlain by 90 feet of limestone. In the Smithfield well it is as follows:

Mauch Chunk shale as shown in Smithfield well.

	Feet.
Red shale with some lime	94
Dark shale	40
Limestone	117
Total	251

The rocks above the Greenbrier limestone lentil consist principally of red and green shale with occasional beds of greenish sandstone. In this region the shale immediately underlying the Pottsville sandstone is of an olive-green color, and it has attained considerable prominence from the fact that it carries small beds of iron ore that were extensively worked before the introduction of Lake Superior ores.

The beds below the Greenbrier lentil are not so uniform in character as those above. They are prevailingly red in color, but the shale is frequently interstratified with thin bands of impure limestone.

The irregularities in the thickness of this formation throughout western Pennsylvania and the fact that beds of different character come into contact with the Pottsville sandstone are presumably due to an unconformity between the Pottsville sandstone and the Mauch Chunk shale. This unconformity is plainly apparent on the west side of the Appalachian coal basin from Pennsylvania to Alabama, and it extends beneath the basin as far as the Uniontown quadrangle. Its significance will be more fully considered in the description of the Pottsville formation.

The Mauch Chunk shale shows in outcrop along Youghiogheny River from the waterworks in South Connellsville to beyond the margin of the quadrangle. In passing over the arch of the Chestnut Ridge anticline it rises several hundred feet above the river, and consequently is visible at only one or two points in passing along the Baltimore and Ohio Railroad. It is also present on Dunbar Creek above the furnace. Owing to the development of the Dulany anticline to the southwest, its outcrop passes from the head of Dunbar Creek to the summit of the mountain at Jumonville. From this point to the edge of the quadrangle it occurs continuously on both sides of Laurel Ridge, but the formation is composed of soft rocks and its outcrop is usually marked by ravines or low gaps in the spurs of the ridge.

PENNSYLVANIAN SERIES.

Pottsville sandstone.—The Pottsville sandstone is the lowest member of the Pennsylvanian series or true coal-bearing rocks. It rests unconformably upon the soft shale of the Mauch Chunk formation and is overlain by the relatively soft rocks of the Allegheny formation. Sandwiched thus between formations which are easily eroded, the hard beds of the Pottsville are conspicuous features in the landscape. To their resistant character is due much of the mountainous topography of this part of the State, and the erosion of the soft shale beneath causes them to stand out in prominent cliffs.

Two sandstone benches with shale and thin coal between.

The Pottsville sandstone is best exposed along Youghiogheny River in Stewart Township. This outcrop is east of the Uniontown quadrangle, but the exposures are so much better than those occurring within the territory that they will be regarded as the type for the field.

The two heavy benches of the formation are well exposed along the Baltimore and Ohio Railroad from Ohiopyle to within 2 miles of Indian Creek. The upper bed is generally more massive and thicker than the lower bed, and it is a much more prominent feature in the topography of the region. Along the river it probably varies from 30 to 80 feet in thickness. The top of the bed seems to be generally regular, but the base is uneven, seeming to rest unconformably upon the shale beneath. The upper bed is generally conglomeratic, but in most of the outcrops the pebbles are not abundant enough to be conspicuous.

The shale interval between the two sandstone benches is very irregular in thickness and composition. It varies from 20 to 50 feet in thickness where it is well exposed in the railroad cuts, but in places it seems to be lacking. Irregular beds of sandstone occur in the shale, and generally a thin streak of coal may be seen in the railroad cuts. This bed of coal is usually too thin and irregular to be of value, but in the vicinity of Ohiopyle it measures about 2 feet in thickness. It is visible just below the falls, and according to Professor Stevenson its thickness ranges from zero to 15 inches. His correlation of this bed with the Mount Savage coal of Maryland has been verified by David White from fossil plants collected in the railroad cuts below Ohiopyle.

The lower sandstone bench is exceedingly irregular in thickness and bedding. In places it is a coarse conglomerate, but generally it is composed of coarse, irregularly bedded sandstone that frequently contains lenses of shale.

The thickness of the bed is difficult to determined. Its top is exposed at a great many places along the railroad, but its base is concealed by the railroad embankment. Between Bear Run and Ohiopyle some greenish shale shows at the railroad level, which possibly belongs to the Mauch Chunk formation, but at this point the upper limit of the sandstone is not visible. Presumably its maximum thickness is less than 100 feet, but it is so variable that measured sections apply only to the point at which they were taken.

The narrow canyon which the river has cut in these beds throughout Stewart Township extends up the stream as far as Ohiopyle, where it is terminated by a waterfall. Above the falls the river follows an east-west course directly across the anticlinal ridge known as Laurel Hill. Southwest of the river the Pottsville sandstones cap the ridge as far as the southern line of the Uniontown quadrangle. The outcrop does not show in the quadrangle, but it is present on the National Pike just east of this territory.

On Youghiogheny River below Indian Creek the rocks rise in a large anticlinal fold which carries the upper heavy plate of Pottsville conglomerate to the summits of the highest hills in the northeast corner of the Uniontown quadrangle. Erosion has been so severe that the sandstone is not always present on the bluffs facing the river, but it shows in a continuous line of outcrop a little distance back from the front. It is particularly prominent on the highest summit south of the river, where it is broken into huge blocks which lie scattered about in picturesque confusion. These are well known as the Elk Rocks, and they have been figured and described in previous reports on the region. North of the river the ridge is capped by the heavy beds of Pottsville, which rise on the west slope of the ridge somewhat more rapidly than the surface, and dip on the east beneath the Allegheny formation in Ligonier Valley.

In the valley of Dunbar Creek the Pottsville is particularly conspicuous. The upper bed is quarried and crushed for glass sand, and the inclined quarry face extends from the bottom of the valley to the summit of the ridge lying between this creek and Youghiogheny River. On the south side of the valley the outcrop of this hard bed forms a terrace diagonally up the side of the mountain from Dunbar furnace nearly to the summit of the mountain at the head of Tucker Run. From the head of Tucker Run the massive sandstone caps Laurel Ridge for 2 or 3 miles, but for the remainder of the distance it has been eroded from the crest of the arch and shows in outcrop only on the flanks of the ridge. It is particularly prominent in Pine Knob south of the National Pike, and its inclined beds form the surface of most of the long spurs on the west side of the ridge. South of this territory the anticlinal fold diminishes and again the Pottsville conglomerate caps the summit of the ridge.

In the exposures along Laurel Ridge it is difficult to obtain a complete section of the Pottsville formation. The upper bed of sandstone is usually well exposed, but the lower and softer members are generally concealed by the débris from the upper bed. Where the formation passes below river level at the waterworks in South Connellsville it shows the same arrangement of beds as it does near Ohiopyle, except that the lower bed is thin, probably not exceeding 30 feet in thickness. The upper bed is massive and it was formerly crushed for glass sand at this point. Its thickness is 60 to 80 feet and it is separated from the lower member by a shale interval from 10 to 15 feet in thickness.

On Laurel Ridge the Pottsville formation appears to be thinner than above Indian Creek, but the apparent thinness may be due to imperfect exposure of the lower part. The upper bench seems to hold about the same thickness that it has in the gap of Youghiogheny River above Connellsville. The lower sandstone bed is not known in this territory south of Youghiogheny River, but it is probably present along Laurel Ridge, since it occurs in its proper position in a section measured by Prof. I. C. White on Cheat River at the mouth of Big Sandy Creek a few miles south of the State line. In this section the upper conglomerate has a thickness of 160 feet; the shale member a thickness of 35 feet, and the lower sandstone bench a thickness of 31 feet.

The heavy sandstone beds of the Pottsville formation underlie the coal basins west of Laurel Ridge. They are easily identified in every reliable well record in the region. In the Upper Middletown well the Pottsville section is as follows:

Pottsville sandstone as shown in Upper Middletown well.

	Feet.
White sandstone	138
Shale	10
Black sandstone	90
Total	238

In the Haddenville well the shale bed either is not present or was not recognized. According to the record of this well the Pottsville has a thickness of 230 feet. The record of the Smithfield well shows the formation more in detail, as follows:

Pottsville sandstone as shown in Smithfield well.

	Feet.
Sandstone	95
Dark shale	35
Dark sandstone	8
Black shale	22
Gray sandstone	52
Total	212

The total thickness of the Pottsville formation in the Masontown well is about the same as in the Smithfield well, but the details differ, as shown by the following section:

Pottsville sandstone as shown in Masontown well.

	Feet.
Sandstone	160
Shale and coal	4
Sandstone	54
Total	218

Significance of the Pottsville and the unconformity beneath it.

The events which attended the deposition of the Pottsville formation constitute one of the most interesting episodes in the geologic history of this region. It was formerly supposed that the variation in thickness of the formation was due to different conditions of sedimentation and that the thinner beds of rock on the west side of the basin corresponded in age with the thicker beds on the east. Through the study of fossil plants David White has recently demonstrated that this is not the case, that the thinner beds are due to lack of sedimentation, and that they are separated from the underlying rocks by a long time interval that is represented by the deposition of at least the lower half of the formation in its full development in the type locality in the Southern Anthracite field.

According to Mr. White the thickness of the Pottsville in the Southern Anthracite basin is 1200 feet, in the Western Middle field 850 feet, and in the Northern field 225 feet. The published reports give it as 160 feet in thickness in the Broad Top basin and 65 feet in the Conemaugh gap. In the Uniontown region its thickness is 200 feet and in the western part of the State its general average is about 300 feet. Toward the south it increases steadily in thickness until on Kanawha River it exceeds the greatest measure known in the anthracite field.

From the evidence afforded by fossil plants, Mr. White proves conclusively that about the beginning of the Pottsville epoch an uplift occurred, which affected much of the Mississippi Valley. A large land area was formed that extended as far east as the Broad Top basin and the Northern Anthracite field. This land area persisted until at least 600 feet of Pottsville sediments were deposited in the Southern Anthracite basin. A subsidence then occurred in the western part of the State, which allowed the Sharon conglomerate and its associated coal group to be deposited, but presumably this area of sedimentation did not extend as far east as the Uniontown quadrangle, since the plants found in this region indicate that the bed first deposited is probably equivalent to the Connoquenessing sandstone.

At the close of the Sharon episode the land along the Allegheny Front apparently sank and unbroken sedimentation was resumed from the anthracite basins to the western edge of the bituminous field.

The lower sandstone bed exposed along Youghiogheny River is probably equivalent to the Connoquenessing sandstone of Beaver Valley; the shale and coal lying between the two plates of sandstone constitute the Mercer group; and the upper and more prominent sandstone is probably equivalent to the Homewood sandstone of the western part of the State.

The Lower Productive measures.

Allegheny formation.—The Allegheny formation overlies the coarse beds of the Pottsville, and its average thickness in this region is about 270 feet. This was formerly called the "Lower Productive measures," from the fact that most of the workable coal beds in the lower part of the series occur within it. More recently it has been referred to as the "Allegheny River series," but in this report it will be spoken of as the "Allegheny formation," so named from the river along which it outcrops in typical form. In the Uniontown and Masontown quadrangles it shows in outcrop only in the mountainous part, except in a narrow belt on the west side of Laurel Ridge. Along this belt its outcrop occurs in the valley at the foot of the ridge or on the steep slopes, and therefore frequently it is obscured by the sandstone débris from the Pottsville formation outcropping on the higher slopes of the ridge. In Ligonier Valley it is more generally exposed. Near the river it remains on some of the highest hills, but in the interior it forms the floors of most of the deep valleys, being deeply covered in the interstream areas by the Conemaugh formation, which lies above it.

In the previous survey it was recognized in the valley of Redstone Creek in the vicinity of Upper Middletown, but the evidence upon which this determination was made is not apparent. During the present survey this region was carefully investigated, but no trace of the undoubted Allegheny formation was discovered. It seems probable that the original determination was based upon the occurrence of a coal bed closely underlying a heavy sandstone. Since such a relationship is generally true of the Upper Freeport coal and the Mahoning sandstone, it was probably assumed that the measures below the sandstone belong to the Allegheny formation. This interpretation might be accepted were it not for the evidence afforded by a deep well that was drilled several years ago at Upper Middletown. In the record of this well, which is published on another page, the Pottsville is easily recognized at a depth of 430 feet below the surface. If the Allegheny formation outcrops along Redstone Creek, it must have a thickness of not less that 430 feet, but no such thickness is known in any of the outcrops, therefore the coal bed which has been assumed to be the Upper Freeport is presumably the Hager coal which lies about 160 feet higher in the series.

Details of beds and thicknesses in the Allegheny formation.

The individual beds of the Allegheny formation vary so greatly in character and thickness throughout the territory that no section can be regarded as typical of the region. One of the best exposures occurs at the mouth of Cucumber Run, in Stewart

Township. The full thickness of the formation is shown here, but some of the details are lacking, as shown in fig. 2. The coal beds are well exposed,

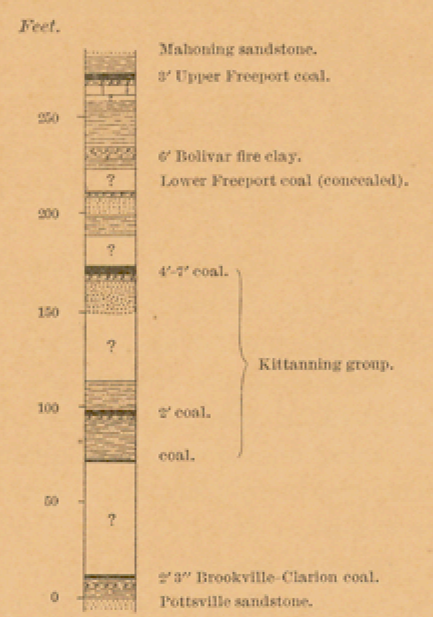


Fig. 2.—Section of Allegheny formation at mouth of Cucumber Run.

and in a general way may be correlated with the coal beds of Allegheny Valley, but it is doubtful if many of them occur at the exact horizon of the coals of the type locality.

Detailed section at mouth of Cubumber River, Stewart Township.

			Feet.
		Mahoning sandstone.	
		Shale ....0–10 feet.	
	1.	Upper Freeport coal	3
	2.	Clay	3
	3.	Freeport limestone	5
	4.	Concealed	4
	5.	Green shale and clay	5
	6.	Sandy shale	19
	7.	Bolivar fire clay	6
	8.	Green mudstones	5
	9.	Concealed	8
	10.	(Lower Freeport coal ?)	
	11.	Fire clay	2
	12.	Green sandstone	10
	13.	Sandy shale	10
	14.	Concealed (sandy shale)	15
Kittanning group.	15.	Coal	4-7
Kittanning group.	16.	Fire clay	3
Kittanning group.	17.	Coarse sandstone	18
Kittanning group.	18.	Concealed (sandy shale)	35
Kittanning group.	19.	Shaly sandstone	15
Kittanning group.	20.	Coal	2
Kittanning group.	21.	Fire clay	3
Kittanning group.	22.	Sandy shale	20
Kittanning group.	23.	Coal (thin)	
	24.	Concealed (shale)	60
	25.	Brookville-Clarion coal	2¼
	26.	Shale or clay	10
		Pottsville sandstone.	
		Total	267¼–270¼

The lowest coal in the Allegheny formation occurs generally within 20 feet of the top of the Pottsville sandstone. Through a misapprehension this bed was called by Professor Stevenson in his Fayette County report the Mount Savage coal, but this was corrected in a later report on Ligonier Valley, and the coal was called Brookville, from a coal bed occupying a similar position in the series in Jefferson and Clarion counties. Prof. I. C. White inclines to the opinion that the Brookville coal is not present in the southern part of Pennsylvania, or in Ohio and West Virginia, and therefore the coal in Fayette County within 20 feet of the Pottsville is probably equivalent to the Clarion coal of Allegheny Valley. Until full collections of fossil plants have been obtained from the various coal beds mentioned it is impossible to correlate them with certainty. This coal will therefore be called the Brookville-Clarion bed. It is probably present throughout this territory.

A thick bed of excellent fire clay sometimes occurs below the Brookville–Clarion coal. It reaches its best development along the west slope of Laurel Ridge, where it has been extensively dug for the manufacture of fire bricks.

In the middle of the Allegheny formation, as shown on Cucumber Run, there is a group of coal beds which undoubtedly occur at the Kittanning horizon, but it is extremely doubtful whether the individual beds correspond with the Upper, Middle, and Lower Kittanning coal beds of Allegheny Valley. In the Cucumber Run section the largest coal lies 100 feet below the top of the formation. Professor Stevenson considered this to be the Lower Freeport coal, but Professor White, in republishing the same section, called it the Upper Kittanning coal. The latter determination is certainly more in accordance with the facts, and in this report the coal is referred to the Kittanning group.

The Lower Freeport coal is not well represented in the Cucumber Run section. It is generally thin in Ligonier Valley, but west of Laurel Ridge it locally attains workable proportions.

The Upper Freeport coal is present throughout this territory wherever its horizon appears at the surface. Along the west side of Laurel Ridge it expands to a thickness of 15 to 16 feet, but the bed is badly broken by shale partings, as will be shown under the heading "Mineral resources." In searching for and indentifying coal beds the Upper Freeport limestone is an important key rock; it is well shown in the vicinity of Cucumber Run, and also at many other places in this territory.

The fire clays associated with the Freeport group of coal beds are well developed in Ligonier Valley. The Bolivar clay, occurring about 36 feet below the Upper Freeport coal, is well shown in the Cucumber Run section, and it is being dug at a number of points along Youghiogheny River between Ohiopyle and Indian Creek.

Although the individual members of this formation are extremely variable, the aggregate thickness seems to be remarkably regular throughout the territory. Professor Stevenson was under the impression that the Allegheny formation diminished rapidly in thickness near the West Virginia line on the west side of Laurel Ridge. His estimate of 125 feet was probably based upon the record of a deep well which was drilled at Hutchinson, about a mile southwest of the National Pike. The section of this well is as follows:

Record of deep well at Hutchinson.

		Feet.	
	Distance of well mouth below Pittsburg coal	180	
1.	Sandstone	18	
2.	Black shale	1	
3.	Blue clay	2	
4.	Limestone	9	
5.	Variegated shale	55	
6.	Sandstone	4	
7.	Shale	25	
8.	Hard sandstone	6	
9.	Shale, with limestone	39	
10.	Blue clay	2	
11.	Black shale	9	
12.	Hard sandstone	6	
13.	Shale	22	
14.	Coal	1	
15.	Shale	26	
16.	Limestone	5	
17.	Variegated shale	15	
18.	Sandstone	3	
19.	Shale	4	
20.	Sandstone	21	
21.	Black shale	12	
22.	Coal	6	
23.	Shale	6	
24.	Sandstone	13	
25.	Red shale	23	
26.	Conglomerate sandstone	6	
27.	Shale	5	
28.	Sandstone	14	
29.	Shale	3	
30.	Sandstone	8	
31.	Black shale	29	
	Thickness of Conemaugh formation		578
32.	Coal	8	
33.	Shale, with thin sandstone	30	
34.	Conglomerate	60	
35.	Shale, with iron ore	70	
36.	Coal	4	
37.	Shale	12	
38.	Limestone	47	
39.	Sandstone	15	
40.	Shale	16	
41.	Sandstone	17	
42	Shale	5	
43.	Coal	3	
44.	Black shale	25	
	Thickness of Allegheny formation		312
45.	Sandstone	2	
46.	Shale	20	
47.	Sandstone	18	

According to Professor Stevenson this well was begun about 180 feet below the Pittsburg coal, or at the horizon of the Morgantown sandstone. The particular item in the record which seems to have been the determining feature is No. 34, the so-called Pottsville conglomerate. If this identification is correct there is no interpretation possible except that which Professor Stevenson gave. But if it is conceded that this conglomerate may be the Freeport sandstone, then the section has an entirely different aspect and agrees with other data in the surrounding region.

If No. 34 is regarded as Freeport sandstone, then No. 32 becomes the Upper Freeport coal bed, and the Conemaugh series lying above it has a thickness of 578 feet. The members lying below this coal bed are not easy to identify, for the reason that the section does not extend deep enough to show any stratum having distinctive characteristics. It seems probable, however, that the driller stopped operations after his drill had entered a few feet into the Pottsville formation, and hence the last item, or possibly the last three items, should be considered as belonging to that formation. If that is granted, the Allegheny formation has, according to this record, a thickness of 312 feet, which agrees very well with measured sections in adjacent territory. According to this record the total distance from the Pittsburg coal to the top of the Pottsville sandstone is 890 feet. According to the Smithfield well record, which is published on another page, the interval from the Pittsburg coal to the top of the Pottsville formation is 910 feet. The difference of 20 feet between these two sections is no greater than the possible error in the determination of the stratigraphic position of the well heads, therefore we may conclude that they are in practical agreement, and that the Hutchison well record, as thus interpreted, is in perfect accord with the Smithfield well record and with the general thickness of the Allegheny formation in the surrounding region.

Conemaugh formation.—The coal-bearing rocks of Pennsylvania were originally subdivided with reference to the coal beds which they contained. The Allegheny formation at the base was called the Lower Productive measures, because it contains a group of coal beds some of which are always of workable thickness. A group of coal-bearing rocks higher in the series was similarly termed the Upper Productive coal measures. Between these two principal coal-bearing horizons occurs a series of beds called the Conemaugh formation. It is composed of shales of varying colors and sandstone, with here and there small beds of coal. Occasionally these beds attain workable proportions, but such a stage of development is maintained only over a limited territory. The base of the formation is marked by the Freeport coal and the top by the Pittsburg coal, and the formation has an average thickness of about 580 feet.

Shales and sandstones between the Freeport and Pittsburg coals.

In Ligonier Valley the rocks of the Conemaugh formation are well exposed. They occupy the center of the valley, extending along the National Pike from Fayette Springs, or Chalk Hill, to near the western line of Henry Clay Township. The upper part of the formation has been eroded from this region, leaving as a maximum only 200 to 300 feet of strata in the center of the basin. The formation is trenched by many of the larger streams to a depth which exposes the workable coals of the Allegheny formation.

West of Laurel Hill the folds in the rock have exposed this formation in wide bands of outcrop across the quadrangles. In the great Uniontown syncline, or southern end of the Connellsville basin, as it is more commonly known, the Conemaugh formation shows from the Pittsburg coal crop outward. Owing to the relatively steep dips on the east side of the syncline, the Conemaugh formation outcrops in a narrow belt along the valley at the foot of Laurel Ridge. On the west side of the syncline the formation is exposed in a broad belt as it laps up over the arch of the Fayette anticline. On the National Pike this belt has a width of about 3 miles. It narrows irregularly southward until in the vicinity of Woodside the Pittsburg coal is almost continuous across the arch, and the outcrop of the Conemaugh formation is limited to the deep ravines. From this point south the formation is widely exposed in the valley of George Creek and around the southern extremity of the Uniontown syncline.

One of the most important members of the formation is the Mahoning sandstone, which occurs at its base and which overlies the Upper Freeport coal. This sandstone is generally coarse and frequently conglomeratic. It is not always present, but in its best development it has a thickness of from 20 to 60 feet. In some places it is replaced by sandy shales, and therefore is not always a reliable guide to the stratigraphy.

About 200 feet above the base of the formation occurs a sandstone which in some localities develops into a very prominent bed of massive sandstone or conglomerate. This was named by Professor Lesley the Saltsburg sandstone, from its great development at the town of that name, on Kiskiminitas River. In the Connellsville quadrangle, which lies due north of Uniontown, this sandstone is of so much importance that it has been mapped separately as a lentil in the Conemaugh formation. It is not prominent, and probably not everywhere present, in the Uniontown and Masontown quadrangles, and at the time they were surveyed it was not deemed of sufficient importance to be shown on the geologic map.

Between the Saltsburg and Mahoning sandstones there is a horizon of black fossiliferous limestone which was used as a key rock by Professor Stevenson in his survey of this region. This limestone is variable in thickness and composition and can be used as a guide only in connection with other members of the formation.

The Morgantown sandstone is another prominent member of the formation. It occurs about 150 feet below the Pittsburg coal, and is generally persistent over the territory. In these quadrangles it is probably more prominent than any of the other sandstone members, but farther north it is outranked in places by the Saltsburg sandstone, previously described. The Morgantown sandstone varies in thickness up to a hundred feet. It is generally present, but sometimes appears to be replaced by sandy shales and thin-bedded sandstones. From 30 to 40 feet below the Morgantown sandstone occurs a thin band of green crinoidal limestone which also was extensively used by Professor Stevenson in stratigraphic determinations. It is a thin bed and in many places it is difficult to find its line of outcrop. Presumably it is variable in its occurrence and should be used only in connection with other beds in determining the stratigraphy of the section.

From 30 to 40 feet below the Pittsburg coal occurs the Connellsville sandstone, which is fairly well developed in this region and in the neighborhood of the city of Connellsville, from which it derives its name. It probably never reaches the thickness attained by the Morgantown or Saltsburg sandstone, and probably it is absent over a much greater territory than either of the other beds. It is not particularly valuable as a horizon marker because the Pittsburg coal bed, which lies so close above it, can generally be identified without the aid of other beds.

Monongahela formation.—The Monongahela formation overlies the rocks of the Conemaugh in the synclinal troughs west of Laurel Ridge. The formation has been called the Upper Productive coal measures, from the fact that it contains most of the workable coal of the upper part of the coal-bearing series. In this region it has a fairly constant thickness of from 370 to 400 feet.

Calcareous shales, sandstone, and limestone beds from the Pittsburg to the Waynesburg coal.

Its base is everywhere well marked, consisting as it does of the great Pittsburg coal bed, which is extensively worked over most of this territory. The upper limit of the formation is not so clearly defined. According to general usage it is at the top of the Waynesburg coal, which is supposed to agree also with the base of the Waynesburg sandstone. Unfortunately this sandstone is not always present, at least as a recognizable bed, and the coal varies so in thickness that it is sometimes impossible to identify it with certainty.

In previous surveys of the region the measures above the Waynesburg coal (Dunkard formation) were not identified in the Uniontown basin except in a very few areas. The basin was supposed to be too shallow to contain these upper rocks. Since that time the great development of mines has shown that the basin is much deeper than formerly was supposed, and that the Waynesburg coal and the measures above it are present in an area of almost unbroken outcrop from Uniontown to the north line of the quadrangle. There is also a small area of these rocks extending southwest from Uniontown as far as Chadville.

Without the data furnished by the extensive developments of recent years it would have been impossible to say with certainty whether the Waynesburg coal is present in this basin or not. The coal is of medium thickness, but under present conditions it is of no commercial importance. The interval between it and the lower recognizable beds seems to be variable, and the Waynesburg sandstone, which is supposed to overlie the coal bed, is generally absent, being replaced by sandy shales and thin sandstones.

In the next synclinal trough to the west the outcrop of the Waynesburg coal is much more extensive than formerly was supposed. This fact was developed also through mine shafts and drill holes which recently have been sunk in the basin. In parts of the trough the Waynesburg sandstone is well developed and the top of the Monongahela formation can be determined with great accuracy; but in many localities the sandstone is either poorly developed or entirely replaced by finer material, and it is only with difficulty that the coal can be separated from other beds of the series.

The trough extends as far west as Merrittstown, in the northern part of the quadrangle. Beyond this point the rocks are nearly flat, and the Waynesburg coal occurs well up toward the tops of the hills in the great bend of Monongahela River between East Riverside and Brownsville. Here the Waynesburg sandstone with its underlying coal is well developed, hence the determination of the upper limit of the Monongahela formation is easy. The river does not cut deep enough to expose the base of the formation except in the extreme northwest corner of the quadrangle, where the rocks begin to rise over the Bellevernon anticline, the axis of which is located beyond the margin of this territory. Above Rices Landing the Pittsburg coal, which is at the base of the formation, is about 100 feet below water level. South of East Riverside its depth increases, reaching about 200 feet at the mouth of Middle Run. Above this point the coal rises gradually and appears at water level about the mouth of Cats Creek. South of Cats Creek the coal rises steadily, until it is more than 300 feet above water level at the southern margin of the quadrangle.

In Greene County the Monongahela formation is present along the river bluffs from Rices Landing to the mouth of Whiteley Creek. South of the latter point it spreads in a wide, irregular band of outcrop that extends to the southwest corner of the quadrangle.

The rocks of the Monongahela formation are varied, but on the whole they are prevailingly calcareous, and in this respect differ materially from the formations previously described. The formation contains locally heavy beds of sandstone, which, together with the coarse overlying Waynesburg sandstone, preserve it from very rapid erosion, and consequently its soft rocks have no appreciable effect on the topography.

From an economic standpoint the Pittsburg coal, at the base of the formation, is its most important member. It will be described, together with other coals of the formation, under the heading "Mineral resources." This coal is usually overlain by shale, sometimes fine and argillaceous, but more commonly stiff and sandy. In the western part of the Masontown quadrangle the shale is replaced by a very massive sandstone, which in many places attains a thickness of 50 feet. This bed appears to be limited to a narrow belt of country extending due north and south through the eastern edge of Greene County and Luzerne Township of Fayette County.

Lithologically the most important member of the formation is the Great limestone, which in places attains a thickness of 140 feet and occurs about 120 feet above the Pittsburg coal. This bed is variable in composition and is never solid limestone. Frequently it may be divided into an upper and a lower division, separated by shales and sandstones. The lower division probably has an average thickness of from 60 to 80 feet, and it is generally composed of alternating bands of limestone and calcareous shale. In places there are beds of solid limestone 10 or 12 feet in thickness, but such occurrences are rare. The limestone beds are usually less than 2 feet thick, but they are generally irregularly bedded and not good for quarrying purposes. The Great limestone is particularly well developed in the northwest corner of the Masontown quadrangle, where it is exposed in all of the ravines leading down to the river. It is generally present over the territory west of Laurel Ridge wherever its horizon is exposed to view.

Dunkard formation.—All of the rocks lying above the Waynesburg coal have been grouped into one formation and named from Dunkard Creek, along which they show in outcrop throughout most of its course. The original thickness of the formation is not known. Undoubtedly much of it has been eroded even from the highest hills. That which remains has a maximum thickness of about 1100 feet. This thickness is reached in the southern part of Greene County, Pa., west of the border line of this territory. The thickest section in the Uniontown and Masontown quadrangles is in the Lambert syncline, where about 400 feet of the Dunkard formation are exposed above the Waynesburg coal.

Shales and limestones above the Waynesburg coal, comprising the highest member of the Pennsylvanian series.

East of Monongahela River, exposures of the Dunkard formation are limited mainly to the synclinal troughs previously described. In the Uniontown basin the Waynesburg sandstone is poorly developed, but from the shaft section of the Leisenring No. 3 mine the measures above the Waynesburg coal are found to have a thickness of 200 feet. Since the surrounding hills rise somewhat higher than the mouth of the shaft, the total thickness remaining in this trough is not far from 300 feet. In the Lambert syncline, in Redstone and German townships, occurs the greatest thickness of the Dunkard formation known in these quadrangles. According to the section shown in the Lambert shaft there are 243 feet of these rocks above the Waynesburg coal. This, added to the height of the hills above the mouth of the shaft, will probably give a total of about 400 feet.

In Luzerne Township, west of this syncline, the remaining portion of the Dunkard formation is thin, probably not exceeding 150 feet in thickness at any point.

In Greene County most of the high land is composed of rocks of this formation. They are cut through in many places by streams, and toward the south the rise of the strata carries the Waynesburg coal so high in the hills that only a small part of the Dunkard formation remains. The thickest section in Greene County is at Turkey Knob, where about 300 feet of the measures are exposed.

The composition of this formation is not very different from that of the Monongahela formation. Limestones are not so abundant, but they are scattered at intervals throughout the formation. A number of coal beds are known in the Dunkard formation, but none of them reach the importance of the coals of the subjacent series.

One of the most important members of the formation is the Waynesburg sandstone, which occurs at its base. This bed is fairly persistent, but it can not be depended upon with absolute certainty. It is usually very coarse and sometimes conglomeratic, but the pebbles are always small and not particularly prominent. It is generally massive, and frequently shows in a line of cliffs along the ravines and river bluffs.

The most important coal bed, the Washington, occurs about 140 feet above the base of the formation. As seen in natural outcrop it appears to be a large and valuable bed, but it is so broken by shale partings as to be nearly worthless. From 40 to 50 feet above the coal bed occurs a series of shales and sandstones in which the latter predominate. These are rather prominent in Greene County, and form most of the high land about Turkey Knob and vicinity.

One of the best horizon markers in the formation is the Upper Washington limestone. This bed is generally present and easily identifiable in parts of Greene and Washington counties, but it is doubtful whether it can be recognized in the Lambert basin of Fayette County.

As a rule the Waynesburg coal closely underlies the Waynesburg sandstone. Occasionally, however, the coal and sandstone are separated by lenses of shale which are crowded with impressions of ferns and other plants that flourished in the Carboniferous swamps. These have been described by Prof. I. C. White as having a Permian aspect, and upon the strength of this evidence he regards the Dunkard formation as of Permo-Carboniferous age. Recent studies of the fossil plants by David White lead to the provisional conclusion that the beds below the Upper Washington limestone are certainly of Carboniferous age, but those above that stratum may belong to the Permian system. Since the Upper Washington limestone was not identified east of Monongahela River the separation of the Permian was not attempted on the geologic maps of this folio.

PLEISTOCENE ROCKS.

Carmichael clay.—After the deposition of the highest rocks of Carboniferous age this region was elevated above sea level, and since that time it has been continuously a land area. Rock material has constantly been removed from the surface throughout this long period of time, and no deposition took place except during the latest period of geologic history, when local deposits were laid down in the abandoned channels of Monongahela River. These channels were obstructed, and in the ponded water back of the obstruction, clay, sand, and gravel were deposited to depths of 60 to 80 feet. As the valley was originally occupied by an active stream the lowest materials are always coarse and well rounded. Above this layer of bowlders the succession of material varied from time to time with no apparent regularity. At times the water appears to have been still, and in it was laid down exceedingly fine and laminated clay; at other times fairly strong currents seem to have prevailed, and sand and coarse material were brought in. Large bowlders were carried in and dropped in the midst of fine deposits, and trees and other vegetable matter were washed down and buried in this accumulation.

River deposits in abandoned channels.

The material laid down at different points in the valleys is generally of similar composition, but in places there are local deposits that differ from the ordinary filling. About a mile and a half southeast of New Geneva there is a deposit of very fine white clay which has been used for pottery purposes. Similar clays were seen at other points, but no extensive deposits were noted. At Carmichaels a log of wood is reported to have been taken from the clay at a depth of 40 feet from the surface.

The abandoned channel at Carmichaels may be considered as a type, since it is one of the most striking examples in the region, and also since the distribution of the sediments affords positive evidence of the conditions which led to its abandonment. The rock floor of this channel has an altitude of about 920 feet above sea level. Clay and sand fill the valley to a depth of 60 or 70 feet, and the gravel and fine silt extend up the sides of the valley to a height of 160 feet above its rocky floor. This condition prevails from the upper end of the valley, near Hatfields Ferry, to about 2 miles below Carmichaels, except that near the former locality the filling has been largely removed by Little Whiteley Creek. About $1\frac{1}{4}$ miles below Carmichaels the valley filling stops abruptly, and below that the remaining portion of the rock floor on the east side of Muddy Run is covered by only a thin coating of river gravel. It seems certain that this part was never silted up, for if it had been so buried there would be traces remaining upon the broad platform that exists on this side of the creek. The abrupt termination of the valley clay seems to mark the location of the barrier that ponded the stream and forced it to seek a new outlet along its present course. This barrier has disappeared, leaving no trace of its existence save the change in character of the material that is now found in the valley. That the channel below the site of this old dam is preserved in the same condition as it was when occupied by the active stream is proof that no ponding occurred below this point subsequent to the formation of the dam.

During the existence of these ice dams the river water must repeatedly have flooded the valleys of the tributary streams, and deposition undoubtedly occurred. Some of these deposits have been recognized and mapped, but many of them doubtless have escaped detection. Since the rejuvenation of the drainage of the region erosion has been very active, and the soft material deposited in the narrow valleys has been largely removed, or at least so cut away as to leave only small areas remaining.

Dunbar Creek has an abandoned channel at Sitka, near its junction with Youghiogheny River, which is similar to the larger valleys of Monongahela River. The stream that occupied it was a rapid mountain torrent, and consequently the material filling it is generally coarse and well rounded.

No other examples of drainage modifications occur in this territory, but at Ohiopyle, just east of the eastern margin of the quadrangle, Youghiogheny River formerly flowed across the narrow neck of the peninsula on the line now occupied by the Baltimore and Ohio Railroad. In this case the stream abandoned a direct course, not over a quarter of a mile in length, and chose a circuitous route around the bend, about 2 miles long, to reach the same point. Its former course is marked by a deposit of rounded bowlders and sand of about the same degree of coarseness as the material transported by the stream to-day. This change of drainage is very peculiar and apparently can be explained only on the hypothesis of a local dam across the neck of the peninsula. There is, however, no direct evidence of the existence of this dam.

The age of these valley fillings may be determined approximately by comparing them with similar features on Allegheny River. Allegheny River is not marked generally by abandoned channels, but its valley is characterized by well-developed rock terraces which merge with the abandoned channels of Monongahela River at Pittsburg. Upon these rock shelves occur great deposits of gravel that were brought down during an early (Kansan?) ice invasion. Since these deposits were laid down the modern gorge has been cut, and it has been partially filled by gravel of the last (Wisconsin) ice invasion.

Since the sequence of events has been approximately the same for both streams, the epoch during which the old channels of Monongahela River were abandoned and new ones cut apparently marks the first great ice invasion in the East, and this probably corresponds with the Kansan stage of the Mississippi Valley.

The duration of arctic conditions at the time of this first ice invasion must have been very great, for it permitted the stream to cut a number of new channels and broaden them to an appreciable extent. This is well illustrated by some abandoned channels back of Bellevernon, which is situated on Monongahela River about 12 miles north of this territory. At this point the river not only abandoned its original channel, but its second position was vacated, leaving three parallel channels, with high land between. All of these channels, except that occupied by the stream at present, are broadened to a considerable extent and the hills bounding them on both sides are reduced to a gentle slope. This indicates a longer period of time than is usually attributed to an ice invasion.

The Kansan (?) invasion appears to have been terminated by a regional uplift which permitted the streams to cut their present gorges from 100 to 140 feet below their abandoned channels. Subsequently the Wisconsin ice sheet gave to the region a cold climate, but either the cold was not so severe as before or the streams were too deeply intrenched to be turned aside by ice jams, and consequently that epoch is not recorded by local changes in the course of Monongahela River.

Alluvium.—Most of the streams of this region have flood plains of varying width along their valleys. The valleys are not broad enough to allow of extensive deposits, but where these have reached their best development they are of mappable proportions and are indicated on the geologic sheet.

Bottom lands of the Monongahela, Youghiogheny, and their tributaries.

The most peculiar feature of the drainage of this region is that the flood plains of the large creeks are better developed than those of Monongahela River. This may be explained by the fact that the wider flood plains of the tributaries survive from a cycle preceding the latest uplift, whereas the river is in a new cycle and is still actively engaged in deepening its channel. This change has affected the lower courses of the major tributaries, but the upper courses still retain traces of their old broad valleys.

The small streams flowing down the western slope of Laurel Ridge have carried immense quantities of sand and gravel down to the foot of the mountain, where it is spread out in broad alluvial fans that conceal most of the underlying formations. No attempt was made to map these accumulations, but they are of considerable size and have a marked effect upon the value of the land for agricultural purposes.

Youghiogheny River and its tributaries show even less alluvial land than the other streams of this region. In its passage through Laurel Ridge the river is still actively engaged in cutting the solid rock in the bottom of its channel, and such flood plains as it has built are of very limited extent and are composed of coarse material. They are eroded and redeposited at every period of high water. After leaving the gorge through the mountain the stream has graded its channel and has built moderate flood plains along much of its course. The upper end of this flood plain shows in the northern part of the Uniontown quadrangle, but it does not extend up the river beyond the waterworks in South Connellsville.

MINERAL RESOURCES.

COAL.

Scope of the discussion.—In undertaking the present geologic survey of a region so well known as southwestern Pennsylvania, it was considered unnecessary to duplicate work previously done, except in so far as to test by modern methods the results obtained. The aim of the present workers is to devote most of their time to those features which received least attention in the previous reports. Under this general plan the geologic structure or lay of the beds, the detailed distribution of various kinds of rocks, including coal, and the physiographic history of the region have been studied carefully in the field and recorded on the maps, so far as was practicable. Detailed sections of coal beds and some other facts have been taken largely from the previous reports, which abound in such information. Special acknowledgment is due to Professor Stevenson for the data thus obtained.

Coal is by far the most important mineral resource of the Uniontown and Masontown quadrangles. All of the rocks occurring above the Mauch Chunk red shale are coal bearing, but the beds are much thicker and more abundant in certain parts of the series than in others. Formerly it was supposed that coal was limited to the rocks overlying the Pottsville formation, and the term Coal Measures was applied to them in contradistinction to the supposed barren strata below. Later this was found to be incorrect, but the term still clings in geologic literature. The extent of the bituminous coal field of Pennsylvania is shown in fig. 28, Illustration sheet.

MOUNTAINOUS REGION EAST OF UNIONTOWN SYNCLINE.

Mercer coal.—In these quadrangles the Pottsville is not an important coal-bearing formation, but between the two benches of sandstone there is usually a thin bed, the Mercer coal, that locally attains workable proportions. Along Youghiogheny River, where it is best exposed, this coal is extremely irregular, ranging from a few inches to 2 feet in thickness.

Mercer coal along Youghiogheny River.

So far as known it reaches its best development near the Wharton Furnace on Chaney Run. It was formerly used in the old furnace, but the poor quality of coke produced from it caused the mines to be abandoned long ago, and now it is difficult to obtain exposures which show its thickness and character. At an opening above the mouth of Braddock Run the coal shows a thickness of 4 feet, hence it seems probable that along the east face of the Chestnut-Laurel ridge in the vicinity of the National Pike this coal, although not adapted to furnace use, may have considerable value for general fuel purposes. In other parts of the field it is too irregular in thickness to promise much for future development, but local basins may be found in which the coal is of workable thickness.

At Wharton furnace.

The correlation of this coal bed with the Mercer horizon of Beaver Valley is based upon fossil plants which were obtained in railroad cuts along Youghiogheny River. The fossils are not abundant, but, according to David White, they are sufficient to establish the identity of the two horizons.

Brookville-Clarion coal.—Throughout this territory a coal bed of considerable importance occurs in the Allegheny formation within 30 feet of the top of the Pottsville sandstone. This was correlated by Professor Stevenson with the lowest coal bed of this formation in Allegheny Valley and named from it the Brookville coal. Prof. I. C. White is of the opinion that the Brookville bed is absent in the southern part of the State and that the coal bed mentioned above should be correlated with the Clarion, or the second coal bed above the Pottsville sandstone. Since the question can not be settled on stratigraphic evidence alone, it is deemed best, for the present, to refer the coal to the Brookville-Clarion horizon and trust that, in the future, fossil evidence will be obtained that will make a definite correlation possible.

The rocks in the lower part of the Allegheny formation are well exposed along Youghiogheny River in the vicinity of Ohiopyle, and the Brookville-Clarion coal has been opened at a number of places. It was formerly mined along the river road between the mouths of Meadow and Cucumber runs, but the mine was abandoned long ago and the coal is not now visible. According to report its thickness is about 2 feet 3 inches (sec. 1, fig. 3). It was also mined just below the forks of Cucumber Run,

Brookville-Clarion coal near Cucumber Run.

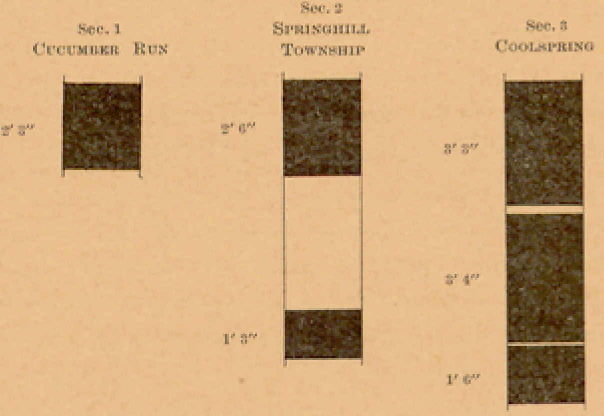


Fig. 3.—Sections of Brookville-Clarion coal.

but the mine has not been worked for a number of years and the coal is inaccessible.

On the opposite side of the river the coal bed at this horizon is reported to have a thickness of 4 feet, but since the openings have all been abandoned it is doubtful whether the coal is as thick as has been reported. The bloom of this bed may be seen in the Baltimore and Ohio Railroad cut just below Ohiopyle, but its thickness can not be determined. About 2 miles north of this point the coal outcrops on Bear Run, where it has a thickness of from 2 to 3 feet.

Throughout most of that part of Ligonier Valley which lies back from the river hills this horizon is below the surface and the coal is not exposed, but it shows in the valley of Big Sandy Creek below the southern line of the quadrangle. No measured section was obtained, but the coal is exposed in natural outcrop at a number of places in the roads, and the size of the bloom indicates that the bed is of workable proportions. Judging from a large bloom which was seen on the Chestnut-Laurel ridge south of this quadrangle, the coal at this horizon holds a fairly constant and workable thickness across the southern line of the Uniontown quadrangle.

Brookville-Clarion coal in Ligonier Valley, Big Sandy Creek.

On the east side of the Chestnut-Laurel ridge indications of coal at this horizon were seen at a number of places. Near the old Wharton furnace it has an apparent thickness of 2 feet and outcrops about 15 feet above the heavy conglomerate of the Pottsville formation. Recently the coal has been opened on the summit of Laurel Ridge east of Percy, but the face of the bed is not visible. Very little coal was seen on the dump, hence it seems probable that the bed is thin and unimportant. At this point it is associated with very valuable fire clay, which will be noted later in the general description of the clays of the region. From this point to the Dunbar furnace the coal has been opened in many places, but presumably it is thin, since all of the mines have been abandoned. On Dunbar Creek the thickness of the coal is only 18 inches. In the Youghiogheny gap through the Chestnut-Laurel ridge it is not known, but the outcrops are so concealed in the gorge that it would not be apparent unless special search were made.

Brookville-Clarion coal on the Chestnut-Laurel ridge, east side.

On the west side of the Chestnut-Laurel ridge the bed is thicker than in Ligonier Valley. In the early days of the iron industry the coal was extensively prospected near Cheat River, a few miles south of the boundary of the quadrangle, in connection with iron-ore deposits which occur near its horizon. The pits were abandoned long before the Second Geological Survey of the State was organized, but the section of the coal bed (sec. 2, fig. 3) is reported to be as follows:

Brookville-Clarion coal on the Chestnut-Laurel ridge, west side.

Brookville-Clarion coal near Cheat River, Springhill Township.

	Feet.	Inches.
Coal	2	6
Clay	3	0
Iron ore	0	6
Coal	1	3
Total	7	3

For some distance north the débris from the mountain completely covers this horizon and the coal is not exposed.

In North Union Township the Brookville-Clarion coal reaches its maximum development. During the operation of the Coolspring furnace east of Uniontown the coal was opened in connection with the development of a bed of iron ore. At this point the section (sec. 3, fig. 3) is as follows:

Brookville-Clarion coal near Coolspring, east of Uniontown.

	Feet.	Inches.
Clay shale.		
Coal	3	3
Clay	0	3
Coal	3	4
Clay	0	1
Coal	1	6
Total	8	5

This section probably represents this bed in its best development, for it is reported that in openings a short distance away the shale partings show a greatly increased thickness without a corresponding increase in the total thickness of the bed. The coal is said to make a good fuel, and it may be utilized when the more regular beds are exhausted.

Kittanning coal group.—There is considerable diversity of opinion regarding the classification of the coal beds of the Allegheny formation in the southern part of the State. In the Cucumber Run section, which may be regarded as the type, and which was published by Professor Stevenson in report KKK of the Second Geological Survey of Pennsylvania, there are six coal beds, as shown in fig. 2. Professor Stevenson called the coal, No. 15 in his report, the Lower Freeport, although it occurs at the abnormally great distance of 95 feet below the Upper Freeport horizon. He recognized the existence of the small coal bed No. 10, but he did not think it worthy of notice, although it is more nearly at the horizon of the Lower Freeport coal than is No. 15, and is apparently identical with a small coal bed on Meadow Run which he called Lower Freeport.

The type section of Kittanning coals on Cucumber Run.

In publishing this section (Bull. U. S. Geol. Survey No. 65, 1891, p. 116) Prof. I. C. White called No. 23 Lower Kittanning, No. 20 Middle Kittanning, and No. 15 Upper Kittanning. To No. 10 he applied the name Lower Freeport coal, but in the case of this bed as well as the Upper Kittanning he signified uncertainty regarding the identifications by inserting question marks after the names. In the present work the classification made by Professor White is adopted as better expressing the facts and also being in closer agreement with the type section of the Allegheny field than that proposed by Professor Stevenson.

On the road leading north from the mouth of Cucumber Run, on which the type section was measured the thickness of the Upper Kittanning coal could not be definitely determined, but from openings in the neighborhood its thickness is seen to range from 4 to 7 feet. In the same section the Middle Kittanning appears to have a thickness of about 2 feet, while the Lower Kittanning shows a very small bloom by the roadside.

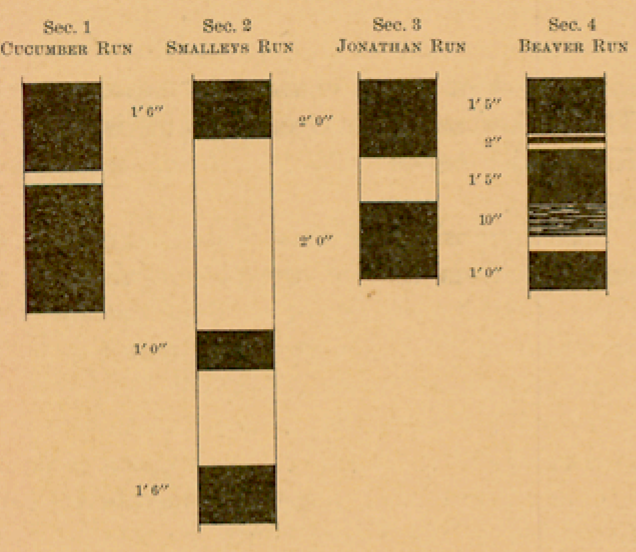


Fig. 4.—Sections of Upper Kittanning coal.

The thickness of the Upper Kittanning coal is shown in the following section, which was measured at the mine of Mr. R. Tharp, in the vicinity of Cucumber Run (sec. 1, fig. 4):

Upper Kittanning coal in vicinity of Cucumber Run.

	Feet.	Inches.
Coal	2	3
Clay	0	4
Coal	3	4
Total	5	11

At this point the bed is reported to be nearly 7 feet thick, but this could not be verified. The coal is extremely variable, as shown by comparison with the following section, which was obtained from an opening on Smalleys Run (sec. 2, fig. 4):

Upper Kittanning coal on Smalleys Run.

	Feet.	Inches.
Coal	1	6
Clay	5	0
Coal	1	0
Shale	2	6
Coal	1	6
Total	11	6

Toward the north the total thickness of the bed is not so great as on Smalleys Run, but the proportion of coal is greater, as shown by the following section from Jonathan Run (sec. 3, fig. 4):

Upper Kittanning coal on Jonathan Run.

	Feet.	Inches.
Coal	2	0
Clay	1	2
Coal	2	0
Total	5	2

In this valley the Middle Kittanning reaches workable proportions. According to report it is 3 feet in thickness in an old opening 65 feet below the outcrop of the Upper Kittaning bed. It also shows at the road crossing near the head of Jonathan Run, but its thickness could not be determined.

The outcrops of these coal beds were seen in a number of places in this region, but the prospecting had been done so long ago that the openings were generally closed and the coal inaccessible. On the headwaters of Haney Run two such old prospect pits were visible which appear to be located on the upper two coals of this group.

Upper Kittanning on Haney Run.

On Meadow Run the Upper and Middle Kittanning beds are exposed in a number of places. In a ravine on the east side of the run below the mouth of Beaver Run Professor Stevenson measured a section which extends from the Upper Freeport coal down for a distance of 135 feet. Twenty-nine feet below the Upper Freeport horizon is a small coal which presumably is identical with the small unnamed coal in his section on Cucumber Run, and which is here called the Lower Freeport. Eighty-five feet below the Upper Freeport horizon is a coal 5 feet in thickness which he classes as Lower Kittanning, although he figures it as lying directly below the Freeport sandstone, and undoubtedly corresponding with the heavy coal in the middle of the Cucumber Run section which he calls Lower Freeport. Forty-five feet lower in the series is a coal having a thickness of 3 feet 6 inches, which he designates Clarion, but which belongs somewhere in the Kittanning group, presumably corresponding to the Middle Kittanning coal bed.

Upper and Middle Kittanning on Meadow Run.

It does not seem probable that the lower members of the Allegheny formation come to light on Meadow Creek or on the lower part of Beaver Run, although Professor Stevenson identified a massive sandstone as the uppermost bed of the Pottsville. Presumably because of this identification he called the lowermost exposed coal the Clarion bed. On Beaver Run the Upper Kittanning coal has been mined about a quarter of a mile above Meadow Run. Only 4 feet of coal is now visible, but the bed is reported as having a total thickness of 5 feet 11 inches. The exposure a short distance farther up the ravine, which Professor Stevenson regarded as belonging to the Clarion coal bed, is presumably Upper Kittanning, although it shows a much more broken section than farther down the stream. The section of the bed at this point is as follows (sec. 4, fig. 4):

Upper Kittanning (?) coal on Beaver Run above Meadow Run.

	Feet.	Inches.
Coal	1	5
Clay	0	1
Coal	0	2
Clay	0	2
Coal	1	5
Bone	0	10
Clay	0	0-10
Coal	1	0
Total (average)	5	6

On Beaver Run at the crossing of the National Pike a coal supposed to be at the horizon of the Middle Kittanning, has been mined for local use. The section in the mine is as follows (sec. 1, fig. 5):

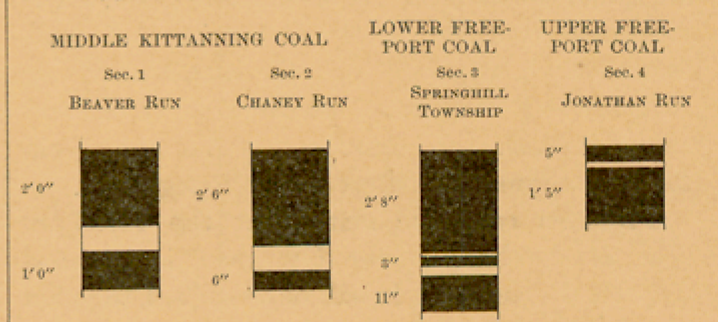


Fig. 5.—Sections of Middle Kittanning, Lower Freeport, and Upper Freeport coals.

Middle Kittanning coal on Beaver Run at National Pike crossing.

	Feet.	Inches.
Coal	2	0
Shale	0	8
Coal	1	0
Total	3	8

South of the National Pike the coal beds of this group soon pass beneath the surface, and they were not seen again in this quarter of the quadrangle. Owing to the northwestward dip of the strata, the Kittanning coals pass below water level on Meadow Run a short distance above the mouth of Beaver Run, and only the coals lying higher in the series outcrop on the headwaters of the stream.

On Chaney Run the Kittanning coal beds were well prospected during the time that the Wharton furnace was in operation. According to Professor Stevenson the Lower Kittanning coal was once mined below the furnace pits. At the entrance of the mine the coal showed a thickness of 6 feet, but under cover it averaged only about 4 feet. Thirty feet below this mine another coal was opened which furnished the following section (sec. 2, fig. 5):

Middle Kittanning coal on Chaney Run.

	Feet.	Inches.
Coal	2	6
Parting	0	6-10
Coal	0	6
Total	3	6-10

It is probable that these outcrops have been incorrectly identified, since no bed of this thickness is known below the Lower Kittanning coal. It seems more likely that the large bed in the vicinity of Wharton Furnace is the same as the large bed on Cucumber Run and consequently belongs to the Upper Kittanning horizon, and that the small bed 30 feet lower is the Middle Kittanning. The Upper Kittanning coal shows a thickness of 4 feet on the main head branch of Big Sandy Creek, near the road from Fayette Springs (Chalk Hill) to Wharton Furnace, but the small coal bed 30 feet below is not visible.

The Kittanning coal beds outcrop on Laurel Run in many places, but no openings were found at which their thickness could be determined.

North of the National Pike the country is largely uncultivated and the coal beds have been only slightly prospected. The rocks are generally nearly horizontal and not in good position to show their outcropping edges. No exposures of the Kittanning coals are known in the region west of Stewart Township.

Kittanning coal on west side of Chestnut Ridge.

On the west side of the Chestnut-Laurel ridge the Kittanning coals are poorly exposed and little information could be gathered concerning them. The great size of the Brookville–Clarion and Upper Freeport beds makes the coals of the Kittanning group appear insignificant by comparison. In South Connellsville the rocks of the Allegheny formation are partially exposed in the sidehill cutting along the Baltimore and Ohio Railroad. The large coal beds of the series were not seen in these exposures, but two small ones show in outcrop by the roadside. One of these seems to occupy the horizon of the Upper Kittanning coal. It is a thin bed, as shown by the following section:

Upper Kittanning (?) coal in South Connellsville.

	Feet.	Inches.
Sandstone roof.		
Coal	1	7
Shale	0	1
Coal	0	5
Total	2	1

Kittanning coals in Springhill Township.

Professor Stevenson states that somewhere in this vicinity a coal having a thickness of 4 feet is reported as occurring, but no definite location is given, except that it is below the horizon of the Upper Freeport coal. From this it seems probable that it belongs to the Kittanning group. He also says that a report is current of its presence in Springhill Township just south of the boundary line of the Masontown quadrangle. At this locality it is 65 feet below the Upper Freeport coal and its reported thickness varies from 3 to 4 feet. The Lower Freeport coal is also present; therefore it seems highly probable that the Kittanning coal is the uppermost one of the group bearing this name.

Irregular character of the Lower Freeport.

Lower Freeport coal.—Professor Stevenson, in his report on Fayette and Westmoreland counties, says that this is one of the most uncertain beds of the series. During the present work this statement was substantiated in every respect except that in Ligonier Valley the coal generally was found to be thin and worthless, whereas Professor Stevenson regarded it as varying from a few inches to 5 feet in thickness. In the opinion of the writer, this supposed variation is due to the misinterpretation of the section and the correlation of the Upper Kittanning coal with the small bed occurring at the Lower Freeport horizon.

In the Cucumber Run section the Lower Freeport has a thickness of only a few inches. On Meadow Run it is not known to exceed 1 foot in thickness at any point. In general, wherever this coal was found east of Laurel Ridge it holds the same characteristics, and presumably is a worthless bed everywhere within this territory.

West of the Chestnut-Laurel ridge the coal is somewhat thicker, but even here it is not a promising bed. It shows in Connellsville, Dunbar, and Springhill townships of Fayette County. The following section (sec. 3, fig. 5) was obtained at an opening in the last-mentioned township:

Lower Freeport coal in Springhill Township.

	Feet.	Inches.
Drab shale roof.		
Coal (high sulphur and ash)	2	8
Clay	0	1
Coal	0	3
Clay	0	3
Coal	0	11
Fire clay		
Total	4	2

The coal from the uppermost bench contains considerable sulphur and almost too much ash to be of any value. The outcrop described is located south of the boundary line of the Masontown quadrangle, and the bed occurs within 32 feet of the Upper Freeport coal.

Upper Freeport coal.—This coal bed is one of the most important members of the Allegheny formation in western Pennsylvania. It is generally persistent and thick, although frequently its great size is attained by the increased thickness of the shale partings which almost always divide it. In the Uniontown and Masontown quadrangles this coal bed is believed to be present wherever its horizon remains uneroded.

Upper Freeport coal in Ligonier Valley.

In Ligonier Valley it occurs throughout all of the deeper portion of the basin, extending from near the eastern line of Wharton Township to the end of Laurel Ridge, and in a northeast-southwest direction reaching beyond the limits of the quadrangle.

On the Uniontown Economic Geology sheet the "lay" of the Upper Freeport coal in this valley has been shown by means of contour lines representing the roof of the coal bed. These contours represent only the broad features of the geologic structure, not having been determined with sufficient accuracy to show the minor details which undoubtedly are present in the region.

Upper Freeport coal on Cucumber Run.

In the Cucumber Run section the Upper Freeport coal is poorly exposed, but it may be seen in adjacent localities, attaining a maximum thickness of 3 feet 6 inches. Generally in this region it appears to be too thin to mine under present conditions. The Freeport limestone is not exposed in the road, but its thickness and position may be obtained in a near-by quarry. An opening was seen on the Upper Freeport coal in one of the small head branches of Jonathan Run, near the schoolhouse which is situated on the road from Tharp Knob to Fayette Springs, and about a mile and a quarter west of the former locality. The coal was imperfectly exposed at this opening, but appeared to have a thickness ranging from 3 to 4 feet. It also shows as a large bloom in the same road near the crossing of the Wharton–Stewart township line. Its thickness in this locality is not known, but judging from the showing in the road, the coal probably maintains a thickness of about 3 feet throughout this territory.

Upper Freeport coal on Jonathan Run.

Near the mouth of Jonathan Run the coal has been opened at a number of places on the river hills, with a thickness of about 3 feet. The Freeport limestone, which normally occurs a few feet below the Upper Freeport coal, is also well exposed in this region, having been somewhat extensively quarried and burned with the coal obtained from the Upper Freeport mines. An exposure of the upper Freeport coal in this general locality gives the following section (sec 4, fig. 5):

Upper Freeport coal near mouth of Jonathan Run.

	Feet.	Inches.
Coal	0	5
Clay	0	2
Coal	1	5
Total	2	0

Upper Freeport coal on Meadow Run.

On Meadow Run, which enters the river at the southern point of the great bend, on the eastern margin of the quadrangle, the Upper Freeport coal is well exposed from the river hills to beyond the National Pike. The first opening seen is at the junction of the Farmington and Beaver Run roads. The details of the section could not be obtained from this opening, but the coal appears to have a thickness of from 4 feet 6 inches to 5 feet. On the east side of Meadow Run the coal ranges from 3 to 5 feet in thickness, and the Freeport limestone, with a thickness of 6 feet, outcrops at a distance of about 3 feet below the coal bed. The Upper Freeport coal approaches close to water level about 2 miles below the National Pike. The coal does not show at the crossing of the National Pike, consequently it passes below the bottom of the ravine somewhere between the forks of the creek north of Farmington and the pike. On the geologic map it is represented as disappearing near the forks of the creek, but it seems more probable that it should extend nearly to the pike before it passes below

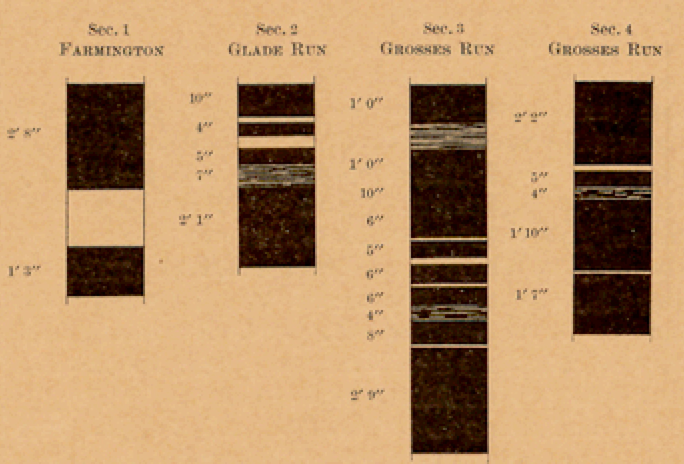


Fig. 6.—Sections of Upper Freeport coal.

water level, for it was formerly stripped from the bed of the creek a little distance south of the pike. In the vicinity of the first road crossing above the pike the coal has been opened in a number of places, but it is now generally inaccessible. Professor Stevenson, however, gives the following section (sec. 1, fig. 6), as measured at one of these mines:

Upper Freeport coal near Farmington.

	Inches.
Coal	30 to 36
Clay	18
Coal	12 to 18

The coal is reported as fairly good in quality, but it can not compete with the Pittsburg coal, even though the latter has to be hauled across the Chestnut-Laurel ridge from the vicinity of Uniontown.

Upper Freeport coal on the Laurel Hill anticline.

East of Farmington the rocks rise rapidly toward the Laurel Hill axis, and the Upper Freeport coal is carried close to the top of the hill near the eastern line of Wharton Township. Beyond this line the coal has been eroded from the National Pike over the broad arch of the anticline. There is a difference of opinion between Professor Stevenson and the present writer regarding the identification and extent of the coal beds in this region. According to the observations made during the present survey, the horizon of the Upper Freeport coal outcrops, as previously mentioned, below the crest of the hill overlying Beaver Run. This determination is not based upon an observed outcrop of the coal, this being concealed, but it depends upon the outcrop of the heavy beds of the Pottsville sandstone about a mile and a half north of the pike in the valley of Beaver Run. This seems to be undoubtedly Pottsville, and if such is the case the position of the Upper Freeport coal is fairly definitely fixed on the line of the National Pike. Professor Stevenson regards the coal which shows near the point where the National Pike crosses the head of Beaver Run as the Philson coal bed, which lies about 65 feet above the Upper Freeport horizon, and he also states that the Upper Freeport coal outcrops a mile and three-quarters farther east along the pike. From observations made during this survey it seems certain that the coal which Professor Stevenson classes as the Philson coal belongs to the Kittanning group, and that the Upper Freeport horizon is entirely above the pike in this portion of Henry Clay Township. The sections of the supposed Upper Freeport coal bed which Professor Stevenson measured in the headwaters of Beaver Run presumably do not belong to that horizon, but are the sections of a coal lower in the series—just what coal bed it is impossible to determine, for the description of the localities where it outcrops is not sufficiently defined to fix its horizon.

Upper Freeport coal in the southeastern part of the Uniontown quadrangle.

The Upper Freeport coal is not well exposed in the southeast corner of the Uniontown quadrangle; the country is generally wooded and little prospecting has been done. A large coal bloom that is supposed to occur at this horizon was seen in the road near the southern margin of the quadrangle and about a mile west of the Henry Clay Township line. Judging from the size of the bloom, the coal probably maintains a fairly good thickness throughout this region.

The Upper Freeport coal horizon is supposed to extend into the peculiar amphitheater-like valley at the head of Stony Run, but the country is so densely wooded that it was impossible to discover any outcrop. It is doubtless present, for south of the line of the quadrangle it has about the maximum thickness that it attains in Ligonier Valley in this quadrangle. At a point on Glade Run the following section (sec. 2, fig. 6) was obtained:

Upper Freeport coal on Glade Run.

	Feet.	Inches.
Coal		10
Shale	0	2
Coal	0	4
Shale	0	4
Coal	0	5
Bone	0	7
Coal	2	1
Total	4	9

Upper Freeport coal on Little Sandy Creek.

The Upper Freeport coal was once opened about one-half mile below Shinbone Alley, on Little Sandy Creek, with a reported total thickness of 9 feet. The Freeport limestone also has a thickness of about 9 feet in this locality, and when burned yields excellent lime.

Upper Freeport coal on Big Sandy Creek.

On Big Sandy Creek the Upper Freeport coal shows in outcrop from near Elliottsville to beyond the southern margin of the quadrangle. It also shows for one-half mile on Stony Run; but above Elliottsville a shallow syncline carries the coal below the bottom of the valley of Big Sandy Creek, and it does not reappear until near the head of the creek. On Stony Run the coal occurs immediately below the massive Mahoning sandstone, and the bed has a thickness of from 5 to 6 feet. It is very promising in this region, but a comparison of the various sections shows that the coal is extremely variable in section, and careful prospecting should be done before developments are undertaken.

The Upper Freeport coal outcrops along the Chestnut–Laurel ridge from the southern margin of the quadrangle to beyond the National Pike. Just below the mouth of Piney Run it has a total thickness of 5 feet, but the details of its structure are not known. Professor Stevenson gives some sections of the Upper Freeport coal which were presumably measured in this region. He states that on Grosses Run near the Clay pike the following section (sec. 3, fig. 6) was obtained at the mouth of a mine belonging to Mr. H. Seaton:

Upper Freeport coal on Grosses Run, at mouth of mine.

	Feet.	Inches.
Shale roof.		
Coal	1	0
Carbonaceous shale	0	8
Coal	1	0
Coal	0	10
Coal	0	6
Clay	0	1
Coal	0	5
Clay	0	2
Coal	0	6
Clay	0	1
Coal	0	6
Bony coal	0	4
Clay	0	0-½
Coal	0	8
Clay	0	1
Coal	2	9
Total	9	7-½

The variability of the coal is shown by the next section (sec. 4, fig. 6), which, according to the same authority, was measured in the same mine 20 yards from the opening:

Upper Freeport coal on Grosses Run, in mine, 20 yards from opening.

	Feet.	Inches.
Coal	2	2
Clay	0	2
Coal	0	5
Bony coal	0	4
Coal	1	10
Clay	0	1
Coal	1	7
Total	6	7

According to Professor Stevenson, the Upper Freeport coal occurs in the hills at the junction of Chaney Run with Big Sandy Creek. This is hardly possible, since the synclinal structure in this region carries the coal considerably below water level, and when it emerges toward the head of the creeks it is with a rather strong easterly dip, which if projected to the west would carry it high above the summit of the Chestnut-Laurel ridge. On Braddock Run the coal is badly broken by partings, the details of which are not known, but in a rough way the section is as follows:

Upper Freeport coal on Braddock Run.

	Feet.
Coal with shale partings	4
Coal	4
Total	8

Upper Freeport coal near Wiggins.

North of the National Pike coal openings occur near the Wiggins post-office. The coal could not be seen, but it undoubtedly belongs to the horizon of the Upper Freeport bed. About three-quarters of a mile northeast of the post-office a new mine has recently been opened on the hillside. This was not visited, but presumably the bed has a total thickness of 4 or 5 feet, and it is probably the Upper Freeport coal.

Upper Freeport coal on west side of the Chestnut-Laurel ridge.

On the west side of the Chestnut-Laurel ridge the Upper Freeport coal is exposed in a continuous line of outcrop across the quadrangle. In a general way it is thicker and more broken by shale partings at the south, but its local variations are so great that it can hardly be regarded as of much economic importance. During the existence of the old iron furnaces this bed was prospected extensively, but at present most of the mines are abandoned and it is now all but impossible to obtain a detailed section of the coal. During the progress of the previous survey many of these mines were accessible and a number of detailed sections were

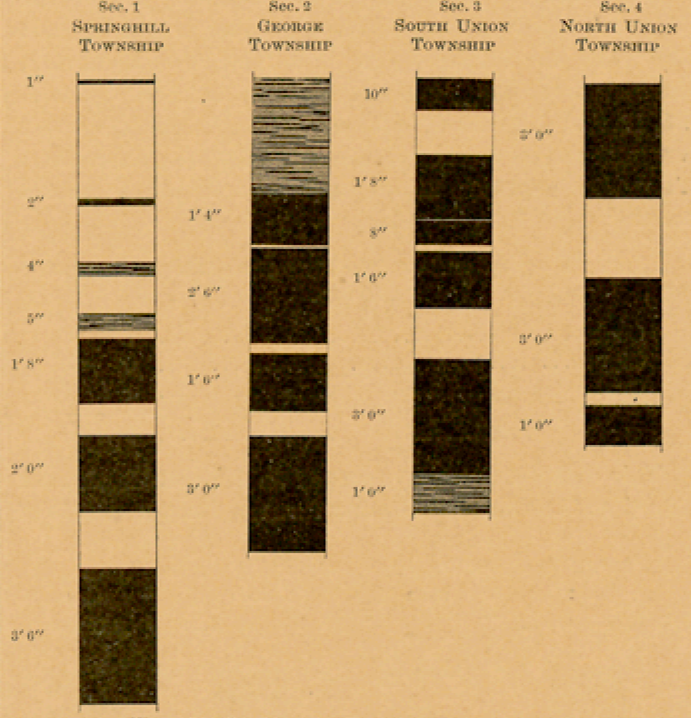


Fig. 7.—Section of Upper Freeport coal.

measured. The following section (sec. 1, fig. 7) was obtained at Jones's bank in Springhill Township:

Upper Freeport coal at Jones's bank in Springhill Township.

	Feet.	Inches.
Sandstone, Mahoning.		
Shale, 15 feet.		
Coal	0	1
Clay shale	3	0
Slaty coal	0	2
Clay	1	6
Coaly shale	0	4
Clay	1	0
Carbonaceous shale	0	5
Clay	0	3
Coal	1	8
Dark clay	0	10
Prismatic coal	2	0
Hard clay	1	6
Coal	3	6
Fire clay, 6 feet.		
Freeport limestone.		
Total	16	3

In George Township the Freeport coal shows a somewhat reduced aggregate thickness, but the details of the section are much the same as in Springhill Township, The following section (sec. 2, fig. 7) was measured at an opening on Black Creek (probably the same as Lowe Hollow) about a mile south of Fairchance:

The coal of the lowest bench is reported to be of good quality, but the bench is thin and consequently of not very great value. The aggregate of the bed is large, but it can hardly compare with some of the beds lying above the Pittsburg coal.

Upper Freeport coal on Black Creek south of Fairchance, George Township.

	Feet.	Inches.
Shale with streaks of coal	3	0
Coal	1	4
Clay	0	1
Coal	2	6
Clay	0	3
Coal	1	6
Clay	0	8
Coal	3	0
Total	12	4

In South Union Township the coal bed shows a still further decrease in thickness, but it maintains the character shown in all the sections so far given on the west side of the ridge. The following section (sec. 3, fig. 7) was obtained from an opening on the main head fork of Redstone Creek; the exact location of this mine is difficult to determine, but it probably lay west of Pine Knob.

Upper Freeport coal on main head fork of Redstone Creek, South Union Township.

	Feet.	Inches.
Coal	0	10
Clay	1	2
Coal	1	8
Clay	0	0–½
Coal	0	8
Clay	0	2
Coal	1	6
Clay	1	4
Coal	3	0
Coal and slate	1	0
Total	11	4

In North Union Township the Upper Freeport bed was formerly exposed at a number of places. The following section (sec. 4, fig. 7) is from an opening somewhere in the neighborhood of Hopwood:

Upper Freeport coal near Hopwood, North Union Township.

	Feet.	Inches.
Coal	3	0
Clay		2–48
Coal	3	0
Hard clay	0	4
Coal, worked	1	0
Total	7 ft. 6 in. to 11 ft. 4 in.	

As this is given on the report of another party it may not be reliable, but evidently the coal decreases in total thickness toward the north, and also its individual benches become thinner.

On Cove Run back of the old Lemont furnace the Upper Freeport was opened at a number of places years ago while the furnaces were in a flourishing condition. Its visible thickness is 3 feet 3 inches in three benches, 21, 12, and 5 inches in thickness, but the coal is not well exposed and its total thickness may be somewhat greater. A partial exposure at the mouth of Chestnut Hollow shows:

Upper Freeport coal on Cove Run at mouth of Chestnut Hollow.

	Feet.	Inches.
Coal	1	3
Clay	0	2
Coal	1	6
Total	2	9

This coal was formerly worked on Dunbar Creek near the site of the present Dunbar furnace, but the coal is of

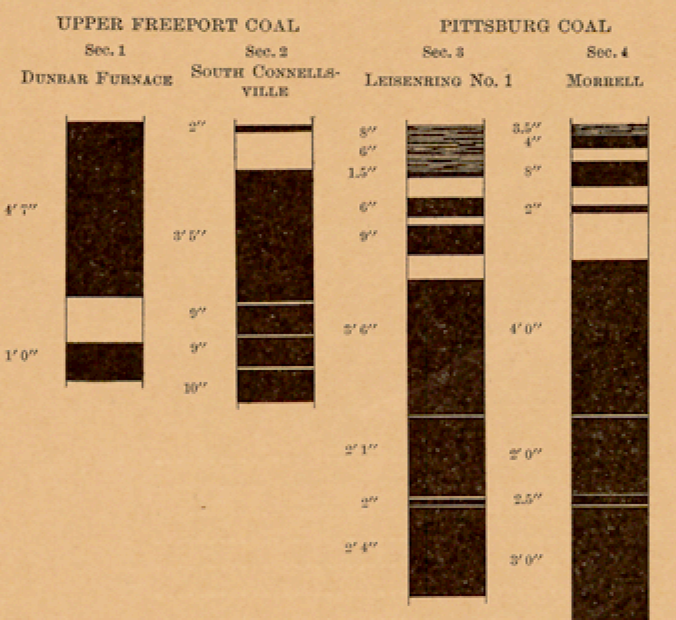


FIG. 8.—Sections of Upper Freeport and Pittsburg coals.

such inferior quality that the mine was abandoned years ago. The following is the section (sec. 1, fig. 8) at this place:

Upper Freeport coal on Dunbar Creek near the Dunbar furnace.

	Feet.	Inches.
Coal	4	7
Clay	1	2
Coal	1	0
Total	6	9

North of Youghiogheny River the Upper Freeport coal has been opened at a number of places on this line of outcrop. At one point in South Connellsville it shows the following section (sec. 2, fig. 8).

Owing to the excellence of the coal of this bed and to its coking qualities, it was referred by many to the Pittsburg horizon, but this is manifestly incorrect, and it clearly belongs to the Upper Freeport horizon. It is probable that most of the operations on this bed north of the river have developed only the largest bench, since an opening in Tramp Hollow shows a thickness of only 3 feet 6 inches.

Upper Freeport coal in South Connellsville.

	Feet.	Inches.
Coal	0	2
Shale	1	0
Coal	3	5
Bone	0	1
Coal	0	9
Bone	0	1
Coal	0	9
Bone	0	1
Coal	0	10
Total	7	2

Altogether the Freeport bed on the west side of Laurel Ridge holds an immense quantity of coal, but it is so broken by partings that under present conditions it is of little value. When the Pittsburg bed is exhausted and the smaller coal beds of the district are needed, the thicker benches of the Upper Freeport may be worked at a profit.

Farmington coal.—This coal is exposed on the National Pike at the little village of Farmington, from which it derives its name. In the report of Professor Stevenson on Fayette and Westmoreland counties it was correlated with the Philson coal that occurs about 135 feet above the Upper Freeport bed in Somerset County. In Fayette County the coal ranges from 40 to 90 feet above the Upper Freeport bed, and it does not seem at all certain that it corresponds with the Philson bed. For this reason the name previously used has been discarded, and the term Farmington, from a well-known locality in this region, has been adopted.

Farmington coal along and north of the National Pike.

On the National Pike this bed probably does not exceed 2 feet in thickness, and it has not been developed in the immediate vicinity of the type locality. One mile east of the village it shows for a short distance along the pike, where it was opened many years ago, but the entries are closed and the coal is not visible at the present time. On Meadow Run north of the National Pike it seems to be present, for its bloom was observed in a number of places, but it is generally thin and its exact section could not be determined at any point. Farther north it becomes more prominent, and on Jonathan Run it has a thickness of about 3 feet and is 70 feet above the Upper Freeport bed. Northeast of Youghiogheny River it holds about the same thickness and position for a considerable distance.

Farmington coal south of the National Pike.

South of the National Pike the bed has a greater development than in the region just described. On Stony Run it shows in outcrop in the vicinity of the road from Farmington to Elliottsville. No good sections were obtained, but its reported thickness is 5 feet 10 inches, with 5 or 6 inches of shale partings. On the northwestern side of Ligonier Valley, in the vicinity of Stone House, a coal that appears to occur at this horizon has been prospected in a number of places. It was seen on the head of Meadow Run about a mile east of Stone House, where the total thickness of the bed seemed to be about 4 feet, but the coal itself is not visible. In the valley of Dunbar Creek the Farmington coal appears to be thin and inconspicuous. It lies about 100 feet above the Upper Freeport coal, and does not exceed 2 feet in thickness. It also has been noted in North Union Township, but it is thin in this locality, not exceeding 18 inches. West of this locality it has not been noted. It may be present over a considerable territory, but if so it is too thin to attract attention.

Hager coal.—In the vicinity of Farmington the higher hills are encircled by the outcrop of a coal bed which occurs about 180 feet above the Upper Freeport horizon. It is well exposed in Hager Hill, on the south side of the National Pike, and from this fact it is here designated the Hager coal. In Professor Stevenson's report this bed was doubtfully identified with the Price coal of Somerset County, but the distance between these outcrops is so great that the correlation has little value, and it seems better to adopt a local name for this thin, though apparently persistent, coal bed. From an opening in Hager Hill the coal was found to have a thickness of about 3 feet. In the ridge south of this hill the coal has been extensively prospected. One of these prospect pits is located near the divide between Stony Run and Big Sandy Creek. It shows coal 2 feet in thickness overlying a thin bed of limestone. At an outcrop farther west, on the south side of the ridge, the following section was obtained:

Hager coal southwest of Hager Hill.

	Feet.
Shaly sandstone	4
Coal	3
Shale	3
Limestone.	

This coal bed doubtless outcrops in the higher hills in the center of the basin, but it was not observed at any other points south of the National Pike.

Presumably the land north of the pike is not high enough to carry the Hager coal except in a few isolated knobs, but in the vicinity of Youghiogheny River the pitch of the syncline carries all of the measures lower, and the upper coals appear in the high land north of Cucumber Run. In Tharp Knob the Hager coal has been opened on the east side of the ridge, where 4 feet of coal is now visible. From the size of the opening it seems as though the bed may have a thickness of 7 or 8 feet, but it is impossible to say whether this is all coal or whether the bed is broken by heavy shale partings.

Hager coal in Tharp Knob.

West of Laurel Ridge but little attention was given to the coals of the Conemaugh formation. The presence of the great Pittsburg beds and the other important coals of the Monongahela formation renders the thin beds lying below them comparatively insignificant.

About a mile northeast of Haydentown an old coal mine was observed which appears to be at the horizon of the Hager coal. The coal itself is not visible, but it is reported to have a thickness of about 4 feet.

Hager coal on Redstone Creek.

The coal which outcrops along Redstone Creek from Upper Middletown to Waltersburg, and which was mistaken by Professor Stevenson for the Upper Freeport coal, apparently belongs to the Hager horizon. The thickness of the coal is 3 feet, and it has been developed to some extent for local purposes. This is the only locality at which the Hager horizon is exposed west of the Chestnut-Laurel ridge.

COAL IN THE UNIONTOWN SYNCLINE.

Pittsburg coal.—The coal from this bed is so widely and favorably known as a first class steam, gas, and coking coal that it is not necessary here to give more than passing mention of its many excellent qualities and of its great value. It constitutes the greatest source of mineral wealth of southwestern Pennsylvania. Much of this coal bed, as originally formed, has been removed by erosion, but it still underlies large areas in this part of the State. Fig. 29 shows its areal extent and also the location of the Uniontown and Masontown quadrangles with reference to the coal fields. From this map it is seen that the western part of the Masontown quadrangle extends into the great field of Greene and Washington counties, while the Uniontown syncline is part of a long basin nearly isolated from the main body of the field.

General extent of the Pittsburg coal.

Extent and depth of the Pittsburg coal in the Connellsville basin.

At present the Pittsburg coal is the only bed worked on a commercial scale in these quadrangles, and by far the larger part of the mining operations is confined to the Uniontown syncline of the Connellsville basin. This portion of the basin extends from a little north of Connellsville, on Youghiogheny River, southwest to the vicinity of Smithfield. The canoe-like structure extends southward beyond the limits of this territory, but the canoe is very shallow south of Smithfield, and the Pittsburg coal is at such an altitude that it has been largely eroded, leaving only an occasional patch here and there upon the summits of the highest hills.

From Smithfield to the northern boundary of the Uniontown quadrangle the outcrop of the Pittsburg coal is unbroken, and many mines are located on it. The coal of this basin is regarded as the type coking coal of this country, but even within short distances there are variations in character between the coal on the eastern and western sides of the trough. In the early days of coke production in this region, only the coal from the eastern side was regarded as good coking coal, but this has been nearly exhausted, and now there is no distinction made between the coke produced in the various parts of the basin. As shown on the Economic Geology sheets, the trough-like structure of the basin is extremely regular, the coal extending from the surface, at an altitude of 1000 to 1200 feet above sea level, to the axis of the syncline, where it reaches a minimum altitude of less than 550 feet. The deepest part of the basin lies between Oliver and Monarch. From this central area the coal rises in all directions, gently along the axis and steeply toward the sides of the trough.

The first mines to be operated in this region were located on the southeast side of the syncline and were operated entirely from slopes driven down on the body of the coal. Many of these mines are still in operation, but the smaller ones are exhausted and most of the coal along the southeastern rim of the syncline has been removed. A few slope mines have also been established on the western margin of the syncline and several shafts have been sunk near the center of the basin. The most southerly of these shaft mines is the Leith mine of the H. C. Frick Coke Company. This is about a mile south of Uniontown, and reaches the base of the Pittsburg coal at a depth of 303 feet. Recently the Continental Coke Company has sunk a shaft about the same distance southwest of Uniontown, which reaches the coal at a depth of about 270 feet. About a mile north of Uniontown the Oliver Steel Company has two shafts on opposite sides of Redstone Creek. On the west side of the creek the base of the coal was reached at a depth of 303 feet, and on the east side at a depth of 416 feet. At Bute the Leisenring No. 2 air shaft shows a depth of 400 feet to the base of the Pittsburg coal, but the deepest shaft of the region is at Monarch, in the Leisenring No. 3 mine of the H. C. Frick Coke Company. This shaft shows a depth of 548 feet to the base of the coal. The Juniata mine is near the edge of the basin, and the coal is reached at a depth of 227 feet. A short distance east of this mine the Mayer shaft was sunk to a depth of 309 feet to the base of the coal. The Leisenring No. 1, of the H. C. Frick Coke Company, is nearly on the axis of the syncline and near the northern margin of the quadrangle. The depth at this point is only 370 feet to the base of the coal, but the difference between this depth and that given for Leisenring No. 3 is not all due to the rise of the coal northeastward toward the point of the syncline. The mouth of the Leisenring No. 3 shaft is at an altitude of 1131 feet, while that of Leisenring No. 1 is only 1002 feet above sea level. Beyond the northern boundary of the Uniontown quadrangle there are a number of shafts near the axis of the syncline, but the coal continues to rise, and none of the shafts are as deep as those of the Uniontown region.

Remnants in hills on the Fayette anticline.

In the northern part of these quadrangles the Fayette anticline carries the Pittsburg horizon so high that the coal has been eroded, but from near the center of the territory to the West Virginia line the anticline is low and the coal still remains in isolated patches on the summits of the higher hills. In these isolated areas the coal is considerably damaged by weathering, so that, as a rule, the larger coal and coke companies do not care to operate upon them, but they are capable of furnishing a large amount of valuable fuel, and in a number of places they are being utilized at the present time.

Thickness and partings of Pittsburg coal in Uniontown syncline.

The Pittsburg coal in the Uniontown syncline ranges from 8 to 11 feet in thickness, usually with only one small "bearing-in slate," about 18 inches from the floor, so that except in the northern end of the basin the characteristic partings and benches of the other districts are largely unknown. Frequently thin binders (one-quarter inch or less) separate the benches in the lower division. Its physical condition, also, is different in this basin from what it is in the main body of the coal to the west. It is generally soft, and during the process of mining it breaks up into rather small particles, coming from the mine in the best possible form for thorough coking. Its typical analysis, as determined by Mr. A. S. McCreath, from mines on Youghiogheny River, is as follows:

Typical analysis of Pittsburg coal from mines on Youghiogheny River.

	Per cent.
Water	1.260
Volatile matter	30.107
Fixed carbon	59.616
Sulphur	.784
Ash	8.233
Total	100.000

The average of a number of determinations made by the H. C. Frick Coke Company is as follows:

Average of several analyses of Pittsburg coal.

	Per cent.
Water	1.130
Volatile matter	29.812
Fixed carbon	60.420
Sulphur	.689
Ash	7.949
Total	100.000

The character of the bed is shown by the following sections, which were measured at some of the most important mines in the basin:

Pittsburg coal at Leisenring No. 1.

(Sec. 3, fig. 8.)

	Feet.	Inches.	Feet.	Inches.
Roof division:				
Bone coal	0	8		
Slate	0	½		
Bone coal	0	6		
Coal	0	1½		
Slate	0	6½		
Coal	0	6		
Slate	0	2¼		
Coal	0	9		
			3	4
Main clay parting			0	8
Lower division:				
Coal	3	6		
Slate	0	⅝		
Coal	2	1		
Slate	0	¾		
Coal	0	2		
Slate	0	½		
Coal	2	4		
			8	2⅞

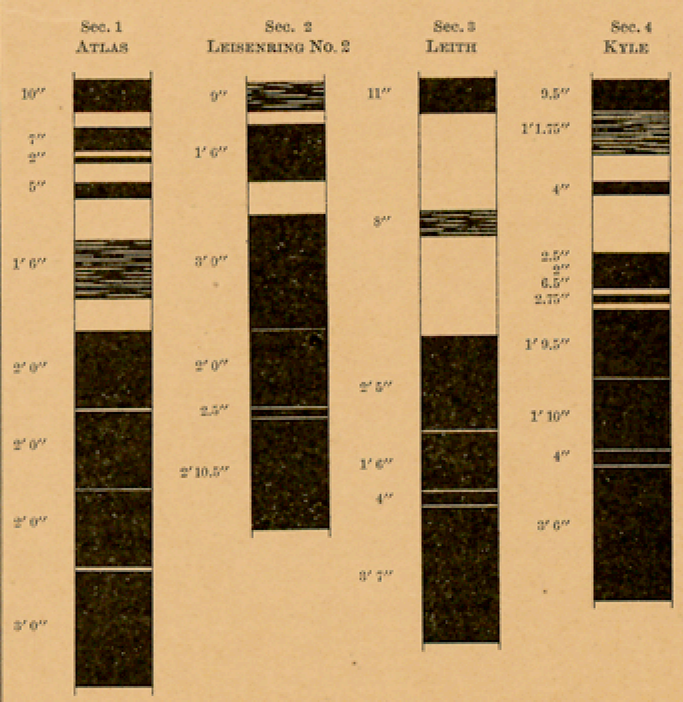


FIG. 9.—Sections of Pittsburg coal.

Pittsburg coal at Morrell mine.

(Sec. 4, fig. 8.)

	Feet.	Inches.	Feet.	Inches.
Roof division:				
Bone coal	0	3½		
Coal	0	4		
Slate	0	4		
Coal	0	8		
Slate	0	6		
Coal	0	2		
			2	3½
Main clay parting			1	3
Lower division:				
Coal	4	0		
Bone	0	1		
Coal	2	0		
Slate	0	½		
Coal	0	2½		
Slate	0	¾		
Coal	3	0		
			9	4¾

Pittsburg coal at Atlas mine.

(Sec. 1, fig. 9.)

	Feet.	Inches.	Feet.	Inches.
Roof division:				
Coal	0	10		
Slate	0	5		
Coal	0	7		
Slate	0	2		
Coal	0	2		
Fire clay	0	6		
Coal	0	5		
Slate	1	1		
Bone coal	1	6		
			5	8
Main clay parting			0	10
Lower division:				
Coal	2	0		
Bone	0	1		
Coal	2	0		
Bone	0	¼		
Coal	2	0		
Slate	0	1		
Coal	3	0		
			9	2¼

The variation of the roof division of this coal is shown by the following section (sec. 2, fig. 9), from the Leisenring No. 2 mine:

Pittsburg coal at Leisenring No. 2 mine.

	Feet.	Inches.	Feet.	Inches.
Roof division:				
Bone coal	0	9		
Slate	0	4		
Coal	1	6		
			2	7
Main clay parting			0	10
Lower division:				
Coal	3	0		
Slate	0	¼		
Coal	2	0		
Slate	0	½		
Coal	0	2½		
Slate	0	¼		
Coal	2	10½		
Limestone				
			8	2

Lemont.

The Lemont mines show the roof division to be 3 feet 7 inches in thickness, main clay 2 inches, and the lower division 8 feet 11 inches, broken by thin partings into four benches of 3 feet 5 inches, 1 foot 7 inches, 6 inches, and 3 feet 3 inches. The roof division at the Leith mine contains very little coal, as shown by the following section (sec. 3, fig. 9):

Pittsburg coal at Leith mine.

	Feet.	Inches.	Feet.	Inches.
Roof division:				
Coal	0	11		
Slate	2	6		
Bone coal	0	8		
Slate	1	8		
			5	9
Main clay parting			0	11
Lower division:				
Coal	2	5		
Slate	0	½		
Coal	1	6		
Slate	0	½		
Coal	0	4		
Slate	0	½		
Coal	3	7		
Fire clay				
			7	11½

The extreme variability and broken character of the roof division is probably best illustrated by the section (sec. 4, fig. 9) from the Kyle mine, which is as follows:

Pittsburg coal at Kyle mine.

	Feet.	Inches.	Feet.	Inches.
Roof division:				
Coal	0	9½		
Bone coal	1	1¾		
Slate	0	8½		
Coal	0	4		
Slate	1	6		
Coal	0	2½		
Coal	0	2		
Coal	0	6½		
Slate	0	2		
Coal	0	2¾		
			5	9½
Main clay parting			0	1¾
Lower division:				
Coal	1	9½		
Slate	0	½		
Coal	1	10		
Slate	0	½		
Coal	0	4		
Slate	0	½		
Coal	3	6		
Fire clay				
			7	7

Along the western margin of the basin the coal holds about the same character and thickness as on the eastern side and near the center of the field. The following section shows the bed in its outcrop in Franklin Township:

Pittsburg coal in Franklin Township.

	Feet.	Inches.	Feet.	Inches.
Roof division:				
Bituminous shale	0	4		
Coal	1	0		
Clay	0	4		
Coal	0	4		
Clay	0	6		
Coal	0	5		
			2	11
Main clay parting			0	8
Lower division, seen			7	0

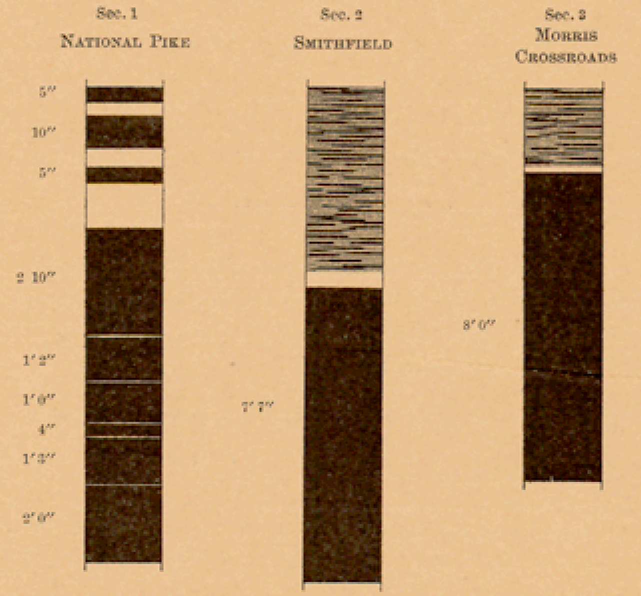


Fig. 10.—Sections of Pittsburg coal.

Pittsburg coal on National Pike.

On the National Pike (sec. 1, fig. 10) west of Uniontown the roof division has a thickness of 2 feet 6 inches, main clay parting 1 foot 2 inches, and lower division 8 feet 6 inches, with six bands 2 feet 10 inches, 1 foot 2 inches, 1 foot, 4 inches, 1 foot 3 inches, and 2 feet in thickness.

Pittsburg coal at Smithfield mines.

The main body of the Pittsburg coal in the Uniontown syncline ends at Smithfield, where several small mines have been established.* The bed section of the coal in this part of the basin resembles that already given, except that the thin partings in the lower division of the bed are irregular in their occurrence and sometimes are wanting near the southern boundary of this territory. This is shown in the following section (sec. 2, fig. 10) of the coal at one of the Smithfield mines: Roof division, 4 feet 9 inches, main clay parting, 5 inches, lower division 7 feet 7 inches.

South of Smithfield there are only isolated areas of Pittsburg coal in the highest hills between George Creek and the State line. A mine has been established at Outcrop, and a number of country banks have been opened in the vicinity of Morris Crossroads. The following section (sec. 3, fig. 10) was measured at the latter place:

Pittsburg coal near Morris Crossroads.

	Feet.	Inches.
Roof division	2	0
Main clay parting	0	2
Lower division	8	0
Total	10	2

Pittsburg coal near Cheat River.

The entire thickness of the lower division is not always removed, but generally coal to a thickness of 7 feet 6 inches is available. South of the boundary line of this quadrangle and near Cheat River the upper division has a thickness of 3 feet, main clay 2 inches, and the lower division 8 feet 4 inches. The lower division carries many clay and mineral charcoal partings. In mining the coal the roof division is never disturbed, and sometimes not all of the lower division is removed.

Coals above the Pittsburg.—In the Uniontown syncline there is considerable difficulty in identifying the coal beds above the Pittsburg horizon. Several of them which usually are persistent and regular are here variable in size, and in many places they are wanting altogether. The other rocks that are usually depended upon as horizon markers seem generally to lack individual characteristics by which they may be recognized. In that part of the basin which lies south of Uniontown the Waynesburg sandstone is fairly well developed, but north of Cove Creek it is doubtful whether this stratum can be identified at any point within this basin. The Great limestone is generally present, but its beds are thin and interstratified with calcareous shale, so that in many places it is difficult to differentiate them from the smaller beds that occur in other parts of the series.

The same difficulty of identification appears to have been encountered by Professor Stevenson in his survey of Fayette County, for he failed to recognize the Waynesburg coal throughout most of this basin, simply mapping a few isolated areas of the Dunkard formation, whereas, according to the mine data now available, it is known that the Waynesburg coal is present in a large area in the center of the basin, and that at the lowest point it has a depth of more than 200 feet below the surface.

North of Uniontown exposures of the coal beds above the Pittsburg horizon are poor, and it is practically impossible to obtain a correct idea of the thickness and position of these beds, but the various mine shafts which have been sunk in this district afford thoroughly reliable evidence regarding the character of the strata and their succession.

Redstone coal in Rogers's type section.

Redstone coal.—According to Prof. H. D. Rogers, who named and described this coal bed, its type locality is near Mount Braddock in this basin. He assigns to it a thickness of from 2 to 3 feet and gives the interval between it and the Pittsburg coal as ranging from 45 to 50 feet. From the section of the Lemont air shaft, which is shown on Columnar Section sheet 2, it will be seen that

Fig. 11.—Sections of Redstone coal.

there is no coal at the supposed horizon of the Redstone bed, but that the first coal above the Pittsburg horizon occurs about 80 feet above the floor of the Pittsburg coal. This may be regarded as the type section for the Redstone coal and for the rocks occurring in the interval between it and the Pittsburg bed. According to the shaft section, the Redstone coal has a thickness of 4 feet (sec. 1, fig. 11) but it is not known whether this is all clean coal or not. This coal is 3 feet thick (sec. 2, fig. 11) on the east side of the basin at Hill Farm, where it is reached in a bore hole 82 feet above the floor of the Pittsburg coal. In both of these sections the coal is closely underlain by the Redstone limestone, which has a thickness of from 11 to 13 feet. In passing to the west across the northern end of the basin the Redstone coal seems to diminish, for in the Leisenring No. 1 shaft it has a thickness of only 8 inches, but its associated limestone is present and it occurs at the normal distance of 80 feet above the base of the Pittsburg bed. At the Mayer shaft, which is located just west of Leisenring No. 1, the limestone is present, but the coal is wanting; the interval, however, holding practically the same, since the top of the limestone occurs 77 feet above the floor of the coal. In the Juniata shaft, which is still farther west, no coal is present at this horizon. The limestone also is doubtfully present, since no bed having the thickness of the Redstone limestone in the type locality shows in the section. Near the center of the basin the coal shows a normal development in the Leisenring No. 3 and also in the No. 2 shaft. But on the west side of the basin, at the Oliver mines, the Redstone coal has a very small development, as shown in the two sections representing the No. 1 and No. 2 shafts. South of Uniontown the coal develops rapidly, as shown by the following section (sec. 3, fig. 11), exposed in the Leith shaft at a distance of 86 feet above the floor of the Pittsburg coal:

Redstone coal at Hill Farm.

Redstone coal in Leisenring No. 1.

Redstone coal in Leisenring No. 2 and No. 3.

Redstone coal at Oliver mines.

Redstone coal in Leith shaft.

	Feet.	Inches.
Coal	3	0
Blue mold	0	3
Coal	2	4
Total	5	7

Redstone coal southwest of Uniontown.

Southwest of Uniontown the coal holds about the same relation to the Pittsburg coal that it does in the type locality. It has a thickness of 3 feet and occurs about 80 feet above the Pittsburg bed in three drill holes on the property of the Continental Coke Company.

Redstone coal in George Township.

In that part of the Uniontown syncline which lies in George Township the Redstone coal was seen at a number of places where it had been opened for local use and where it is exposed in the roadway. It is well shown in a crossroad about halfway between Brownfield and Oliphant Furnace. It was seen as a large bloom where the road from Fairchance to Highhouse crosses Muddy Run, and it is also well exposed on the west side of the syncline in the vicinity of Highhouse. It has been prospected in this locality, but the prospect pits have fallen shut and it is impossible to obtain measurements on the coal. About a mile north of this point it has recently been exposed in the cuts of the Pennsylvania Railroad east of Continental No. 3 mine. Its thickness at this point seems to be about 4 feet, but it is probable that the coal is mixed with much slaty material. This coal probably reaches its best development in the vicinity of Fairchance, where it is exposed in a number of places. At an opening over the Kyle mine it shows a thickness of from 4 feet 6 inches to 5 feet.

Redstone coal near Fairchance.

In the southern extension of the Uniontown syncline it is difficult to identify the coals above the Pittsburg bed. Throughout Springhill Township, or rather that part of Springhill Township which lies in the Masontown quadrangle, there is a large coal bed about 60 feet above the Pittsburg, which at one point Professor Stevenson identified as Sewickley and at another as Redstone. If the section is compared with that of the Lemont air shaft it will certainly appear that the coal bed at Morris Crossroads is at the Redstone horizon, and it is so considered in this report, but there seems to be good evidence that in the vicinity of Greensboro the interval between the Redstone and Pittsburg coal beds does not exceed 30 feet, therefore the coal in Springhill Township may represent either the Redstone coal or the Sewickley bed. It has a thickness of about 5 feet and it is well exposed in natural outcrop about Morris Crossroads and in the high land along the Point Marion and New Geneva road. In the latter locality it has been mined for local use, but the openings are closed and the coal is not visible at any point. It will not be used to any extent until the Pittsburg coal is exhausted, and then it probably will have been so disturbed by the breaking down of the roof of the Pittsburg coal that it will be valueless. The generally poor character of this bed renders its development highly improbable. As shown in some of the mine shaft sections, there is occasionally a small coal bed about halfway between the Redstone coal and the great Pittsburg bed below. This coal appears to be developed sporadically, and it is too thin to be of value commercially, but it seems probable that in places it has been mistaken for the Redstone coal.

Redstone or Sewickley coal in Springhill Township.

Coal between the Redstone and Sewickley horizons.—Above the Redstone coal bed and below the position of the Sewickley bed the shaft sections show a coal which has not heretofore been recognized or named. Its height above the floor of the Pittsburg coal varies from 118 to 142 feet. At no point does it reach a greater thickness than 2 feet, and in the Leith section it is entirely absent. It is probably not an important bed anywhere, but is one that may be easily confused with either the Redstone below or the Sewickley above.

Sewickley coal.—The mine shaft sections show the Sewickley coal bed in its proper position at the base of the Great limestone, and at a distance of from 153 to 177 feet above the floor of the Pittsburg coal. This bed is present in all of the sections except the Hill Farm bore hole, but it is hardly of commercial thickness in any of the sections except that of the Leith shaft, in which the coal has a thickness of 5 feet 3 inches (sec. 1, fig. 12). It was also found in a bore hole at the Continental No. 2 mine, at the head of Cove Lick Run. At this point it is reported to have a thickness of 5 feet and to occur 140 feet above the Pittsburg coal.

Sewickley coal at Continental No. 2 mine.

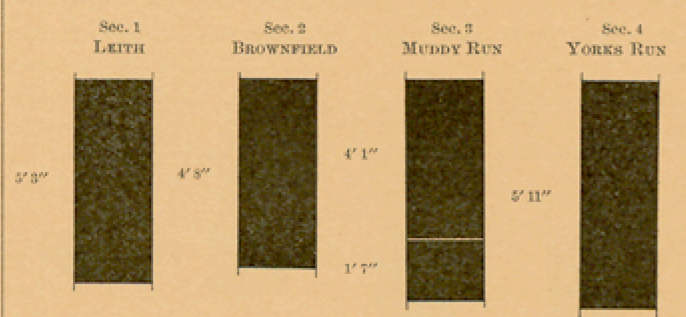


Fig. 12.—Sections of Sewickley coal.

Sewickley coal above the Redstone mine.

In outcrop the Sewickley coal bed was seen in a number of places. Above the Redstone mine at Brownfield it has a thickness of 56 inches, (sec. 2, fig. 12), and it was once operated for local use, but with the development of the Pittsburg bed beneath, mines on the Sewickley have almost all been abandoned. At this point it occurs under massive sandstone, which is a prominent feature of the region, but the sandstone is a local development and is not generally present over the coal. In the vicinity of Oliphant Furnace the Sewickley coal has been opened at a number of places, and it is at present being mined just west of the Uniontown and Fairchance road, on one of the head branches of Muddy Run. No measurements were obtained in this locality, but at an opening a little farther west it has the following section (sec. 3, fig. 12):

Sewickley coal near Muddy Run, north of Fairchance.

	Feet.	Inches.
Coal	4	1
Clay	0	½
Coal	1	7
Total	5	8½

Sewickley coal on Yorks Run.

On Yorks Run this bed has been opened in a number of places, but the openings are generally in such a condition that it is impossible to obtain a full measure of the bed. Near the head of the main fork of the creek an opening shows 5 feet 11 inches of coal (sec. 4, fig. 12), but the coal is soft and badly cut by many thin partings which greatly detract from its value. It is high in ash and contains considerable sulphur, and consequently is not greatly esteemed for fuel purposes.

Uniontown coal absent north of Uniontown.

Uniontown coal.—The absence of the Uniontown coal bed in the shaft sections is a noticeable feature. No shaft north of Uniontown shows a trace of coal at the horizon of the Uniontown bed, but south of that point, in the Leith shaft, a coal having a thickness of 4 feet 6 inches (sec. 1, fig. 13) is shown at a distance of 251 feet above the floor of the Pittsburg coal. This seems undoubtedly to be the Uniontown bed, but since it is not present in either shaft of the Oliver mines its disappearance must be very sudden in the Uniontown region. Professor Stevenson correlated the Uniontown coal with the small bed

Position of Uniontown coal in Leith shaft.

that shows on Cove Run near Hogsett. The development of the Oliver mines directly under this point shows clearly that this coal is at the Waynesburg horizon instead of the Uniontown, and the section of the Oliver

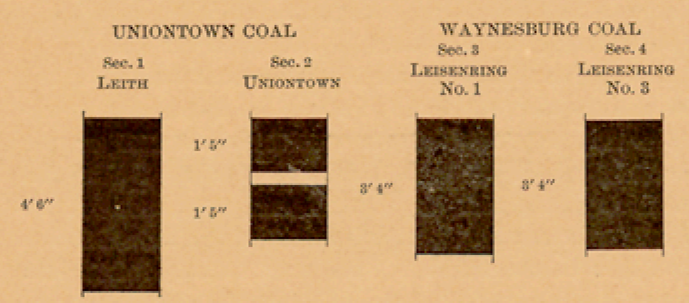


FIG. 13.—Sections of Uniontown and Waynesburg coals.

shaft also shows that the Uniontown coal is not present in that locality. At the type locality the Uniontown coal was once well exposed in the old cement quarries, where it had the following section (sec. 2, fig. 13):

Section of Uniontown coal in the old cement quarries, Uniontown.

	Feet.	Inches.
Coal	1	5
Clay and coal	0	2
Clay	0	2
Coal	1	5
Total	3	2

At the Poor farm, northwest of Uniontown, the coal shows a thickness of about 3½ feet, which is rather remarkable considering its absence from the basin a few miles to the north. It is also exposed by the roadside in the southwest corner of South Union Township, where 2 feet of coal are now visible. South of this point no good exposures of the Uniontown coal were seen, but small coal blooms at this horizon were noticed in a number of places; altogether the outlook is not promising in this direction.

Uniontown coal at Poor farm near Uniontown.

Waynesburg coal.—In all of the longer shaft sections a coal is given above the Great limestone, which, judging from its distance above the Pittsburg coal, belongs at the Waynesburg horizon. In the Hill Farm bore hole this coal has a thickness of 2 feet, and is 380 feet above the floor of the Pittsburg coal. In the Leisenring No. 1 shaft a coal which is probably the same bed has a thickness of 3 feet 4 inches (sec. 3, fig. 13), and is 333 feet above the bottom of the Pittsburg coal. If this supposed correlation is correct it is extremely interesting, since the two coals mentioned mark the limits of the Monongahela formation, and hence the intervals correspond with the thickness of the formation. In the Leisenring No. 3 shaft the coal has a thickness of 3 feet 4 inches (sec. 4, fig. 13), and is 335 feet

Thickness and position of Waynesburg coal with reference to Pittsburg coal.

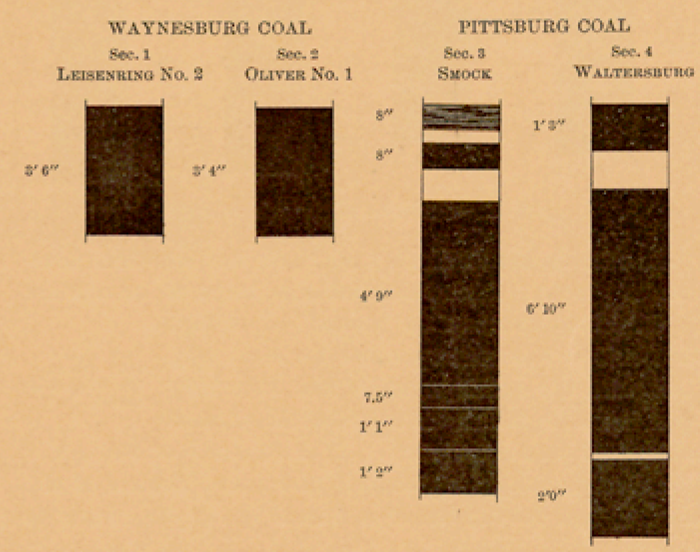


FIG. 14.—Sections of the Waynesburg and Pittsburg coals.

above the floor of the Pittsburg coal. In the Leisenring No. 2 shaft the thickness of the coal is 3 feet 6 inches, (sec. 1, fig. 14), and its height above the Pittsburg coal is the same as that just given for No. 3. In the Oliver No. 1 shaft the coal is slaty, but with a total thickness of 3 feet 4 inches (sec. 2, fig. 14), and a height above the Pittsburg coal of 342 feet. In general there is a close agreement in the position of this coal in the various sections except the Hill Farm bore hole. This increase suggests the thickening of the Monongahela formation toward the east, or in the supposed direction of the continental area from which the coal-bearing sediments were derived. South of Uniontown the Waynesburg coal shows in outcrop in a territory limited to the high ridge along the center of the syncline. The Waynesburg sandstone, which overlies the coal, is present along the Morgantown road from the hill south of Uniontown to the first forks of the road beyond Chadville. At this point the coal is seen in outcrop underlying the coarse Waynesburg sandstone. The outcrop of the coal is also observed on the road running northwest from Chadville near the township line, but the outcrop is merely a bloom by the wayside and the thickness of the bed could not be determined.

COAL IN FAYETTE COUNTY, WEST OF THE UNIONTOWN SYNCLINE.

Pittsburg coal.—On the western limb of the Fayette anticline the Pittsburg coal dips below the surface, and the northwestern half of the Masontown quadrangle is underlain by this bed. Its outcrop crosses the territory diagonally from Smock on the north edge of the quadrangle to New Geneva on the south, but in the latter locality the dip of the bed is so low that its outcrop is very irregular, extending from the summit of the Fayette anticline to Grays Landing. West of this line of outcrop the coal is below water level, except in the extreme northwest corner of the quadrangle, where it is exposed for a short distance as it rises on the eastern flank of the Bellevernon anticline.

Area of occurrence of Pittsburg coal.

The general character of the Pittsburg coal in this region has been well described in previous reports and it seems unnecessary to attempt to add to the description already given. Although the section of the coal bed is variable, fig. 15 may be considered as the type, in the sense that it shows the various benches that have been generally recognized, and serves as an illustration for Professor Stevenson's description (Rept. K, Second Geological Survey of Pennsylvania, pp. 70–71), which is as follows:

Representative section of the Pittsburg coal.

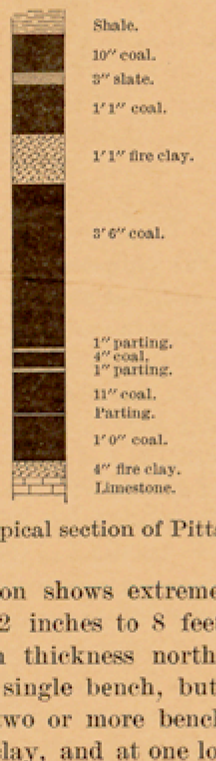


FIG. 15.—Typical section of Pittsburg coal.

"The roof division shows extreme variations. Its thickness is from 2 inches to 8 feet, but there is a distinct increase in thickness northward. Occasionally it is a single bench, but commonly it contains two or more benches of coal, separated by clay, and at one locality it is broken into twenty divisions. The coal is invariably poor, owing to the large proportion of ash. The clay partings are subject to abrupt variations, for on the Panhandle Railroad the roof shows twenty divisions at a little distance east from Raccoon station, while at the station it shows 5 feet of coal, broken only by partings so thin that they can hardly be distinguished on the weathered surface. The changes in thickness of the whole division are equally abrupt, several instances having been observed where within a short distance it varied from a single 2-inch bench of coal to a mass of coal and shale 3 feet thick.

Stevenson's description of the Pittsburg coal.

"I have said that this roof division thickens northward. This statement is the result of many comparisons, for if one were permitted to select examples he could without difficulty find many cases in Allegheny and northern Washington where the roof is as thin as at any place in Greene or southeastern Washington. But taking all the measurements in the southeastern portion, and comparing them with all those made in the northern portion, it becomes apparent that the roof is thicker northward, and that in northwestern Washington and Allegheny the thickness is suddenly and greatly increased.

"The lower division of the Pittsburg coal is from 3 feet 6 inches to 9 feet thick, and contains three persistent partings, usually thin, which divide it into four benches, known as the 'Upper,' the 'Bearing-in,' the 'Brick,' and the 'Lower Bottom.'

"In the first or Upper bench there is occasionally a parting, which is rarely seen except at the extreme northwest, where it seems to be a common feature. This is the thick bench and usually yields the best coal.

"The 'Bearing-in' bench varies from 2 to 4 inches, and is invariably distinct, except where the bed is a block coal, and all the partings are missing. The name is applied because on this bench the miner works in to gain a face against which to bring out the other portions of the bed. This is generally a good coal, but in removal it is reduced to slack.

"The 'Brick' bench is characterized by cleavage planes which break the coal into blocks in size and shape like a common brick, whence the name. It yields a good coal, hardly inferior to that from the Upper bench.

"The 'Lower Bottom' bench is the lowest of all, always of inferior quality, and for the most part utterly worthless. It is broken by numerous thin layers of clay, as well as by cleavage planes, so that it is brittle and full of ash.

"The Upper bench contains thin partings or binders of pyrites, one of which, at from 10 to 15 inches from the top, is quite persistent. This impurity sometimes occurs in the Brick, and is always present in the Lower Bottom.

"The thickness of the whole lower division of the Pittsburg bed diminishes northward, as the roof division seems to increase in that direction; but, with the exception already noted, the various benches are persistent throughout. In the southeastern part of the district the total thickness is from 7 to 9 feet; greatest at Brownsville, where the roof is 4 inches and the lower division is 9 feet. In the vicinity of Pittsburg and the adjoining portions of Allegheny County it varies little from 5 feet 6 inches, while in northwestern Washington it varies from 3 feet 6 inches to 5 feet, the former (3 feet 6 inches) being found at Midway, on the Panhandle Railroad, where the coal is a block."

On Redstone Creek where it crosses the Lambert syncline, near the northern boundary of the Masontown quadrangle, a number of mines have been opened on the Pittsburg coal bed within the last few years. The general section for the vicinity of Smock is as follows (sec. 3, fig. 14):

Pittsburg coal on Redstone Creek.

Pittsburg coal in vicinity of Smock.

	Feet.	Inches.	Feet.	Inches.
Roof division:				
Coal and clay	0	8		
Clay	0	4		
Coal	0	8		
			1	8
Main clay parting			0	10
Lower division:				
Coal	4	9		
Parting.				
Coal	0	7½		
Parting.				
Coal	1	1		
Parting.				
Coal	1	2		
			7	7½

South of Smock the lower division is thicker and the roof division has lost some of its partings, as shown by the following section from an opening west of Waltersburg (sec. 4, fig. 14):

Pittsburg coal in opening west of Waltersburg.

	Feet.	Inches.	Feet.	Inches.
Roof division:				
Coal			1	3
Main clay parting			1	0
Lower division:				
Coal	6	10		
Clay	0	2		
Coal	2	0		
			9	0

In the second ravine which enters Redstone Creek from the west above Waltersburg, a mine has been opened about 1½ miles above the mouth of the creek. At this point the upper division is imperfectly exposed, but apparently consists for the most part of black carbonaceous shale. The lower division has a thickness of about 8 feet. In several country banks located on the outcrop of the Pittsburg coal between Redstone Creek and the National Pike the lower division of the coal is reported to show at one point a thickness of 5 feet 10 inches, at another 7 feet, and at another 9 feet. It is mined at a number of points along the National Pike, and at one of these mines, which is located at the first crossroads east of Searights, the lower division of the coal shows three well-defined benches 50, 21, and 31 inches thick (sec. 1, fig. 16), separated by very thin partings.

Pittsburg coal along the National Pike.

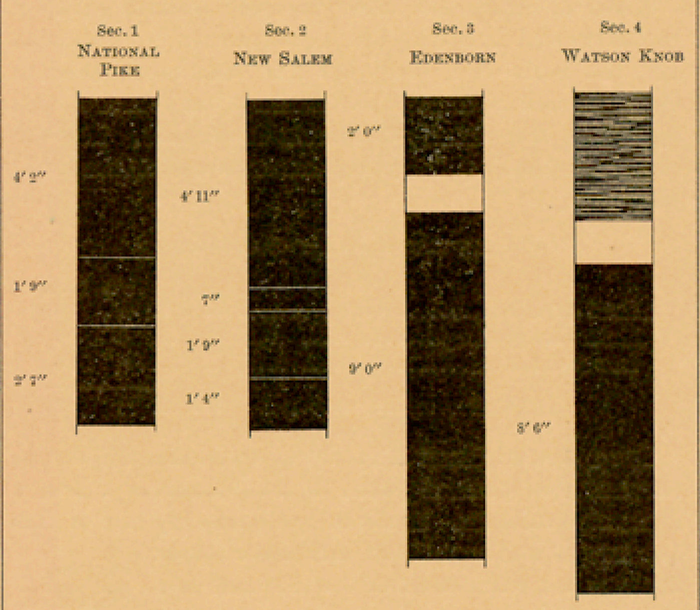


FIG. 16.—Sections of the Pittsburg coal.

From the National Pike to the Uniontown and New Salem road the outcrop of this coal has been prospected extensively, but most of the pits are closed and the section of the coal can not be determined. On the road which follows the outcrop north from the last-mentioned road the following section is exposed:

Pittsburg coal north of Uniontown-New Salem road.

	Feet.	Inches.	Feet.	Inches.
Roof division:				
Coal	1	0		
Coal and clay	1	4		
Bituminous shale	1	0		
			3	4
Main clay parting			0	6
Lower division			7	11

The lower division is broken up by slate partings which range from one-eighth to one-quarter inch in thickness, and, in descending order, the benches which they separate have thicknesses of 30, 23, 22, and 20 inches, respectively. Along this line the coal dips rapidly toward the northwest, and passes below creek level about a mile east of New Salem. At this point the lower division has the following structure (sec. 2, fig. 16):

Pittsburg coal a mile east of New Salem.

	Feet.	Inches.
Upper bench	4	11
Bearing-in	0	7
Brick coal	1	9
Lower bottom bench	1	4
Total	8	7

Two mines have recently been established in this locality on opposite sides of the creek. On the north side the coal bed appears to have a thickness of about 9 feet, but only the lower bench, having a thickness of 7 or 8 feet, is mined. In the Buffington shaft, which is located about a half mile west of New Salem, the coal bed is reported to show a thickness of 9 feet, but doubtless this includes the roof division, and the workable coal probably does not exceed 6 or 7 feet. In the Lambert shaft, which is located on the headwaters of Middle Run, the same thickness is reported, but this likewise undoubtedly includes some, if not all, of the roof division. The Edenborn shaft gives the section of the coal in greater detail. The roof division is reported to have a thickness of 2 feet, main clay division 1 foot, and bottom bench 9 feet (sec. 3, fig. 16). In the Gates shaft, located at the mouth of Middle Run, the coal is reported to have a thickness of 10 feet, but, like the other large measures, this doubtless includes some clay or shale partings.

In the Buffington shaft.

In shafts on Middle Run.

In the vicinity of Balsinger the coal shows in a number of hills located on the anticline. At an opening in Watsons Knob the coal shows the following structure (sec. 4, fig. 16):

Pittsburg coal at opening in Watsons Knob.

	Feet.	Inches.	Feet.	Inches.
Roof division;				
Carbonaceous shale	0	6		
Clay and coal	2	0		
Carbonaceous shale	0	10		
			3	4
Main clay parting			1	2
Lower division			8	6

The lower division is said to reach a thickness of 11 feet at some places in this opening, but the general thickness runs from 7 feet to 8 feet 6 inches. West of Balsinger on the main outcrop of the coal in the Lambert syncline, the roof division has a thickness of 3 feet 10 inches, main clay 1 foot; and of the lower division a thickness of 7 feet was visible at the point where the section was measured. On the North Fork of Browns Run the coal shows in outcrop for a distance of at least 2 miles, but the rapid western dip carries it from the tops of the highest hills in the vicinity of Messmore to water level near the junction of the North and South forks. At the former place the structure of the coal bed is shown in the following section (sec. 1, fig. 17):

West of Balsinger.

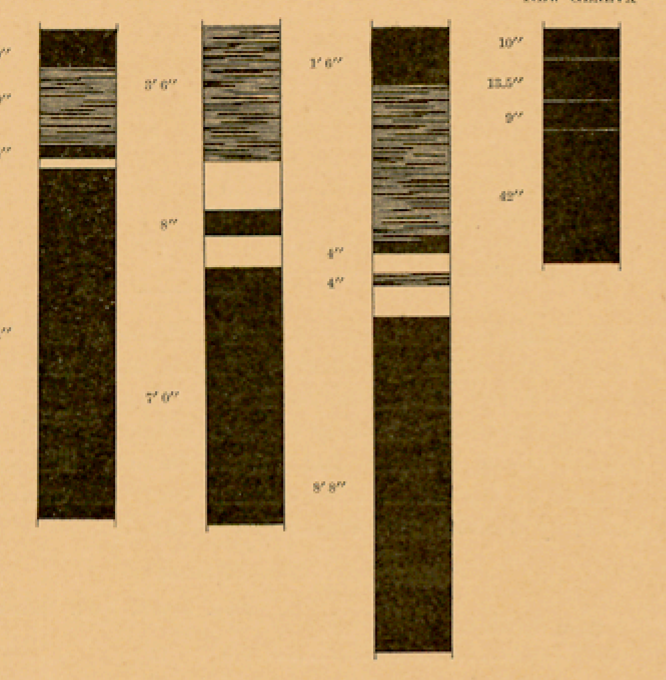


FIG. 17.—Sections of Pittsburg coal.

Pittsburg coal at Messmore.

	Feet.	Inches.	Feet.	Inches.
Roof division:				
Coal	1	0		
Clay and coal	2	0		
Coal	0	4		
			3	4
Main clay parting				1–5
Lower division			9	1

Near the junction of the two forks of Browns Run the lower division has a reduced thickness, as shown by the following section:

Pittsburg coal near junction of forks of Browns Run.

	Feet.	Inches.	Feet.	Inches.
Roof division:				
Coal and shale	2	4		
Shale	0	4		
Coal	0	2		
Shale	0	9		
Coal	0	6		
			4	1
Main clay parting			1	6
Lower division			6	0

At an old mine on the hilltop about a half mile southeast of Leckrone the thickness of the lower division is 10 feet 3 inches. This is not well exposed, but no shale partings were observed in it, and presumably the full thickness is available coal.

On Cats Creek the Pittsburg coal has been extensively mined for a number of years, and recently a railroad has been built, giving this district connection with the main trunk lines, and a large mine is being developed south of Masontown. A detailed section of the outcrop on this creek is as follows (sec. 2, fig. 17):

Pittsburg coal on Cats Creek near Masontown.

	Feet.	Inches.	Feet.	Inches.
Roof division:				
Coal and clay	3	6		
Clay	1	3		
Coal	0	8		
			5	5
Main clay parting			0	10
Lower division			7	0

The coal has been mined for local use in the outliers which cap the ridge in the vicinity of Old Frame. At an old mine a mile or so north of this point the following section was measured (sec. 3, fig. 17):

Pittsburg coal near Old Frame.

	Feet.	Inches.	Feet.	Inches.
Roof division:				
Coal	1	6		
Clay and coal	4	0		
Slaty coal	0	4		
Clay	0	6		
Coal and clay	0	4		
			6	8
Main clay parting			0	10
Lower division			8	8

A short distance south of Old Frame the roof division is 3 feet, main clay 1 foot, and lower division 8 feet in thickness. The thickness of the lower division in this region appears to be remarkably constant, for a detailed section on Jacobs Creek shows the roof division to be 3 feet 11 inches, main clay 2 feet, and lower division 8 feet 2 inches in thickness. The coal has been mined in a number of places on the ridge back of New Geneva, but the majority of the mines are worked only a portion of the year, and during the remainder of the time the coal is not accessible. South of George Creek the territory underlain by this coal bed is small and the coal also appears to be thinner than in the region just described. The reduction in thickness of the Pittsburg coal appears to be connected in some way with the development of the Pittsburg sandstone immediately over the coal. In the Uniontown syncline, and also generally along the eastern outcrop of the coal in the Lambert syncline, the roof division is overlain by a large body of shale, which varies from place to place from a fine, highly carbonaceous to a very sandy shale. In certain areas in the western half of the Masontown quadrangle the shale is replaced by a massive sandstone which is always coarse and occasionally conglomeratic. This sandstone frequently rests directly upon the lower division of the coal, and the natural inference is that the roof division was eroded before the sand was deposited. In fact, it seems probable that in many places erosion not only removed the roof division, but cut deeply into the main bench of the coal, reducing its thickness in places to not over 4 feet. The Pittsburg sandstone is particularly heavy on Dunkard Creek, and it is developed also to some extent between Crows Ferry and Morris Crossroads. The sandstone is also seen in Luzerne Township near the northwest corner of the Masontown quadrangle and at other points farther north. The facts of its distribution suggest that the current which eroded the coal flowed in a north or south direction and that its course extended considerably beyond the limits of this territory. At the clay pits about a mile southeast of New Geneva the coal shows in four benches (sec. 4, fig. 17) having a thickness of 10, 13½, 9, and 42 inches. At an opening about three-quarters of a mile east of Lock No. 8 an old prospect pit showed a thickness of only 4 feet of coal, but it is not certain that this represents the entire thickness of the bed. It seems possible, however, that it does, since two other outcrops within about a mile and a half of Morris Crossroads show the coal to have a thickness of 4 feet in one case and 5 feet in the other. At these openings the coal is overlain by heavy sandstone, and the presumption is that all of the bed except that which was seen has been removed.

On Jacobs Creek.

South of George Creek.

Thinning of Pittsburg coal under Pittsburg sandstone.

Near New Geneva and Morris Crossroads.

It was formerly supposed that all of the Pittsburg coal lying outside of the Connellsville basin was poorly adapted to the manufacture of coke, but since the construction of a railroad along Redstone Creek a number of coking plants have been established, and their product compares very favorably with that of the type locality, the Connellsville basin. Many years ago a coking plant was established on the east side of Monongahela River near Grays Landing, but for some unknown reason it proved a failure. Within the last four years operations have been begun again in the Lambert syncline, and the coke produced seems equal to that manufactured in the Connellsville basin. As the result of this discovery a number of large coking plants have been established. Most of these are located on the eastern outcrop of the coal, and their operations are carried on by means of slopes which extend down the dip of the bed. A few operators have secured property near the center of the basin and have reached the coal by means of deep shafts. The most southerly shaft is that of the Edenborn mine west of McClellandtown, which reaches the floor of the coal at a depth of 486 feet. At the mouth of Middle Run the Gates shaft found the same horizon at a depth of 243 feet below the surface. Near New Salem the Buffington shaft was sunk to a depth of 389 feet, to the bottom of the coal. The deepest shaft in this district is that of the Lambert mine, on the headwaters of Middle Run, which begins on high land and is located nearly on the axis of the syncline. It reaches the floor of the coal at a depth of 631 feet below the surface.

Developments and coking plants in Lambert syncline.

As described in the paragraphs on the geologic structure of this region, there is a small anticline which lies west of the Lambert syncline. It is extremely irregular and the coal has an irregularly warped surface instead of lying in a distinct fold. In the northwestern part of the Masontown quadrangle the coal rises above water level on the flanks of a pronounced anticline whose axis lies a short distance beyond the quadrangle. Throughout this broad expanse of the northwestern half of the quadrangle, embracing an area of a little over 100 square miles, the Pittsburg coal is untouched except at the plants just mentioned and a few others that are located on the outcrop of the coal. These mines are comparatively new, and hence but little of the coal has been removed. The deepest part of the syncline is near the Lambert shaft in Fayette County, but all through the extreme western end of this county and the eastern side of Greene County, as far south as Dunkard Creek, the coal lies at a very moderate depth below the surface and could easily be reached by a shaft at any point in the region. The speedy development of coal will depend chiefly on its quality; it seems probable that throughout most of this region it maintains essentially the same characteristics that it holds in the so-called Klondike region about Leckrone.

Occurrences in northwestern part of Masontown quadrangle.

Redstone coal.—The Redstone coal bed appears to be generally persistent in this syncline, but in places it consists almost entirely of carbonaceous shale. Owing to the strong dips which generally prevail near the outcrop of this bed, its distance above the Pittsburg has not always been accurately determined. The mine shafts which have been recently sunk in this region afford the best evidence regarding the position and character of the Redstone as well as of the Sewickley coal. According to the record supplied by the owners of the Buffington shaft, which is located near New Salem, the only coal beds encountered are one near the head of the shaft, which undoubtedly occurs at the Waynesburg horizon, and one at a depth of about 260 feet, which is the normal position for the Sewickley bed. Between the latter horizon and the Pittsburg coal no other coal bed, or even black carbonaceous shale, is reported, so that it seems probable that the Redstone coal is entirely wanting in this vicinity.

Redstone coal absent in Buffington shaft.

The Lambert shaft, located at the head of Middle Run, shows the Waynesburg and Uniontown coals in their normal positions, but the coal beds close to the Pittsburg are puzzling and difficult to classify. The lowest bed occurs at an interval of 20 feet above the Pittsburg coal, and the second bed 64 feet from the same horizon. The lower of these two beds is underlain by black, sandy shale, and neither in its position nor in its associated rocks does it correspond to the Redstone bed. The bed 64 feet above the Pittsburg is underlain by 15 feet of limestone, which seemingly corresponds with the Redstone limestone, which, in the normal section, closely underlies the Redstone coal bed. For this reason the coal is here considered to belong to the Redstone horizon. If this is correct the Sewickley coal does not appear in the shaft section. Its position very nearly corresponds with a bed of black "block slate" underlain by fire clay at an altitude of 108 feet above the Pittsburg bed.

Redstone present, Sewickley wanting in Lambert shaft.

The Edenborn shaft section corresponds very nearly with the type section of the Monongahela formation. The interval between the Redstone and Pittsburg coals is 60 feet, the former is 1 foot thick and is underlain by a bed of limestone which has a thickness of about 15 feet. The Sewickley coal shows a thickness of only 8 inches and its position is 138 feet above the Pittsburg bed.

Redstone and Sewickley in Edenborn shaft.

The Gates shaft section, which is located at the mouth of Middle Run, shows a small coal bed 10 feet above the Pittsburg. This is probably the rider that frequently occurs above the Pittsburg coal in Fayette County. At a distance of 50 feet above the Pittsburg coal the Redstone bed appears, with a thickness of 2 feet 2 inches. This is underlain by a bed of limestone, and in every respect it resembles the Redstone bed of the type locality. At a distance of 116 feet above the Pittsburg coal there is a small bed which undoubtedly belongs at the Sewickley horizon. From these sections it will be seen that the Redstone and Sewickley coal beds are not of very great importance in this region. At the surface their outcrops were observed in a number of places as blooms by the wayside, but no openings were found in the northern part of the syncline at which the thickness of the coals could be determined.

In the Gates shaft.

Southwest of Masontown the Redstone coal bed is exposed by the side of the road leading to the mouth of Jacobs Creek. At this point the coal shows a thickness of 3 feet without partings, but the full section is not exposed, and it seems possible that it may have a total thickness of 3 feet 6 inches. The coal is overlain by black shale, and it rests upon a bed of calcareous nodules about 15 feet in thickness.

Redstone coal near mouth of Jacobs Creek.

Near the village of Old Frame, in Nicholson Township, a coal bed shows about 40 feet above the Pittsburg. This has an exposed thickness of 2 feet; the total thickness is somewhat greater, but it probably does not exceed 3 feet. In the vicinity of New Geneva there is some doubt about the identification of the coal beds. On the opposite side of the river there are two coals within about 60 feet of the Pittsburg bed. The uppermost one of these is large and seems to correspond to the Mapletown bed, which is at the Sewickley horizon. Between this prominent coal and the Pittsburg bed there is a small coal included in a mass of bituminous shale which was regarded by Professor Stevenson as at the Redstone horizon. Although the interval between this bed and the underlying Pittsburg coal does not exceed 30 feet, it presumably will ever be regarded as Redstone, on the supposition that the interval below is abnormally thin in this region. The extent of this abnormal interval has not been made out, consequently the coal beds above the Pittsburg on the east side of the river can be determined only provisionally at the present time. About a mile north of New Geneva a coal bloom is visible in the road on both sides of the summit. This presumably occurs about 40 feet above the Pittsburg, and hence is regarded as occurring at the Redstone horizon. It was also reported from the north side of Jacobs Creek at a distance of about 50 feet from the Pittsburg bed. At this point there is an old opening, but the coal is concealed by the falling in of the roof and its thickness could not be ascertained. It seems to show, however, that the interval between the Redstone and Pittsburg beds increases northward to about the normal interval in the vicinity of Masontown. On the road east from New Geneva a prominent bloom was observed about 50 feet above the Pittsburg which seems also to belong to the Redstone horizon, but with a considerably greater interval than is shown a mile away on the west side of the river.

Supposed Redstone and Sewickley coals near New Geneva.

In Luzerne Township, west of the Lambert syncline, the Redstone coal was not observed, although its horizon appears at the surface in the northwest corner of the township. Professor Stevenson reports that it is present in the hills opposite Millsboro, and he assigns to it an estimated thickness of about 5 feet. In his description he speaks of it as a mass of carbonaceous shale associated with a very thin coal. From all of the evidence available it seems probable that the Redstone coal has little or no economic importance in this township.

Redstone coal in Luzerne Township.

Sewickley coal.—As previously stated, the Sewickley coal is present in the Buffington shaft 137 feet above the top of the Pittsburg bed. In this vicinity two shafts and a bore hole have been sunk, and in each one the coal is shown to have a different thickness and position. In the westernmost shaft the coal shows a thickness of 3 feet and was struck at a distance of 260 feet below the surface. In shaft No. 1, which is the main hoisting shaft, its depth is 255 feet, and its thickness varies from 0 on one side of the shaft to 2 feet on the other. In the bore hole its reported thickness is 2 feet. In the Lambert shaft the Sewickley coal is not present, according to the reported section, but as before described, its place is probably occupied by a black carbonaceous shale resting on fire clay at a distance of about 108 feet above the Pittsburg bed. In the Edenborn shaft its reported thickness is 8 inches and its position 138 feet above the Pittsburg bed. In the Gates shaft it occurs 116 feet above the Pittsburg, and its thickness is shown by the following section:

Variable position and thickness of Sewickley coal in shaft sections.

Sewickley coal in Gates shaft.

	Feet.	Inches.
Coal	0	10
Black slate	0	1
Coal	1	5
Total	2	4

In four carefully kept records of wells located on the ridge between Masontown and Leckrone the Sewickley coal is reported at the following distances above the Pittsburg bed: 111, 115, 136, and 137 feet. The thickness of the bed is reported as 4, 5, 4, and 3 feet, respectively. These measures are considerably in excess of the thicknesses given in the shaft sections already quoted, and the probability is that they are somewhat exaggerated.

Sewickley coal between Masontown and Leckrone.

In the northern part of the Lambert syncline the Sewickley coal is not well exposed in outcrop. Its bloom was seen in a number of places, but no definite idea could be gained regarding its thickness, except that it is probably too thin to mine under existing commercial conditions. At an opening on the road from New Salem to Heisterberg the coal is exposed to a thickness of 2 feet. The roof of the coal is composed of heavy sandstone, but the opening was so obscured by the caving of the sides that the base of the bed was not visible. Near the Leckrone mine the bloom of the Sewickley coal is visible in the road at a distance of about 120 feet above the Pittsburg coal. Its thickness could not be determined, but presumably it corresponds closely to that given for the Edenborn shaft. Northeast of New Geneva the Sewickley coal bed is visible at a number of points on the Old Frame road, but its thickness could not be determined. In the vicinity of New Geneva the interval between this coal and the Pittsburg bed gradually decreases. At one point about midway between Old Frame and New Geneva the distance above the Pittsburg seems to be about 90 feet; but at the exposure about one-half mile from New Geneva the interval is reduced to somewhat less than 80 feet. On the north side of Jacobs Creek the coal shows in the road from Old Frame to Masontown at an interval of about 110 feet above the Pittsburg bed. Its thickness at this point could not be determined.

Sewickley coal in the northern part of Lambert syncline.

West of the Lambert syncline the Sewickley coal is poorly exposed in Fayette County. Professor Stevenson reported the bed as fully concealed at the time of his examination. During the present survey its bloom was noted at only a few points, and no reliable estimate of its thickness could be obtained. It is probably thin and of little value, although on the opposite side of the river, in Cumberland Township, Greene County, it varies from 2 to 3 feet in thickness in outcrop along the river hills.

Sewickley coal in Fayette County west of Lambert syncline.

Uniontown coal.—The Uniontown coal is probably of little value in this region. It is generally thin and inconspicuous and was noted at only a few localities. According to the record of the Buffington shaft, the coal occurs 302 feet above the Pittsburg bed and has a thickness of 3 feet, but from the fact that the coal fails to show in a bore hole in the same general locality it is probable that the coal is variable in thickness and irregular in distribution. In the Lambert shaft it has a thickness of 2 feet and it was encountered 300 feet above the base of the Pittsburg coal. In the Edenborn shaft it has the same thickness and is recorded at 293 feet above the Pittsburg bed. No other sections of the coal were obtained in this territory, and Professor Stevenson makes no mention of the Uniontown bed in his report.

Waynesburg coal.—Throughout the Lambert syncline, as well as in the territory farther west, in Fayette County, the Waynesburg is the most prominent coal bed exposed at the surface. In the northeastern part of the basin this bed is less prominent than farther west. In fact, it was scarcely seen on the eastern side of the syncline from the northern boundary of the quadrangle to the vicinity of McClellandtown. In the Buffington shaft it is doubtful whether the Waynesburg bed was encountered, since the head of the shaft is probably at about its horizon. Near the surface a bed 6 or 8 inches in thickness is reported, and in some water wells in the locality a coal at about this horizon is reported to have a thickness of 3 feet, but it is badly mixed with slate, so that presumably the bed has little or no value. The Waynesburg sandstone, which normally overlies the coal, is poorly developed in this region, and consequently it is difficult to identify the coal with certainty. In the road northeast of New Salem there is a large bloom that presumably marks the horizon of the Waynesburg coal. It apparently has a thickness of 2 or 3 feet, but no detailed measurements could be obtained.

Waynesburg coal in the Lambert syncline, general character.

North of the Masontown quadrangle, in the bluffs along Redstone Creek, the Waynesburg coal has been opened in a number of places, and presumably has a fair thickness on the east side of the syncline, but even here its greatest development appears to be west of the axis. The following section is from an opening north of the National Pike, and presumably a short distance beyond the limits of the Masontown quadrangle:

Waynesburg coal near northern limit of Masontown quadrangle.

	Feet.	Inches.
Sandstone roof.		
Shale	1	0
Coal	0	4
Shale	5	0
Coal	0	4
Clay	0	2
Bony coal	0	4
Coal	1	8
Clay	0	2–6
Coal	2	5
Total	10	5–9

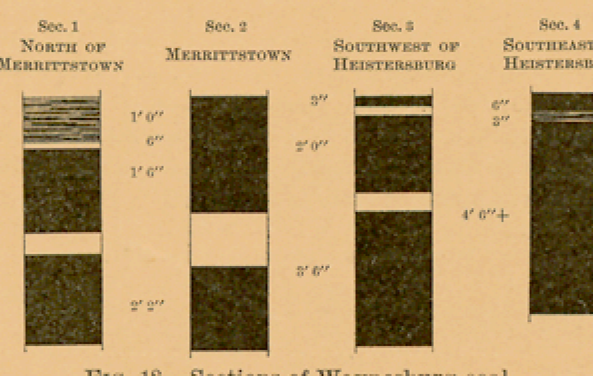


Fig. 18.—Sections of Waynesburg coal.

At another opening in the same general locality the section is as follows (sec. 1, fig. 18):

Waynesburg coal north of Merrittstown.

	Feet.	Inches.
Coal and clay	1	2
Clay	0	2
Coal	2	2
Clay	0	7
Coal	2	4
Total	6	5

On the roads leading into the valley of Dunlap Creek near the northern margin of the quadrangle the Waynesburg coal makes a large showing. At an opening the following section was obtained:

Waynesburg coal near northern margin of Masontown quadrangle.

	Feet.	Inches.
Coal	1	2
Clay	0	2
Coal	1	10
Clay	0	11
Coal	1	6
Total	5	7

The bottom bench was not well exposed at this opening and the coal probably slightly exceeds the thickness given. In the vicinity of Merrittstown the coal has been mined extensively for local use, and its section at this point is as follows (sec. 2, fig. 18):

Waynesburg coal near Merrittstown.

	Feet.	Inches.
Coal	1	0
Brick coal	0	6
Coal	1	6
Clay	0	10–24
Coal	2	2
Total (average)	6	7

Throughout Luzerne Township the Waynesburg coal has been mined at many places for local use. In this region the sandstone is coarse and generally massive and the coal is easily identified. It was seen on almost all roads that crossed its horizon, but it was difficult to obtain complete sections. About 1 mile west of Heistersburg a recent opening on the road leading to Arensburg Ferry shows the following section:

Waynesburg coal a mile west of Heistersburg.

	Feet.	Inches.
Coal	1	6
Shale	3	0
Coal	1	0
Total	5	6

According to this section the coal is so badly broken by partings that it has little commercial value, but from the thinness of the section it seems probable that one or two benches remain concealed. Professor Stevenson gives the following section from an opening 1 mile southwest of the village, presumably from mines now abandoned, on the Arensburg Ferry road (sec. 3, fig. 18):

Waynesburg coal a mile southwest of Heistersburg.

	Feet.	Inches.
Clay shale	0	3
Coal	0	3
Clay	0	3
Coal	2	0
Clay	0	2–10
Coal	3–4	
Total (average)	6	6

About 1 mile southeast of Heistersburg the following section was obtained at a mine which recently has been operated (sec. 4, fig. 18):

Waynesburg coal a mile southeast of Heistersburg.

	Feet.	Inches.
Coal	0	6
Bony coal	0	3
Coal	4	6+
Total	5	3+

The bottom bench is somewhat obscure and its thickness may be several inches more than the measure given.

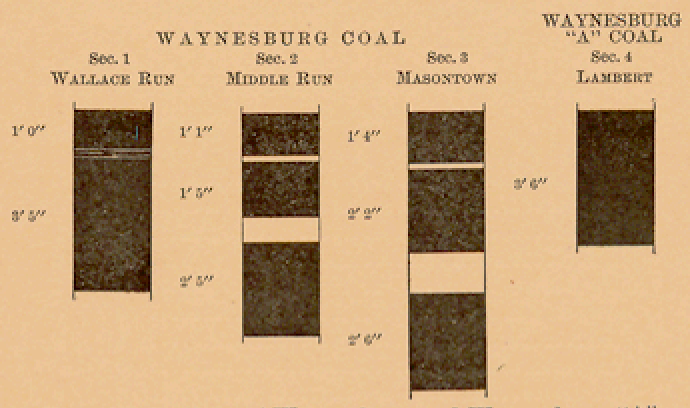


Fig. 19.—Sections of Waynesburg and Waynesburg "A" coals.

At this point the bed is overlain by about 10 feet of shale, which separates the coal from the Waynesburg sandstone above. On Wallace Run a mine has recently been opened on the Waynesburg coal about 1½ miles northeast of East Riverside. At this mine the following section was obtained (sec. 1, fig. 19):

Waynesburg coal on Wallace Run.

	Feet.	Inches.
Clay roof.		
Coal	1	0
Bone	0	3
Coal	3	5
Total	4	8

On Antram Run the coal has been opened in a number of places. No detailed measures were obtained, but the total thickness of the bed appears to be about 5 feet. It is well exposed also on Middle Run near the crossing of the Edenborn and Dearth road, where it shows the following detailed section (sec. 2, fig. 19):

Waynesburg coal on Middle Run.

	Feet.	Inches.
Coal	1	1
Clay	0	2
Coal	0	8–25
Clay	0	1–14
Coal	2	4–6
Total (average)	5	8

North of Masontown, on the road leading to McCanns Ferry, an opening occurs at which the following section was obtained (sec. 3, fig. 19).

At this point a good vertical section was obtained showing the Uniontown coal with a thickness of 2 feet 6 inches, 100 feet below the outcrop of the Waynesburg bed.

Waynesburg coal north of Masontown.

	Feet.	Inches.
Coal	1	4
Clay	0	2
Coal	2	2
Clay	0	5–20
Coal	2	6
Total (average)	7	2

The rise of the strata on the western limb of the Fayette anticline carries the Waynesburg coal above the tops of the hills in the region south of Masontown. On the whole the Waynesburg bed is prominent throughout the northwest corner of Fayette County on account of its great aggregate thickness, but the number and thickness of the clay partings make the bed expensive to mine, and the high percentage of sulphur and ash which the coal usually carries renders it of little value under existing conditions. It has been mined in a desultory way to supply local needs, and probably in the future, when the Pittsburg coal is practically exhausted, this bed may receive some attention, but the prospect is not bright for immediate utilization.

Waynesburg "A" coal, its position and relations.

Waynesburg "A" coal.—The first coal bed above the base of the Dunkard formation has been designated in previous reports the Waynesburg "A" coal. In the Lambert shaft section it occurs 61 feet above the Waynesburg coal and it has a thickness of 3 feet 6 inches (sec. 4, fig. 19). Although not showing so great a total thickness as the Washington coal, higher in the series, still, so far as quality is concerned, it is probably the most important bed in the Dunkard formation.

In the type section of Washington County the Waynesburg "B" coal is supposed to be next in the series, and is separated from the Waynesburg "A" by an interval of about 30 feet. In the Lambert shaft section this coal is not present and the next bed above the Waynesburg "A" coal is approximately at the position of the Little Washington coal as given by Professor Stevenson in his type section. This is an unimportanat bed in the Lambert shaft, but its occurrence is interesting, since it shows the wide extent of some of these minor coal horizons.

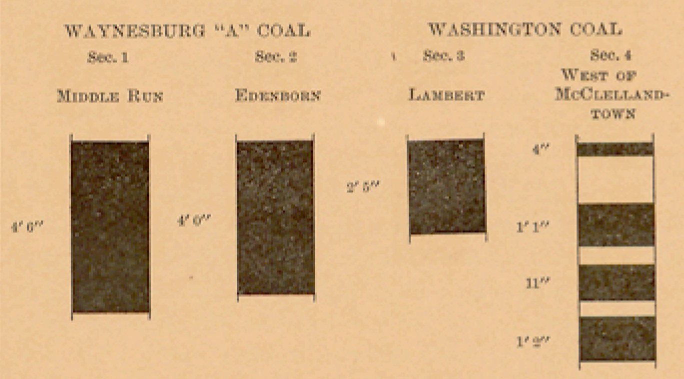


Fig. 20.—Sections of Waynesburg "A" and Washington coals.

Waynesburg "A" coal, its character at various places.

On Middle Run the Waynesburg "A" coal has been opened in several places. Just above the crossing of the road from McClellandtown to Dearth it shows a thickness of 4 feet 6 inches (sec. 1, fig. 20). On Antram Run it has also been prospected for local use. About 1 mile from the mouth of the run an opening reveals a thickness of about 3 feet. The bloom of this bed was seen in a number of places on the margins of the Lambert syncline and in Luzerne Township, where it closely overlies the heavy Waynesburg sandstone. From the showing which it makes in crossing the roads, it seems possible that its thickness over most of this territory ranges from 2 to 3 feet.

In the Edenborn shaft a thickness of about 80 feet of the Dunkard formation was pierced before reaching the Waynesburg coal. In that interval the Waynesburg "A" coal is reported 57 feet above the Waynesburg horizon and its thickness is given as 4 feet (sec. 2, fig. 20). The quality of the coal from this bed is not given, but if it is the same as reported from mines on the outcrop in various parts of the basin, and if it holds a thickness of 4 feet over any considerable territory, the Waynesburg "A" coal will be of value when the larger coals are exhausted.

Washington coal its typical occurrence.

Washington coal.—The Washington coal bed can not be identified in the Uniontown syncline. In the Lambert basin a bed at about this horizon has been noted in a number of places. Its character and position are probably best shown in the Lambert shaft, where it has a thickness of 2 feet 5 inches (sec. 3, fig. 20) and occurs 140 feet above the Waynesburg coal. It seems probable, however, that its thickness as given above includes several shale partings, for the section (sec. 4, fig. 20) measured at an opening on the river bluff west of McClellandtown shows the following broken character:

Washington coal in river bluff west of McClellandtown.

	Feet.	Inches.
Coal	0	4
Clay	1	3
Coal	1	1
Clay	0	6
Coal	0	11
Clay	0	5
Coal	1	2
Total	5	8

Washington coal on Middle Run.

The Washington coal shows in several localities on Middle Run, but it does not appear to be the thick complex bed that it is in the type locality. At one point a thickness of 32 inches was observed at this horizon, and at another 24 inches of coal are visible.

Above the Washington coal a number of small beds were encountered in the Lambert shaft. From an economic standpoint they are of no value, and it is doubtful if they can be correlated with the coal beds of the type section in Greene and Washington counties.

COAL IN GREENE AND WASHINGTON COUNTIES.

General occurrence of Pittsburg coal.

Pittsburg coal.—The Pittsburg coal shows in outcrop over a very small area of Greene County. It rises from water level on Monongahela River about the mouth of Cats Creek, and from this point it occurs in the river bluffs on both sides of the stream as far as Greensboro and New Geneva. Beyond this point it recedes somewhat from the immediate vicinity of the river and is found in outcrop several hundred feet above water level. On the west side of the river the coal has been mined to some extent in the vicinity of Greensboro. At an old mine on the Mapletown road the following section is exposed (sec. 1, fig. 21):

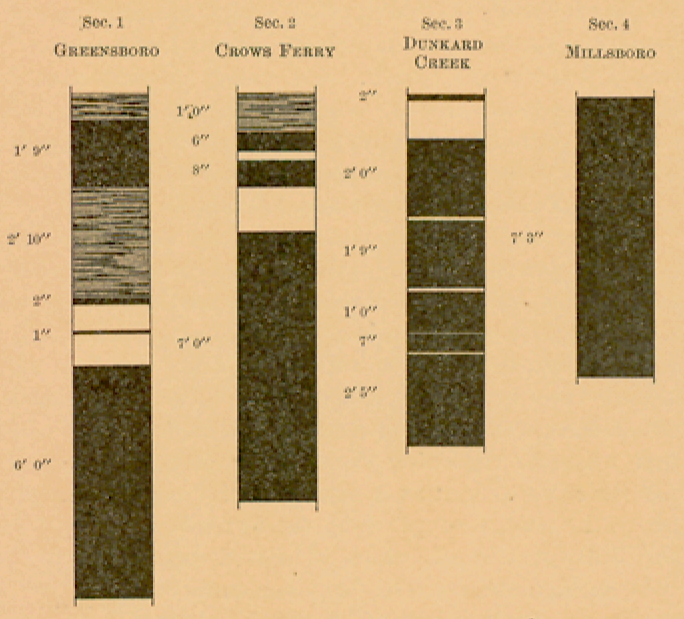


Fig. 21.—Sections of Pittsburg coal.

Pittsburg coal at old mine north of Greensboro.

	Feet.	Inches.	Feet.	Inches.
Roof division:				
Dark shale	0	6		
Coaly shale	0	8		
Coal	1	9		
Clay with coal streaks	2	10		
Coal	0	2		
Clay	0	8		
Coal	0	1		
			6	8
Main clay parting			0	10
Lower division (seen)			6	0

The Pittsburg sandstone makes its appearance south of Greensboro, as shown in the following section (sec. 2, fig. 21), which was obtained on the hills back of Crows Ferry, but in this locality the sandstone does not appear to have replaced the coal as at other points in this part of the quadrangle.

Pittsburg coal in hills back of Crows Ferry.

	Feet.	Inches.	Feet.	Inches.
Roof division:				
Sandstone.				
Shale and coal	1	0		
Coal	0	6		
Clay	0	3		
Coal	0	8		
			2	5
Main clay parting			1	2
Lower division			7	0

On Dunkard Creek the Pittsburg coal is exposed to beyond the limits of this territory. Near Robtown, which is located near the southwest corner of the Masontown quadrangle, the coal has the following section (sec. 3, fig. 21):

Pittsburg coal near Robtown on Dunkard Creek.

	Feet.	Inches.
Coal	0	2
Clay	1	0
Coal	2	0
Clay	0	1
Coal	1	9
Clay	0	1
Coal	1	0
Clay	0	⅛
Coal	0	7
Clay	0	½
Coal	2	5
Total	9	1⅝

River outcrop of Pittsburg coal from Tenmile Creek to Meadow Run.

In the small area of Washington County which lies in the northwest corner of the Masontown quadrangle the Pittsburg coal is exposed in the river bank near water level from the mouth of Tenmile Creek above Millsboro around the bend to the mouth of Meadow Run. Coal has been mined for a long time on this outcrop, but at present the production is largely restricted to three mines of the Monongahela River Consolidated Coal and Coke Company, which lie in the Fifth Pool, just beyond the boundary line of the quadrangle. The town of Millsboro is built upon a terrace underlain by the massive Pittsburg sandstone, which generally forms cliffs above the coal in this region.

At one point on the west side of the river the lower division of the coal shows a thickness of 7 feet, and at another opening in the vicinity it has a thickness of 7 feet 9 inches. On the east side of the stream the coal shows the following section (sec. 4, fig. 21):

Pittsburg coal near Millsboro.

	Feet.	Inches.
Roof division	1	8
Main clay		9–11
Lower division	6½–8	0
Total (average)	9	9

The roof division is frequently absent, being replaced by the heavy Pittsburg sandstone, which is particularly well developed in this vicinity.

Redstone coal, general relations and character.

Redstone coal.—There is considerable uncertainty regarding the thickness and position of the Redstone coal west of Monongahela River. It is exposed in natural outcrop only in the southern part, reaching water level on Monongahela River near Hatfields Ferry. According to measured sections at the surface and to drill records the interval between the Redstone coal and the Pittsburg bed seems to range from 30 to 80 feet. In composition the bed probably varies greatly. In the southern part of the quadrangle the Redstone is thin and composed almost entirely of bituminous shale with occasional layers of coal a few inches in thickness. In the vicinity of Greensboro it reaches a thickness of 18 inches and the inclosing bituminous shale has a thickness of nearly 13 feet. From this point northward the mass of the shale grows less and less until near the mouth of Whiteley Creek it disappears, leaving the coal about the same thickness as at Greensboro. In the record of a deep well drilled near Willow Tree, a coal presumably corresponding to the Redstone occurs at a height of 80 feet above the base of the Pittsburg bed and 90 feet below the Mapletown or Sewickley coal. So far as known this is the greatest recorded interval in this territory. On Dunkard Creek there is a small coal bed at about 70 feet above the Pittsburg, which is supposed to be equivalent to the one reported in the Willow Tree well. In the vicinity of Greensboro the interval between the Pittsburg coal and the first bed higher in the series is only 25 or 30 feet. Either the interval between these beds has decreased between Willow Tree and Greensboro or the coal which shows in the Mapletown road back of Greensboro is at a lower horizon than the one encountered in the Willow Tree well. Since the Redstone coal bed is unimportant in this region, its exact cofrelation is not a matter of much moment, except in showing the great variation of the measures in this part of the field. In the vicinity of Greensboro the interval seems to be variable, since on the left fork of the road leading up the hill back of Greensboro the Redstone bed appears at a distance of about 50 feet above the Pittsburg coal.

Northward from this point the coal dips gently, reaching water level west of Masontown. At the mouth of Cats Creek the coal has been opened on the north side of the creek, where it shows the following section:

Redstone coal at mouth of Cats Creek.

	Feet.	Inches.
Black shale	1	6
Coal	3	0
Shale	1	0
Limestone	6	0
Total	11	6

At this point the coal is about 50 feet above the Pittsburg bed, a relation which appears to hold for some distance northward, since in the Gates shaft, at the mouth of Middle Run, a coal 2 feet 2 inches in thickness is reported at the same distance above the Pittsburg coal.

Previous to the discovery of petroleum in this State the rich bituminous shale associated with the Redstone coal bed was distilled for oil, but the discovery of the great pools on Oil Creek quickly terminated this industry.

Sewickley coal, importance and relation to Pittsburg coal.

Sewickley coal.—The Sewickley coal bed is of considerable importance in the southern part of Greene County, ranking second only to the great Pittsburg coal. It lies near the base of the Great limestone, and the interval between it and the Pittsburg bed has a fairly constant thickness of about 140 feet. Near the southwest corner of the quadrangle an old opening was observed in which the bed has a thickness of 5 feet, but the details of parting could not be obtained. South of Wiley an opening displays 4 feet 6 inches of coal, overlain by 2 feet of shale, but the entire thickness of the bed is not exposed. At this point it appears to be about 125 feet above the Pittsburg coal.

On the road from the mouth of Dunkard Creek to Mapletown the Sewickley coal has been opened at a number of places. On the first summit above the river road it shows as a large bloom in the road, but its thickness could not be determined. At this point it is approximately 140 feet above the Pittsburg bed. In an old opening about three-quarters of a mile farther north coal to a thickness of 3 feet is exposed, but the base of the bed is concealed and its full thickness could not be determined. At this point it is not less than 135 feet above the Pittsburg coal. On the direct road between Greensboro and Mapletown the Sewickley coal shows as a large bloom by the wayside, and recently it has been opened in a small ravine on the south side of the road. The base of the bed is concealed by standing water, but

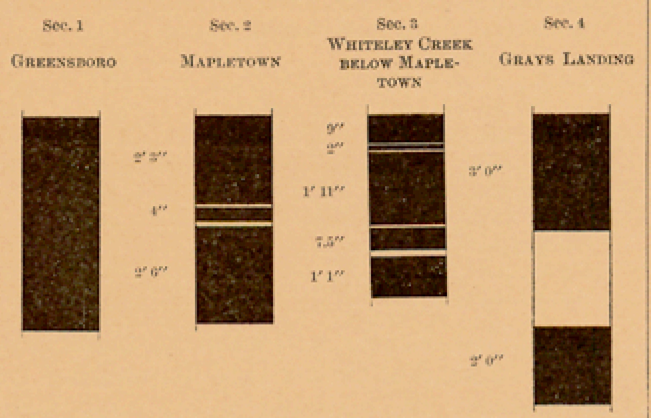


FIG. 22.—Sections of Sewickley coal.

above that 4 feet of the clear coal are visible in the opening. The full thickness is reported to be 5 feet 6 inches (sec. 1, fig 22).

This coal probably reaches its best development in the vicinity of Mapletown, and for that reason it is locally known as the Mapletown coal. It has been mined here extensively for local use, and in general it supplies a fair quality of domestic fuel. The bed has a total thickness of about 5 feet, but it usually contains small clay partings, which detract considerably from its value. A detailed section at this point is as follows (sec. 2, fig. 22):

Sewickley coal near Mapletown.

Sewickley coal near Mapletown.

	Feet.	Inches.
Coal	2	3
Clay	0	½
Coal	0	4
Clay	0	2
Coal	2	6
Total	5	3½

The coal of the upper bench is of good quality, but that of the lower contains so high a percentage of sulphur and ash that its fuel value is comparatively low. The interval between the Sewickley and the Pittsburg coals is well shown in the Willow Tree well record previously referred to. According to that record there is an interval of 135 feet between these beds. This agrees fairly well with a number of accurate well sections recently drilled northeast of Masontown, on the ridge between Cats Creek and Browns Run. In four of these wells the interval was found to be 111, 115, 136, and 137 feet.

The structure of the Sewickley coal bed varies greatly from place to place, as shown by a comparison of the Mapletown section with the following sections (sec. 3, fig. 22) of two mines on Whitely Creek between Mapletown and the crossing of the wagon road from Greensboro to Sigsbee:

Sewickley coal near Mapletown.

	Ft.	In.	Ft.	In.
Coal	0	9	0	7
Clay	0	⅛	0	¼
Coal	0	2	0	7½
Clay	0	½	0	⅛
Coal	1	11	1	10
Clay	0	1	0	½
Coal	0	7½	0	1
Bituminous clay	0	2½	0	2
Coal	1	1	1	2
Total	4	10⅝	4	6 7/12

The top and bottom benches are reported as containing good coal, generally preferred to that from the Waynesburg bed, and also preferred to that from the middle bench, which carries considerable sulphur. From a drill record near this point the interval between the Sewickley and Pittsburg beds is known to be 125 feet. On Whiteley Creek near the crossing of the Greensboro and Carmichaels road this bed shows a thickness of 4 feet of coal. A section from an opening on the west bluff of the river about one-half mile above Grays Landing shows the Sewickley coal to have a thickness of 6 feet and to lie 56 feet above the Redstone coal. The Sewickley was once extensively mined at Grays Landing, where the following section (sec. 4, fig. 22) was obtained:

Sewickley coal at Grays Landing.

	Feet.	Inches.
Coal	3	0
Clay	2	6
Coal	2	0
Total	7	6

Below Grays Landing the shale partings appear to thicken rapidly, completely spoiling the bed for mining purposes. This is exemplified by the following section, measured by Prof. I. C. White about a quarter of a mile above the mouth of Big Whiteley Creek:

Sewickley coal near mouth of Big Whiteley Creek.

	Feet.	Inches.
Coal	2	6
Sandstone	15	0
Coal	0	5
Shale	2	0
Coal	0	1
Sandstone	12	0
Coal	1	6
Total	33	6

Although the Sewickley coal is above river level throughout the Masontown quadrangle, it is not developed to any extent below Hatfields Ferry. It is generally thin in this region and is composed largely of bituminous shale.

Uniontown coal.—This bed, although seemingly persistent throughout this part of Greene County, is too thin to be of commercial importance under present conditions. The horizon was recognized at a great many localities by a small coal bloom in the road, but no details of the bed could be obtained. At the time of the previous survey of this region this bed was worked on a small scale in Cumberland Township. The bed section at this opening is as follows:

Uniontown coal in Cumberland Township.

	Feet.	Inches.
Coal	1	6
Sandstone	10	0
Coal	1	0
Total	12	6

Waynesburg coal.—This bed reaches its greatest development in Greene County. Its total thickness is frequently 7 or 8 feet, but it is so broken by clay partings and the coal is frequently so impure that mining is expensive, and the coal has generally been discarded as a fuel in this region.

Owing to the southward rise of the strata, the outcrop of this bed recedes from the river south of the mouth of Whiteley Creek, and on the ridge between Whiteley and Dunkard creeks the Waynesburg coal is exposed only in the highest points and its outcrop is limited to a few square miles in extent. Near the western edge of the quadrangle, on one of the tributary branches of Dunkard Creek, an opening was seen which shows 5 feet of clear coal with a sandstone roof. Other old openings exist in

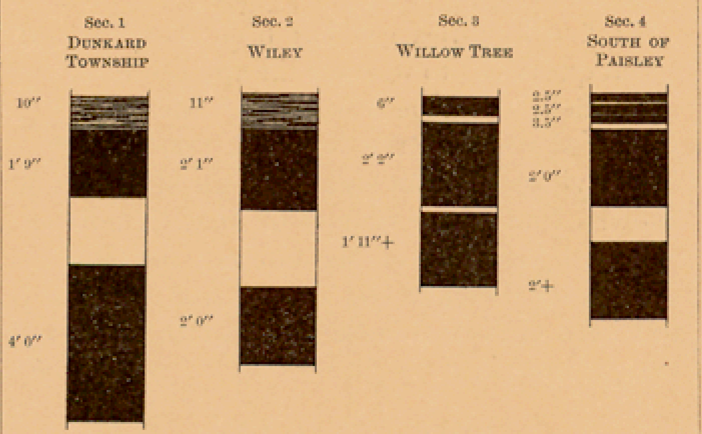


FIG. 23.—Sections of Waynesburg coal.

this vicinity, but they are generally closed and the coal is inaccessible. The following detailed section (sec. 1, fig. 23) was measured at an opening on the Morgantown road near the Greene Township line:

Waynesburg coal in Morgantown road, Dunkard Township.

	Feet.	Inches.
Coaly shale	0	10
Coal	1	9
Clay	1	9
Coal	4	0
Total	8	4

A partial section from a mine near the northeast corner of Greene Township is as follows (sec. 2, fig. 23):

Waynesburg coal near Wiley.

	Feet.	Inches.
Coal and shale	0	11
Coal	2	1
Clay	2	0
Coal, seen	2	0
Total	7	0

The coal in this locality is generally poor and can not compete with coal from the Pittsburg bed, which is accessible all along Dunkard Creek in this quadrangle.

Since the mines on the Waynesburg coal generally have been abandoned in this region, it is extremely difficult to obtain details and thicknesses of the various members of the bed. At an opening about a mile west of Willow Tree the following section (sec. 3, fig. 23) was obtained:

Waynesburg coal a mile west of Willow Tree.

	Feet.	Inches.
Clay shale.		
Coal	0	6
Clay	0	2
Coal	2	2
Clay	0	2
Coal, seen	1	11+
Total	4	11+

On the road leading north from Willow Tree across Turkey Knob several coals are exposed, and there is some doubt as to which of these should be called Waynesburg. In preparing the geologic map, the uppermost bed, which shows in the road as a strong bloom under shaly sandstone, was considered to be the Waynesburg coal, but the coal showing 70 feet lower in the road makes also a heavy bloom, and this is overlain by coarse, massive sandstone which resembles the typical Waynesburg sandstone much more strongly than that which overlies the upper coal, and it seems possible that the lower coal is the true Waynesburg bed. If this interpretation prevails, the structure about Willow Tree, as indicated by the contour lines, should be considerably modified and rendered more complicated than by the present interpretation. If the Waynesburg horizon is lowered 70 feet it will apparently introduce a syncline, or, at least, a decided flattening almost on the axis of the Brownsville anticline, which, although feebly developed in Greene County, seems to extend at least as far as the western margin of the quadrangle.

Uncertainty of identification of Waynesburg coal north of Willow Tree.

Throughout all of the region south of Turkey Knob the Waynesburg coal is of workable proportions, but its character is such as to preclude extensive use until most of the other coal beds of the region are exhausted.

In the northern part of Monongahela Township the Waynesburg coal shows in a number of places in natural outcrop, and it has been mined at several points. Several old openings were observed above Sigsbee, but at no point was coal visible. It shows also as a bloom under massive sandstone on the road from Sigsbee to Paisley, on the north side of the divide. It was formerly mined on the road from Carmichaels to Greensboro, on a small branch of Little Whiteley Creek. The roof of this mine is composed of massive sandstone, beneath which the following section (sec. 4, fig. 23) was measured:

Waynesburg coal south of Paisley.

	Feet.	Inches.
Shale.		
Coal	0	2½
Bone	0	½
Coal	0	2½
Bone	0	¼
Coal	0	3½
Shale	0	1½
Coal	2	0
Shale	0	11
Coal, seen	2	0+
Total	5	9¾+

Owing to the imperfect drainage of the mine, the lowest bench is not well exposed, but its thickness is probably not much greater than that given. The variation in character of the Waynesburg sandstone is well illustrated in the vicinity of this mine. On the north side of the ridge the coal is overlain by 50 feet of very coarse sandstone, while on the opposite side of the ridge, within less than a quarter of a mile from the mine, the strata overlying the coal consisted entirely of sandy shale, bearing no resemblance to the heavy bed on the

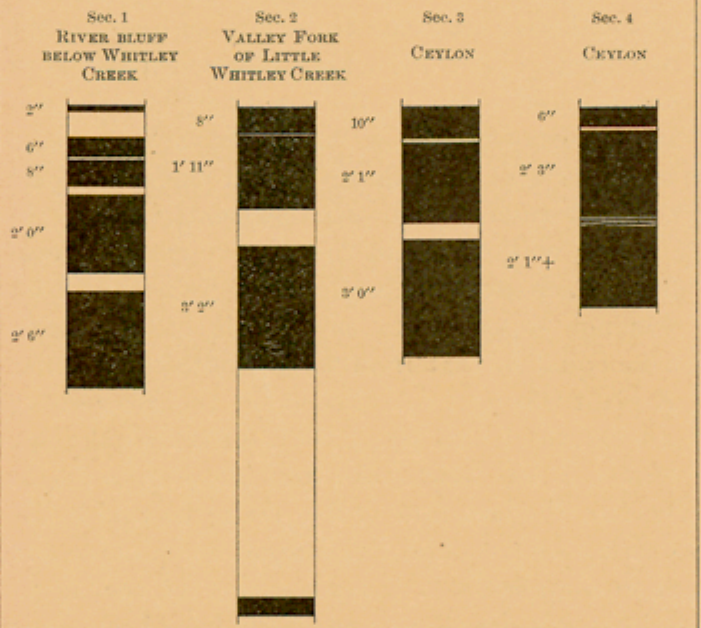


FIG. 24.—Sections of Waynesburg coal.

opposite side of the ridge. On the river bluff directly east of the last-described mines and about a quarter of a mile below the mouth of Whiteley Creek the following section (sec. 1, fig. 24) of the Waynesburg coal is exposed:

Waynesburg coal on bluff below mouth of Whiteley Creek.

	Feet.	Inches.
Coal	0	2
Clay	0	8
Coal	0	6
Clay	0	1
Coal	0	8
Clay	0	3
Coal	2	0
Clay	0	6
Coal	2	6
Total	7	4

At this point the interval between the Waynesburg coal and the Uniontown bed is 91 feet. The latter has a thickness of 2 feet and lies 136 feet above the Sewickley bed.

On the Valley Fork of Little Whiteley Creek the Waynesburg coal has been extensively prospected. Most of the pits have been so poorly cared for that the roof has fallen in and the coal is no longer visible. The best sections are the following from three openings about a mile from the main creek, which were published in Report K of the Second Geological Survey of Pennsylvania, p. 120, upon Greene County (sec. 2, fig. 24):

Waynesburg coal on Valley Fork of Little Whiteley Creek.

	Ft.	In.	Ft.	In.	Ft.	In.
Coal	1	0	1	0	0	8
Clay	0	1	0	½	0	½
Coal	2	2	2	1	1	11
Clay	0	10	0	8	1	0
Coal	2	9	2	11	3	2
Totals	6	10	6	8½	6	9½

On all the roads leading out of the lower part of this valley the bloom or old openings of this coal were observed, but most of the latter had been made years ago and were not accessible at the time of examination. In the vicinity of Ceylon the coal has been more extensively mined than at any other point on the stream. Some of the mines are still open and give the following section (sec. 3, fig. 24):

Waynesburg coal near Ceylon.

	Feet.	Inches.
Coal	0	10
Clay	0	1
Coal	0	24-26
Clay	0	1-10
Coal	3	0
Total (average)	6	6

Its quality is said to be fairly good, and it is used by the blacksmiths to some extent. A mine just east of the village gave the following partial section (sec. 4, fig. 24):

Waynesburg coal just east of Ceylon.

	Feet.	Inches.
Massive sandstone roof.		
Coal	0	6
Shale	0	1
Coal	2	3
Shale and bone	0	3
Coal, seen	2	1
Total	5	2

Judging from the previous section, it seems probable that the lower bench is somewhat concealed at this opening, but the coal varies so greatly from place to place that it is impossible to speak with certainty unless the coal is actually exposed.

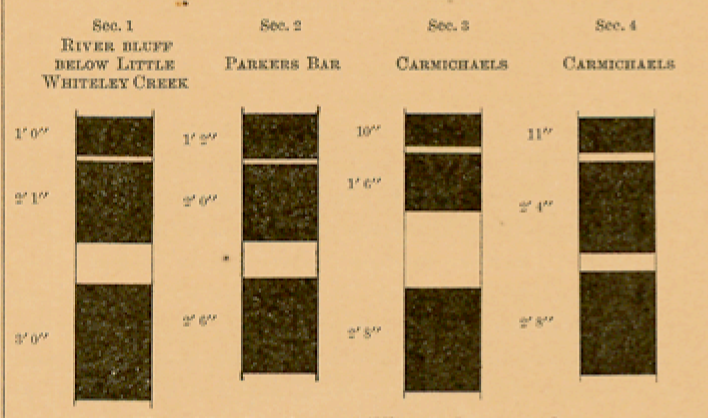


FIG. 25.—Sections of Waynesburg coal.

From Little Whiteley Creek to Carmichaels the valley has been so deeply filled with alluvium that the horizon of the Waynesburg coal is concealed. It shows, however, in the river bluffs at a number of places. About one-half mile below Little Whiteley Creek the following section (sec. 1, fig. 25) is exposed in an opening 190 feet above water level:

Waynesburg coal in bluff below mouth of Little Whiteley Creek.

	Feet.	Inches.
Coal	1	0
Clay	0	2
Coal	2	1
Clay	1	1
Coal	3	0
Total	7	4

At this point the Waynesburg is 90 feet above the Uniontown coal, which shows a thickness of 1 foot 6 inches. At a distance of 1½ miles below Little Whiteley Creek the coal shows the following section (sec. 2, fig. 25):

Waynesburg coal at Parkers Bar.

	Feet.	Inches.
Coal	1	2
Clay	0	2
Coal	2	0
Clay	1	0
Coal	2	6
Total	6	10

On the road from Carmichaels to Parker Bar a large coal bloom occurs in the road at about the horizon of the Waynesburg coal. The Waynesburg sandstone is poorly developed at this point, and the identification of the coal bed is made partly on its supposed agreement in altitude

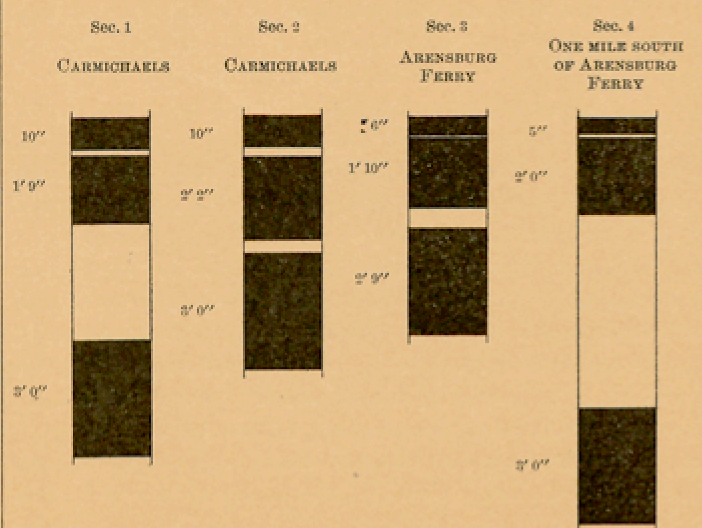


FIG. 26.—Sections of Waynesburg coal.

with the Waynesburg horizon and also upon the size of the bloom. The bed appears to be about 5 feet in thickness, but details regarding partings could not be obtained. It was formerly opened on the road west of Browns Ferry, but the mine is closed at the present time and no measurements could be obtained.

The Waynesburg coal has been extensively developed on Glade Run, which flows nearly due north about a mile east of Carmichaels. The following sections represent the coal as it appears in four openings located about due east of Carmichaels (secs. 3, 4, fig. 25 and secs. 1, 2, fig. 26):

Waynesburg coal 1 mile east of Carmichaels.

	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
Coal	0	10	0	11	0	10	0	10
Clay	0	2	0	3	0	2	0	3
Coal	1	6	2	4	1	9	2	2
Clay	2	0	0	6	3	0	0	4
Coal	2	8	2	8	3	0	3	0
Totals	7	2	6	8	8	9	6	7

The coal has also been mined on Muddy Run north of the village. The pits are generally in such condition that the coal cannot be measured, but the following section is reported from this locality:

Waynesburg coal on Muddy Creek north of Carmichaels.

	Feet.	Inches.
Coal	1	0
Clay	0	2
Coal	1	9
Clay	0	2–10
Coal	2	2
Clay	3	0
Coal	0	3
Clay	0	4
Coal	0	5
Total (average)	9	7

General relations on Muddy Run.

In the lower part of Muddy Run Valley many old pits were observed at this horizon, but generally the coal is not accessible. At a mine on the east side of the run, about a mile from the river, the coal lies in three benches, the uppermost having a thickness of 11 inches, the middle bench 2 feet 1 inch, and the lower bench 2 feet 6 inches. The clay parting between the middle and lower benches varies from 7 inches to 1 foot 6 inches in thickness. At the mouth of the run the coal is also divided into three benches, which are 8, 18, and 28 inches in thickness. At this point the Uniontown coal has a thickness of 2 feet, and it has been opened in the hillside 93 feet below the Waynesburg coal and 113 feet above the Sewickley coal, which has a thickness of 3 feet. In a similar section one mile below the mouth of Muddy Run the uppermost bench of the Waynesburg coal has a thickness of 9 inches, the middle bench 2 feet, and the lower bench 2 feet 6 inches. The Uniontown coal, with a thickness of 1 foot 6 inches, was identified 93 feet below the Waynesburg horizon, and the Sewickley, showing a thickness of 2 feet 6 inches, was found at an interval of 111 feet below the Uniontown horizon. At an opening 2 miles below the mouth of Muddy Run the Waynesburg coal shows the following section (sec. 3, fig. 26):

Waynesburg coal at Arensburg Ferry.

	Feet.	Inches.
Coal	0	6
Clay	0	½
Coal	1	10
Clay	0	6
Coal	2	9
Total	5	7½

At this locality the Uniontown and Sewickley coals were found in their normal positions, 92 feet and 206 feet respectively below the Waynesburg horizon. They are each reported to have a thickness of 2 feet.

One mile south of Arensburg Ferry the following section (sec. 4, fig. 26) was measured at the mouth of a mine entry:

Waynesburg coal 1 mile south of Arensburg Ferry.

	Feet.	Inches.
Coal	0	5
Clay	0	1
Coal	2	0
Clay	0	2–60
Coal	3	0
Total	5 ft. 8 in. to 10 ft. 6 in.	

The lowest clay parting, which at the mouth of the entry has a thickness of only 2 inches, swells to a thickness of 5 feet in a distance of 100 feet within the mines.

The Waynesburg coal was seen at several points west of the road from Arensburg Ferry to Carmichaels, but at no point could its thickness be determined.

Throughout Greene County the Waynesburg coal bed appears to be continuous and to carry a large amount of fuel, but it is so broken by clay partings, and the coal itself is generally so impure, that on the whole the bed is not of great prospective value.

Waynesburg "A" coal.—This coal bed is reported to be generally persistent throughout Greene County, but it is doubtful whether it attains as great a thickness in this region as it does in the Lambert syncline of Fayette County. It probably ranges from 1 to 3 feet, with an average in most of the territory of about 2 feet.

A section measured a short distance below the mouth of Little Whiteley Creek shows the coal bed to have a thickness of only 1 foot 6 inches. It is much better developed in the valley of Muddy Run above Carmichaels, where it has been mined, with a thickness of 3 feet 6 inches. The coal is reported to be of excellent quality, being very much superior to that of the Waynesburg bed. Throughout Monongahela Township at a number of places traces of this coal were seen which indicate that it maintains a thickness of about 2 feet throughout much of the territory. Its great development on Muddy Run is presumably local, since Professor Stevenson reports that it thins out and disappears a short distance west of this point.

The Waynesburg "B" coal and the Little Washington bed are doubtless present throughout much of this territory, but they are too thin to be of commercial value, and hence need not be discussed.

Washington coal.—The blossom of this coal was observed at a number of places in Greene County, but no sections of the bed could be obtained. It is probable that the aggregate thickness is considerable, but the actual amount of coal is only a fractional part of the whole and consequently the bed has little commercial value.

COKE.

Almost all of the coal mined from the Pittsburg bed in this region is converted into coke. This industry has reached wonderful proportions, although its development has been limited almost entirely to the decade just passed. In 1860 there were but 70 coke ovens in use in the Connellsville district. From this small beginning the plants have grown steadily in size and number until at present there are approximately 25,000 ovens in constant use in the territory embraced in the Connellsville basin and the Lambert syncline, including over 7000 ovens in the Uniontown and Masontown quadrangles.

Coking qualities of Pittsburg coal.

The character of the coal varies considerably in the Connellsville and adjacent territory in which the Pittsburg coal is coked. In the early days of the industry no coal except that mined from the southeastern side of the basin would be used, and it is claimed by old operators in the field that the coke produced on that side was far superior to that from the opposite side. At the present time most of the coal from the eastern side of the syncline has been exhausted, and in the trade there is no discrimination made in the coke from the various parts of the field. South of Uniontown the coal is under slight cover and there is a large amount of weathered coal which can not be used in the manufacture of coke. This is especially true of the isolated areas in the vicinity of Smithfield and Morris Crossroads. Yet even in these small areas the coal is being mined and the better part coked at several small establishments.

Until within the last four or five years the coal in the Lambert syncline south of Redstone Creek was not supposed to be capable of producing coke equal to that from the Uniontown syncline. A plant was once established on the river above the mouth of Cats Creek, but, for some unknown reason, it was abandoned and allowed to decay. Within the last four or five years the coal in the Uniontown syncline has become so valuable and is so completely in the possession of the larger coke companies that great efforts have been made to locate new territory from which coke could be produced for the various steel companies which were operating independently. This led to the establishment of the large mines in the southern end of the Lambert syncline, and they are rapidly developing.

It is impossible to predict the extension of the coking field in this direction, since the coal is almost entirely below drainage level and is inaccessible except by shafting, which has not been done west of Monongahela River. The Pittsburg coal in the Lambert syncline is successfully coked along Redstone Creek north of this quadrangle, and extensive developments, just described, have taken place on the eastern limb of the basin from New Salem to Masontown. It seems probable that in the near future the remainder of this basin will be made available and that the coal under parts of Luzerne Township and in Greene County west of the river will be found to contain coal capable of producing coke well adapted for furnace use.

The Connellsville coke is regarded as the standard of excellence in this country. The essential points in a coke for furnace use are hardness of body, well-developed cell structure, purity, and uniform quality.

Average composition of Connellsville coal and coke (McCreath).

	Coal.	Coke.
	Per cent.	*Per cent.*
Water	1.260	.300
Volatile matter	30.107	.460
Fixed carbon	59.616	89.576
Sulphur	.784	.821
Ash	8.233	9.113
Phosphorus	....	.014
Total	100.000	100.284

The average composition of Connellsville coal and its resultant coke, according to Mr. A. S. McCreath, is given in the preceding table.

The average of a number of analyses made in 1893 and reported by the H. C. Frick Coke Company shows the following composition:

Average composition of Connellsville coal and coke (Frick Company).

	Coal.	Coke.
	Per cent.	*Per cent.*
Water	1.130	.070
Volatile matter	29.812	.880
Fixed carbon	60.420	89.509
Sulphur	.689	.711
Ash	7.949	8.830
Total	100.000	100.000

NATURAL GAS.

General occurrence of gas.

Natural gas has been encountered in nearly all wells which have been sunk in the Masontown quadrangle, but with the exception of a few localities it has not been found in paying quantities. In nearly every case the sands that have yielded oil have also yielded some gas. The gas, however, is by no means confined to these horizons, but is encountered in slight amounts in nearly all of the more porous sandstones.

Locations of gas fields.

At five localities gas has been found in sufficient quantities to warrant the application of the term "field." The most northerly field is located south of the National Pike in the vicinity of Haddenville; the second is on Browns Run in the vicinity of McClellandtown; the third lies north of Masontown; the fourth is about a mile west of Old Frame; and the fifth is just back of New Geneva in the southern part of the quadrangle.

HADDENVILLE GAS FIELD.

The Haddenville field has been developed since the field work of the present survey was completed, and hence none of the wells are located on the map. Judging from the somewhat vague and indefinite reports, it probably outranks the other fields of the Masontown quadrangle. At the present time nine wells are located in this field. In all except two gas is derived from both the Gantz and "Fifty-foot" sands. The two exceptional wells found gas in the Big Injun sand.

Thompson well.—Well No. 2 of Economic Geology sheet, located on Dearth farm, three-quarters of a mile south of Haddenville, Menallen Township. Elevation, 1150 feet. Well mouth about 170 feet below Pittsburg coal. (Second Geological Survey of Pennsylvania, Report I^5, pp. 320–321.)

About 1886 this well was sunk to a depth of about 2000 feet on the Dearth farm, three-quarters of a mile south of Haddenville, in Menallen Township. A flow of gas was obtained at depths of 1200 and 1712 feet, presumably from the Big Injun and Gantz sands. The "pay streaks" lie respectively at 1040 and 1540 feet below the top of the upper "red-rock" of the drillers (Conemaugh red shale); the top of the red shale is ordinarily from 300 to 315 feet below the Pittsburg coal; hence, if the latter were present the approximate intervals between it and the "pay streaks" would be 1340 and 1840 feet, respectively. The following record shows the succession of beds encountered:

Record of Thompson well, near Haddenville.

	Thickness in feet.	Depth in feet.
Conductor	20	20
Slate	10	30
Limestone	10	40
Sandstone and slate	30	70
Slate, black	40	110
Sandstone, black and hard	20	130
Slate, white	30	160
Red rock	20	180
Sandstone	10	190
Red rock	25	215
Slate	30	245
Sandstone	25	270
Red rock	20	290
Slate, black	10	300
Sandstone, white	35	335
Slate and shells	25	360
Coal	1	361
Slate	9	370
Shells, hard	8	378
Sandstone, white, pebbly (Mahoning)	100	478
Slate, dark	50	528
Sandstone, white (gas)	28	556
Slate and shells	35	591
Sandstone (salt water)	10	601
Slate, very black	70	671
Sandstone	5	676
Red rock	20	696
Slate	10	706
Red rock	25	731
Slate	5	736
Red rock	20	756
Slate	10	766
Red rock	20	786
Sandstone, white (Pottsville)	230	1016
Slate	5	1021
Limestone	90	1111
Sandstone, white, hard (Pocono; gas at 1200 and 1212)	190	1301
Slate and shale	100	1401
Sandstone, dark	25	1426
Shale, white	100	1526
Slate, white	47	1573
Sandstone, dark	50	1623
Slate, white	25	1648
Sandstone, dark	30	1678
Slate	32	1710
Sandstone (gas)	2	1712

It seems probable that there is an error in this section, since for a distance of 110 feet above the supposed Pottsville sandstone the prevailing color of the rocks is reported to be red—a color that is seldom found in the Allegheny formation.

This well is located almost at the very crest of the anticline, a position usually considered as most favorable for the occurrence of gas. The fact that only a little gas was found, while in the wells recently drilled on the western slope of the anticline and nearly a mile from its axis large flows of gas were obtained, may possibly be due to the lenticular character of the various individual layers of sand and shale making up the producing formations, or to a lack of porosity in the sand at its highest point.

Hugh Thompson well.—Well No. 1 of Economic Geology sheet. Located a few hundred feet northeast of the post-office at Upper Middletown. Elevation, 950 feet. (Second Geological Survey of Pennsylvania, Report I^5, p. 319).

Gas in small quantities has been obtained from this well which was sunk to a depth of 2440 feet. Its position is near the crest of the Fayette anticline. The gas reaches the surface accompanied by a strong flow of water, but is collected under a tank and supplies the needs of the town. The amount is apparently too small and the depth too great to encourage further drilling in the vicinity. Following is a record of the well:

Record of Hugh Thompson well at Middletown.

		Thickness in feet.	Depth in feet.
Conductor		10	10
Coal		4	14
Soapstone		20	34
Sandstone, white, hard		15	49
Slate, black		60	109
Sandstone, white		30	139
Limestone, blue		10	149
Slate, black, and coal		40	189
Sandstone, white, hard		38	227
Slate		50	277
"Salt sand" (gas)		20	297
Slate and coal		80	377
Slate and shells		40	417
Sandstone		10	427
Slate		40	467
"100-foot" sand	(Pottsville)	138	605
Slate		10	615
Sandstone, black		90	705
Red rock and slate		145	850
Sandstone, shaly	(Pocono)	20	870
Sandstone, white		145	1015
Slate		5	1020
Sandstone, white		120	1140
Slate and shells		80	1220
Sandstone, white, hard		35	1255
Slate and shells		175	1430
"Stray" sand (black)		18	1448
Slate, white		15	1463
Slate, black, and shells		175	1638
Sandstone, pebbly		30	1668
Slate and shells		180	1848
Red rock		310	2158
Slate and shells		50	2208
Sandstone, bluish		20	2228
Slate, white, to bottom		22	2440

FAYETTE GAS FIELD.

The second largest field was that designated by the Second Geological Survey of Pennsylvania as the Fayette field. This was opened in 1887 by the Ryder well, located on the North Branch of Browns Run a mile or more southeast of McClellandtown. This well was a powerful one, the gas being piped to Uniontown and supplying the needs of that town for some time. The position of the well is high up on the flank of the anticline, its curb being below the outcrop of the Pittsburg coal. The gas was from the Big Injun sand. A few other wells were sunk in the vicinity of the Ryder well and small amounts of gas were obtained, but no extensive pool was developed. The record of the Jos. Mack well gives the succession of the rocks of the field.

Jos. Mack well.—On farm of Jos. Mack, North Branch of Browns Run, about a mile southeast of McClellandtown, German Township (Second Geological Survey of Pennsylvania, Report I^5, pp. 321–322).

Record of Jos. Mack well, near McClellandtown.

	Thickness in feet.	Depth in feet.
Conductor	15	15
Shale, sandy, dark, hard	27	42
Sandstone, blue, hard	40	82
Slate, dark	33	115
Shale, red	20	135
Slate, blue	15	150
Sandstone, blue	7	157
Shale, yellow	16	173
Sandstone, gray, hard	19	192
Slate, blue, soft	25	217
Limestone, gray	10	227
Shale, sandy	11	238
Shale, red	12	250

	Thickness in feet.	Depth in feet.
Sandstone, white, hard	50	300
Slate, blue	26	326
Sandstone, dark, hard	6	332
Slate, blue	24	356
Sandstone, gray	16	372
Sandstone, light gray, hard (Mahoning)	38	410
Shale and coal	14	424
Shale, brown	19	443
Limestone, dark	30	473
Sandstone, gray, hard	33	506
Shale, dark	24	530
Shale, black	14	544
Shale, blue	60	604
Sandstone, brown, hard	26	630
Sandstone, white, hard	23	653
Shale and coal	16	669
Sandstone, white, hard	18	687
Shale, blue	50	737
Sandstone, white	47	784
Shale, black (Pottsville)	20	804
Limestone, gray	15	819
Shale, dark	42	861
Sandstone, light, hard	20	881
Shale, blue	8	889
Slate, red	33	922
Sandstone, blue, soft	39	961
Shale, red, some lime	20	981
Limestone, shaly, blue	23	1004
Limestone, hard	18	1022
Limestone, very hard. (Greenbrier)	33	1055
Limestone, shaly, soft	20	1075
Limestone, siliceous and red	12	1087
Shale, soft	7	1094
Limestone, siliceous, white	59	1153
Sandstone, white	30	1183
Sandstone, white (strong gas) (Pocono)	13	1196

MASONTOWN GAS FIELD.

The limits of the Masontown gas field can not be defined at present, as every well sunk in the region produces some gas. The best wells, however, are confined to an area lying between Masontown, Monongahela River, and Browns Run. The gas is mainly from the Gantz sand of the lower part of the Pocono formation, and is encountered at intervals of 1831 to 1886 feet below the Pittsburg coal. At least one well (Gilmore) encountered considerable gas in the Big Injun sand in the upper Pocono at 1371 feet above the coal. The record below gives the succession and thickness of the beds encountered by the wells of the Masontown field as reported by the drillers.

The supply from the Masontown wells has held out fairly satisfactorily. The gas has been piped to Uniontown, about 12 miles to the east, and was the principal source of supply for that town for some time.

S. T. Gray well.—Well No. 17 of Economic Geology sheet. On farm of S. T. Gray, Cats Run, three-quarters of a mile southeast of Masontown. Elevation, 880 feet. Well mouth 15 feet below Pittsburg coal. (Second Geological Survey of Pennsylvania, Report I[5], pp. 322–323.)

Record of S. T. Gray well, on Cats Run.

	Thickness in feet.	Depth in feet.
Unrecorded	375	375
Sandstone, gray, hard	15	390
Shale, black	60	450
Sandstone	35	485
Shale and limestone	20	505
Shale, dark	45	550
Sandstone (Mahoning)	50	600
Shale, black	40	640
Sandstone, gray	8	648
Shale, black	35	683
Sandstone, gray	18	701
Shale, dark	30	731
Sandstone, dark	25	756
Shale, black	40	796
Shale, gray	6	802
Shale, black	16	818
Sandstone, white	15	833
Sandstone, dark	30	863
Sandstone, white	7	870
Sandstone, soft, white (Pottsville)	108	978
Shale and coal	4	982
Sandstone, soft	18	1000
Sandstone, white, hard	36	1036
Limestone, shaly	24	1060
Limestone and red shale	70	1130
Limestone, greenish and shaly	10	1140
Limestone, red, soft	60	1200
Limestone, sandy, white	32	1232
Limestone, shaly	43	1275
Limestone, sandy, white	17	1292
Limestone, shaly	11	1303
Limestone, sandy	77	1380
Sandstone, white (oil show)	41	1421
Shale, sandy	34	1455
Sandstone, gray	10	1465
Slate, sandy	15	1480
Sandstone, gray, hard	10	1490
Shale, dark	50	1540
Sandstone, gray, soft	95	1635
Shale, dark	130	1765
Sandstone, gray	15	1780
Shale, dark	85	1865
"Gantz sand" (gas at 1894 feet)	35	1900
Shale	5	1905
"Fifty-foot sandstone"	60	1965
Slate and shells	185	2150
"Gordon sand"	5	2155
Shale, sandy, red	227	2382
Sandstone	15	2397
Slate, sandy	53	2450
Slate to bottom	75	2525

GAS FIELD NEAR OLD FRAME.

A group of wells somewhat over a mile west of Old Frame, in Nicholson Township, marks the position of another small gas pool. The gas is said to be obtained from the Big Injun at a depth of about 1350 feet below the Pittsburg coal. The record of one of the wells of this pool is given below.

David Gans well.—Well No. 22 of Economic Geology sheet. Located 1 mile west of Old Frame, Nicholson Township. Elevation, 1040 feet. Well mouth about 80 feet below Pittsburg coal. Finished December 16, 1899. Authority, J. W. Shay, Washington, Pa.

Record of David Gans well, near Old Frame.

	Thickness in feet.	Depth in feet.
Conductor	12	12
Limestone	13	25
Sand	25	50
Unrecorded	35	85
Limestone (water)	10+	95+
Slate	65	160
Sandstone	30	190
Slate	40	230
Sandstone	30	260
Red rock	30	290
Slate and limestone	90	380
"Little Dunkard sand"	15	395
Slate	55	450
"Big Dunkard sand" (show of oil at 465 feet)	30	480
Bottom of limestone		580
"Lower Dunkard" (Mahoning)	40	620
Slate and limestone	140	760
"Gas sand"	55	815
Slate and shells	50	865
"Salt sand"	80	945
Slate (Pottsville)	25	970
Sandstone	20	990
Slate	25	1015
Red rock	40	1055
Limestone (Greenbrier)	60	1115
Red rock	30	1145
Limestone	55	1200
"Keener sand"	20	1220
Unrecorded	35	1255
Top "Big Injun sand"		1255
Gas (Pocono)		1261
Bottom of well		1265

The well is located about 1½ miles northeast of the axis of the Fayette anticline, which is here flattened until the dips do not exceed 80 or 90 feet per mile.

NEW GENEVA GAS FIELD.

The development of the New Geneva gas field is of recent date and little is known regarding it, except that four wells located within a mile of the village derive their supply of gas from the Big Injun sand, and others a little farther away from the town find a good flow of gas in the "Fifty-foot" sand.

MISCELLANEOUS WELLS.

A considerable number of other wells have been drilled within the limits of the quadrangle, but have rarely met with success. The records of two of these wells are given below.

Smithfield well.—Well No. 23 of Economic Geology sheet. Located on west side of Yorks Run, 1 mile north of Smithfield. Elevation, 970 feet. Well mouth about 100 feet below Pittsburg coal. Authority, E. L. Geer, Masontown, Pa.

Record of Smithfield well.

	Thickness in feet.	Depth in feet.
Conductor	15	15
Shale, soft blue	10	25
Hard, dark iron ore	2	27
Coal	1	28
Shale, light	15	43
Shaly sandstone, blue, hard	30	73
Sandstone, hard, gray	20	93
Sandstone, white, very hard	22	115
Sandstone, white, pebbly	14	129
Shale, light	6	135
Coal	1	136
Shale, black	7	143
Shale, dark, gritty	13	156
Ore, dark, very hard	4	160
Shale, blue	16	176
Coal	2	178
Shale, blue	17	195
Shale, red	6	201
Shale, light	25	226
Shale, red	16	242
Sandstone, hard, blue	6	248
Shale, red	10	258
Shale, light	40	298
Shale, dark	20	318
Limestone, dark	4	322
Shale, light	15	337
Shale, red	15	352
Sandstone, greenish gray	33	385
Shale, black	15	400
Sandstone, gray, very hard	5	405
Shale, black	30	435
Shale and sandstone, hard	10	445
Shale and limestone, blue	45	490
"Lower Dunkard" sandstone, open, gray (Mahoning)	30	520
Shale, black, loose	6	526
Sandstone, hard, gray	70	596
Shale, black and coal	15	611
Limestone, hard, brown	50	661
Shale, black	10	671
Shale, hard and soft alternating	15	686
Sand, dark gray, hard spots	15	701
Shale, black, and coal	12	713
Shale, soft, light	35	748
Shale, sandy, dark	12	760
Coal, hard	4	764
Shale, light	12	776
Sandstone, close, brown	35	811
Sandstone, white to brown	60	871
Shale, dark	35	906
Sandstone, dark, very hard (Pottsville)	8	914
Shale, black, loose	22	936
Sandstone, hard, gray	52	988
Shale, red, (some lime)	94	1082
Shale, dark	40	1122
Limestone shells, soft	24	1146
Limestone, dark, hard	67	1213
Limestone, gray, hard	10	1223
Limestone, dark	16	1239
Sandstone, light, hard (some lime; show of oil)	21	1260
Limestone, hard, gray	4	1264
Sandstone, light, hard (some lime)	20	1284
Sandstone, light, (hard salt water)	36	1320
Sandstone, white, hard (some lime)	70	1390
Shale, dark	20	1410
Sandstone, gray, hard	10	1420
Shale, dark, sandy	45	1465
Sandstone, gray, hard (some gas)	82	1547
Shale, dark	10	1557
Sandstone, gray, hard	28	1585
Shale, dark shells	100	1685
Sandstone, gray, hard	10	1695
Shale, dark	39	1734
Sandstone, gray, hard	20	1754
Shale, blue	34	1788
"Gantz sand," hard, white	12	1800
Shale, blue	30	1830
Sandstone, hard, gray (show of gas)	28	1858
Finished in dark shale and sandstone.		

Stoner well.—Well No. 24 of Economic Geology sheet. Located 2½ miles southeast of New Geneva, on branch of George Creek 1 mile south of the main creek. Elevation, 920 feet. Well mouth about 200 feet below Pittsburg coal. Drilled by Greensboro Natural Gas Company. Authority, J. W. Shay, Washington, Pa.

Record of Stoner well, near New Geneva.

	Thickness in feet.	Depth in feet.
Conductor	16	16
Limestone	29	45
Unrecorded	65	110
Red rock	80	190
White slate	30	220
Coal	5	225
Hard sandstone	40	265
Slate	8	273
Hard sandstone	113	386
Slate	20	406
Sandstone	70	476
Limestone	30	506
Coal (light gas)	6	512
Slate	65	577
Sandstone	87	664
Coal	6	670
Hard sandstone (Pottsville)	198	868
Black sandstone	10	878
White slate	5	883
Fine shale	5	888
Red rock	9	897
Red limestone	139	1036
White slate	14	1050
Red limestone	22	1072
Sandstone	8	1080
Limestone	66	1146
Sandstone	15	1161
Limestone	20	1181
Red sand	16	1197
Big Injun sand (light gas at 1245, 1258, 1277)	160	1357
Slate	33	1390
Sandstone	140	1530
Slate	15	1545
Limestone	55	1600
Slate	76	1676
Sandstone	19	1695
Slate	35	1730
Sandstone (light gas at 1832)	120	1850
Slate	6	1856
Sandstone	19	1875
Slate	49	1924
Sandstone	11	1935
Slate	8	1943
Red rock	32	1975
Sand	15	1990
Slate	8	1998
Red rock	52	2050

PETROLEUM.

In the Masontown quadrangle no large pools of oil have so far been discovered, but there are three distinct districts from which some oil has been obtained.

MOUNT MORRIS-MANNINGTON OIL FIELD.

The most southerly district is the great Mount Morris-Mannington field, which is so extensively developed in West Virginia. This field extends a few miles into Pennsylvania, terminating in the valley of Dunkard Creek near the southern line of the Masontown quadrangle.

This valley has experienced two periods of production. The first exploitation for oil dates back so many years that little information can be obtained regarding it. According to Professor Stevenson's report on Greene County, which was published in 1876, the field had then been so long abandoned that the majority of the wells were closed.

The top sand from which the oil was derived lies about 425 feet below the Pittsburg coal. The "pay streak" is at variable depths, ranging from 425 to 463 feet below this horizon. The sandstone is usually regarded as equivalent to the Mahoning sandstone of Allegheny Valley, but the interval between it and the Pittsburg coal is considerably smaller than in adjacent regions, and the sandstone is separated from the Freeport coal by the abnormally large interval of 60 to 70 feet, as shown in some of the well records from near this field. Presumably it has been classed as Mahoning on account of the coarseness of the sand, but in southwestern Pennsylvania many of the beds above the Mahoning horizon are equally coarse, and sometimes conglomeratic, so that it is possible, as is frequently shown at the surface, for the Mahoning sandstone to disappear and be replaced by a coarse bed a little higher in the series.

The second period of development in the valley followed the discovery of oil in the Mount Morris-Mannington field in 1886. The producing sandstone in this field is known to the drillers as the Big Injun sand, and corresponds with some part of the Pocono formation. The field has yielded a large amount of oil, but the productive territory probably does not extend into this quadrangle. The character and succession of the rocks are shown in the following section, which is the record of one of the early wells drilled near Mount Morris, in Greene County:

Core well, No. 2.—Near Mount Morris, Greene County, Pa. (Bull. Geol. Soc. Am., Vol. III, p. 189.) Record kept by Mr. John Garber, contractor.

Record of Core well No. 2, near Mount Morris, Greene County.

	Thickness in feet.	Depth in feet.
Conductor	21	21
Slate	104	125
Sandstone (Waynesburg)	45	170
Coal (Waynesburg)	10	180
Limestone and shale	120	300
Sandstone	25	325
Limestone (Great limestone)	85	410
Black slate	10	420
Coal (Sewickley ?)	10	430
Limestone	85	515
Coal (Pittsburg)	10	525
Slate	70	595
Sandstone	55	650
Red shale	35	685
Sandstone	15	700
Red shale	10	710
Blue shale	25	735
Sandstone (Morgantown)	55	790
Blue slate	40	830
Blue and red slate	20	850
Limestone and hard beds	80	930
Red slate	5	935
Sandstone	25	960
Dark slate	60	1020
Sandstone (Mahoning)	30	1050
Slate, light gray	60	1110
Sandstone (Freeport)	80	1190
Dark slate	25	1215
Limestone	40	1255
Dark slate	40	1295
Sandstone, hard	5	1300
Slate	60	1360
Salt sand	150	1510
Slate	10	1520
Limestone (?) (Pottsville)	20	1540
Slate	10	1550
Dark pebbly sand	20	1570
Light-colored sandstone	95	1665
Limestone, hard	22	1687
Red shale	13	1700
Dark slate	45	1745
Red shale	3	1748
Limestone (Greenbrier)	56	1804
Big Injun sand (Pocono) (oil)	101	1905

WHITELEY CREEK FIELD.

The Whiteley Creek field, in the eastern part of Greene Township, is the most important of the oil fields lying entirely within the limits of the Masontown quadrangle. Though never so productive as the Dunkard Creek field, it contains a great many wells, some of which produced as high as 100 barrels or more a day at the start. This field is confined to the immediate vicinity of Whiteley Creek. Its eastern limit is probably not far from the Greene-Monongahela township line, from which point it extends westward along the creek to beyond the limits of the quadrangle.

The Whiteley Creek field is located west of the Fayette anticline. The general geologic structure is flat, but near the oil field there is a shallow local basin, with its center about three-quarters of a mile east of Willow Tree. From this point the rocks rise gently in all directions, the most marked rise being to the west and extending beyond the limits of the quadrangle. The wells of the Whiteley Creek field are located upon this westward rise, the altitudes of the rock strata varying from 30 to 60 feet above their position at the center of the basin.

In the area of the Whiteley Creek field, as here defined, oil has been obtained only from the upper sands. Thus at Vance's mill, on Whiteley Creek about a mile southeast of Willow Tree, oil was reported at horizons of 120, 368, and 395 feet below the Pittsburg coal. On the Gregg farm, half a mile south of Willow Tree, a number of wells have been sunk to the "Dunkard" sand, which here lies at a depth of 480 feet below the coal. Many of these were successful, some yielding as high as 100 barrels a day at the start. The oil of the upper horizon is heavy and is not fit for illuminating purposes. The oil from the Dunkard and the immediately overlying sandstones is lighter, having a gravity of about 40 degrees. As in the Dunkard Creek district, the caving of the soft shales was a constant source of trouble in early operations in the field, but the difficulty is now remedied by proper casing. A number of wells are still active in this field.

The succession of rocks encountered in the wells drilled on the Gregg farm, just south of Whiteley Creek, is given in the following record:

Gregg well.—Well No. 20 of Economic Geology sheet.

On Gregg farm, one-half mile south of Willow Tree, Greene Township, Greene County. Elevation, 980 feet. (Record above Dunkard or Mahoning sandstone is new. Record below that horizon is adjusted from record on p. 316 of Report I[5] of Second Geological Survey of Pennsylvania.)

Record of Gregg well.

	Thickness in feet.	Depth in feet.
Limestone	60	60
Slate and slaty sandstone	30	90
Mapletown coal	5	95
Limestone with slaty partings	60	155
Black shale and cannel coal	20	175
Coarse sandstone	50	225
Pittsburg coal	9	234
Slate	30	264
Limestone shells	20	284
Slate	40	324
Sandstone, coarse (water)	20	344
Slate	50	394
Sandstone, "First Dunkard"	80	474
White slate	70	544
Red rock	70	614
White slate	15	629
Sandstone	15	644
White slate	40	684
"Dunkard sand"	30	714
Slate	10	724
Sandstone, white (Mahoning)	66	790
Sandstone, black (Mahoning)	16	806
Slate and shells	86	892
Sandstone, white	32	924
Slate and shells	120	1044
Slate	20	1064
Sandstone, black (oil show)	17	1081
Coal	8	1089
Sandstone, white (salt water at 1109) (Pottsville)	50	1139
Slate (Pottsville)	35	1174
Sandstone, white (salt water at 1209) (Pottsville)	90	1264
Red rock	145	1409
Sandstone, white (gas and salt water at 1587 and 1629)	320	1729
Slate and shells	15	1744
Slate	30	1774
Sandstone, red (oil show)	39	1813
Slate and sand shells	140	1953
Sandstone, gray	36	1989
Slate and shells	95	2084
Sandstone, brown	30	2114
Slate and pebbles	15	2129
Sandstone, gray, supposed to be the Gantz sand	25	2154

BLACKSHIRE POOL.

The Blackshire pool, the wells of which draw their supply from the Big Injun sand at depths of from 1250 to 1350 feet below the Pittsburg coal, is a pool of very limited area situated on Whiteley Creek at the point where it is crossed by the direct road between Mapletown and Sigsbee, in Monongahela Township. The original Blackshire well gave 100 barrels or more a day at the start, and was the incentive for the sinking of a number of other wells surrounding the first, but only one or two produced oil, and these only in small quantities. The production of the original well rapidly declined and soon ceased.

The pool is located on the outer portion of the western slopes of the Fayette anticline. The dips are very gentle, though the rocks still show a perceptible pitch to the northwest. In the immediate vicinity of the wells there appears to be a local flattening, which interrupts the general northwestward dip, and may account for the occurrence of oil at this point.

OTHER WELLS AND PROSPECTS.

Well near Greensboro.

A well starting about 150 feet below the outcrop of the Pittsburg coal and about 30 feet above the river was sunk by Williams and Ruppert near the pottery works at Greensboro, about 3 miles southeast of the Blackshire pool. The Mahoning sandstone was encountered at 300 feet, and it is said to have yielded about a barrel a day. The drilling was continued to a depth of 1300 feet. The Big Injun sand was entered at 1107 feet and yielded some gas and a show of oil. The quantity of oil is so slight, however, that the presence of a pool can not be considered as established.

Wells near Masontown.

A number of wells have been drilled for gas near Masontown and in the region between this place and Monongahela River and Browns Run. Several of these wells encountered indications of oil, and two or three produced slight amounts from the Big Injun (Pocono) group of sands at depths of from 1250 to 1375 feet below the Pittsburg coal. It does not appear, however, that anything which could be termed an oil pool exists at this point, the sand being barren except at a few scattered localities, where it has given, at the most, only a few barrels a day.

The position of the producing wells is upon the westward flank of the Fayette anticline. Near Masontown there is a somewhat marked flattening of the dip, from 200 feet to the mile just east of the town to 75 or 100 feet per mile in the vicinity of the wells. It is presumably this flattening of the dip which has been the cause of the retention of the oil in the sandstone at this point. Little or no oil is now produced, and very little drilling is going on in the region.

Although many wells have been sunk for gas along the west flank of the Fayette anticline from Masontown northeastward along its course, the region can not be said to have been thoroughly exploited, and it is possible that future drilling may develop new pools at other points along the anticline to the northeast.

Flat dips, such as characterize the Blackshire, Whiteley, and Dunkard Creek fields, present much more favorable conditions for the retention of oil than the steep dips prevailing northeast of Masontown. Flat dips hinder and steep dips facilitate the loss of the oil by its upward passage through the porous rocks or along the bedding planes toward the surface. The presence or absence of oil in the more steeply dipping beds along the anticline, however, can be determined only by actual drilling.

DEPTH OF PRODUCING SAND.

The following table shows the depth at which the producing sand was struck in the various wells listed in the Masontown quadrangle:

Elevation and product of wells in the Masontown quadrangle and depths of sands struck.

(Compiled from data furnished by operators and from published reports).

No. on map.	Elevation above sea.	Name of well.	Product.	Producing sand.	Depth to pay streak.	Depth of pay streak below Pittsburg coal.	Depth to Big Injun sand.	Depth to Gantz sand.
	Feet.				*Feet.*	*Feet.*	*Feet.*	*Feet.*
1	950	Hugh Thompson	Gas				870	
2	1150	Thompson	Gas	?	530		1110	
			Gas	Big Injun	1200			
			Gas	Gantz	1700			
4	1020	Parshal	Small gas	Big Injun				
5	980	T. A. Hoover	Small oil	Big Injun	1730	1376	1590	2213
6	1020	Hess	Large gas	Gantz	2228	1839		2228
7	960	J. E. McWilliams	Big gas	Gantz	2161	1840		2161
8	1100	J. V. Hoover	Small oil	Big Injun			1673	2313
			Large gas	Gantz	2313	1886		
9	1100	Gilmore	Good gas	Big Injun	1830	1371	1690	2327
10	940	Lardin	Small gas	Big Injun	1570	1390	1430	2055
11	1040	Louck	Brine	Big Injun	1610	1391	1470	
12	1020	David Coffman	Small gas	Big Injun	1213	1423	1073	
13	800	Keener-Durr North	Gas				1422	1980
14	800	Keener-Durr South	Light gas	Gantz				
15		J. B. Sterling	Large gas	Gantz	2110	1850		
16	1010	E. W. Sterling	Oil, 3 bbls.	Big Injun	1610	1376	1470	2096
17	880	S. T. Gray	Small gas	Gantz	1894	1909		1865
18	800	Shay	Good gas	Gantz				
19	880	Blackshire	Oil, 100 bbls.	Big Injun				
20	980	Gregg	Oil, 5-100 bbls.	Dunkard	714	480		
21	810	Williams & Reppert	Oil show	Dunkard	300	470	1107	
			Gas	Big Injun	1132	1302		
22	1040	David Gans	Oil show	Dunkard	465	545	1255	
			Gas	Big Injun	1261	1341		
23	970	Smithfield	Oil show	Big Injun	1239	1339	1240	1788
			Brine		1284	1384		
			Show of gas		1465	1565		
			Show of gas	Gantz	1830	1930		
24	920	Stoner	Show of gas	Big Injun	1245	1445	1197	
			Show of gas	Big Injun	1258	1458		
			Show of gas	Big Injun	1277	1477		
			Show of gas		1832	2032		

CLAY.

The clay interests in the Masontown and Uniontown quadrangles are of considerable importance. This is particularly true of the more refractory clays which are used in the manufacture of fire brick for the construction of coke ovens. Since the number of coke ovens in this territory exceeds 7000, there is a demand for fire brick for their constant repair and for the construction of new ovens. Aside from the demand for highly refractory clays there are also a number of plants producing ordinary red brick, vitrified paving brick, and pottery ware.

Character of clays.

The clays of this district may be divided into two classes. The first class, or regularly bedded deposits, usually occur in association with beds of coal. These have received the general designation fire clays, although they vary greatly in their refractoriness, or, in other words, in their ability to withstand intense heat. The second class is made up of residual surface clays and of deposits in the abandoned channels of Monongahela River.

Utilization of the surface clays.

The surface clays are used almost exclusively in the manufacture of ordinary red brick. Plants for their manufacture are located at Fairchance and Uniontown. Since the demand for this class of structural material depends upon the general development of the country, the increase in demand is likely to be slow, and the future for this industry is not particularly promising.

In the vicinity of New Geneva and Greensboro, beds of very good plastic clay occur in the material filling the old abandoned channels of Monongahela River. Since 1854 this clay has been utilized for the manufacture of blue stoneware, such as jugs, jars, etc. It is only a small industry, but has been very successfully carried on not only at New Geneva but at Greensboro, on the west side of the river. The clay pits from which the potteries derive their supply are located about 1 mile south of New Geneva and at an altitude of about 96 feet above river level. The workable clay is of a bluish-white color. It is 6 to 8 feet thick and is associated with the ordinary sand and clay deposits that are common to these abandoned channels throughout this territory. Similar clay was formerly obtained on the west side of the river back of Greensboro, but the quality is not so good as that just described south of New Geneva.

Occurrence of fire clays.

The so-called fire-clays of the region are largely confined in their occurrence to the Allegheny formation. They occur at several horizons, and the thickness and quality of the clay are frequently such as to make the deposits of great economic importance. The lowest horizon at which an important clay bed has been discovered is directly beneath the Brookville-Clarion coal bed.

Clay under Brookville-Clarion coal.

The geographic extent of this bed is not known, but recent openings were seen on Laurel Ridge east of Mount Braddock, and also on Tucker Run, where it has been dug for use in the fire-brick works near the Dunbar furnace. An excellent exposure of this bed is seen in the Mount Braddock pits, which are situated on the crest of Laurel Ridge about 3 miles east of Percy. At this point the clay shows a thickness of 8 to 10 feet. It is a flint clay of excellent quality and is well adapted to the manufacture of fire brick, the purpose for which it is used. Near the head of Tucker Run this bed has been extensively developed. It shows a thickness of from 4 to 14 feet of excellent flint clay, and its position is within 20 feet of the top of the Pottsville sandstone.

Clays associated with Kittanning coal.

The Kittanning group of coals frequently contains important beds of fire clay in this district. They have been noted along the west side of Laurel Ridge from the West Virginia line to near Youghiogheny River. A bed of highly refractory fire clay occurs on Drague Run, in Springhill Township, a short distance south of the Masontown quadrangle. The clay has a thickness of from 4 to 6 feet and has been used for the manufacture of fire brick. It occurs about 80 feet below the Upper Freeport coal, and consequently belongs to the upper part of the Kittanning group. The same bed shows 90 feet below the Upper Freeport coal on Dunbar Creek, where it has a thickness of about 6 feet. Since these exposures occur on opposite sides of the quadrangle, it seems probable that the bed is constantly present along the west base of Laurel Ridge, but there is no evidence to show that it maintains its highly refractory character throughout the territory.

Several of the fire-brick works in this region derive their supply of clay from pits along Youghiogheny River between Indian Creek and Ohiopyle. Below Stewarton the clay from the Kittanning horizon is being mined at two localities, one about a mile below the station and another half a mile farther down the stream. The clay bed occurs about 150 feet above the Pottsville sandstone, and in thickness it ranges from 10 to 12 feet. It is an excellent flint clay, and it immediately underlies a coal bed from 15 to 18 inches in thickness.

Clay beneath the Upper Freeport coal.

The most important clay bed in this territory underlies the Upper Freeport coal bed and is generally known as the Bolivar clay, from the town on Conemaugh River at which clay works have been extensively developed. In the type locality the clay bed is 10 to 20 feet below the coal, and it varies in thickness from 6 to 25 feet. In Ligonier Valley, in Fayette County, the Bolivar fire clay is well developed below the Freeport limestone, and a small bed occurs just beneath the Upper Freeport coal, but the former is of very much greater importance than the latter. In the Cucumber Run section the fire clay below the limestone is well exposed by the roadside. Owing to the weathered condition of this outcrop it is difficult to state the exact thickness of the flint clay, but presumably it varies from 12 to 15 feet. A small exposure of clay was noted that probably occurs just below the Upper Freeport coal, although the latter bed does not show in outcrop in this section. Clay beds at the Bolivar horizon have been opened on the east side of Youghiogheny River just north of Bear Run, or from 1 to 2 miles north of Ohiopyle. From the imperfect exposures at this point it was difficult to determine the exact horizon of this bed, but presumably it corresponds with the thick bed of fire clay exposed in the Cucumber Run section. At the pits on the east side of the river the flint clay is overlain in places by from 2 to 4 feet of plastic clay and from 10 to 18 inches of coal. The clay from these pits is shipped by rail to Connellsville and other points in the coke region and is used almost exclusively for the manufacture of fire brick.

The clay beds associated with the Freeport coals appear to be generally present along the west side of Laurel Ridge, but the quality and thickness of the beds are variable, and they have not been prospected thoroughly enough to determine their exact condition. In the region just south of the Masontown quadrangle the clay bed underlying the Upper Freeport coal has a thickness of about 6 feet. The character of the clay is variable, but in its best development is used to some extent in the manufacture of glass pots. According to Prof. T. C. Hopkins the analysis of a sample of this clay from Wymp Gap is as follows:

Analysis of clay from Wymp Gap.

	Per cent.
Loss on ignition	11.94
Alumina (Al_2O_3)	32.80
Silica (SiO_2)	54.23
Oxide of iron	0.21
Total	99.18

A bed at about this horizon is reported from the vicinity of Wharton Furnace, where it has an exposed thickness of about 10 feet. The clay appears to be generally present over this region in the outcrop of the Allegheny formation, but its quality can be determined only by examination.

There are doubtless many beds of shale in the coal-bearing series of this territory that might be utilized in the manufacture of vitrified brick, but up to the present time they have been developed to only a small extent.

STONE.

Sandstone.—Many of the prominent sandstone beds in this region yield building stone of fair quality for rough work, but they have been utilized only for local purposes.

The Homewood sandstone is the most massive bed, and it is probably best adapted for furnishing stone of large dimensions. A considerable amount has been quarried and shipped from this bed at Bear Run, 2½ miles below Ohiopyle.

Generally at some point within the territory the prominent sandstones of the Conemaugh formation yield a good quality of building stone, but they have not been used except for local needs.

Limestone.—This portion of the Appalachian coal field is particularly well provided with beds of limestone, for the enrichment of its soils and for building purposes. The Great limestone is perhaps the largest source of supply, but the smaller beds of the coal-bearing series are frequently quarried, and the Greenbrier limestone is the main dependence of Ligonier Valley.

The Great limestone is available in almost all parts of the territory where the Monongahela formation shows in outcrop. Nearly all of its beds are good enough for agricultural uses, but only a few yield a good, strong lime for building purposes. The weathering of these beds produces a very rich soil, and consequently the outcrop of this formation is characterized by much better farming land than that which is formed from the Conemaugh rocks, which are relatively barren of calcareous material.

In addition to the Great limestone, the Monongahela formation carries some smaller beds that locally are of considerable importance. The Waynesburg limestone lies a few feet below the coal bed of the same name. In thickness it varies from 8 to 35 feet, and everywhere it yields a lime of superior quality. The Fishpot limestone, lying below the Sewickley coal, is generally persistent, but its quality is not equal to that of the beds above the coal horizon and consequently it is not much used for the manufacture of lime. The Redstone limestone, immediately underlying the Redstone coal, yields lime of a much better quality. It was quarried extensively for flux years ago, when the iron furnaces flourished along the western base of Laurel Ridge, and at the present time it is used for enriching the land.

In the Allegheny formation the Upper Freeport limestone furnishes lime for farm use, especially in Ligonier Valley, where such material is not so abundant as it is west of Laurel Ridge. The most important bed of limestone in the mountainous part of this territory is the Greenbrier limestone in the Mauch Chunk formation.

This is associated with considerable calcareous shale, but the better portion yields an excellent lime, which is widely used for fertilizing purposes.

It is unfortunate that the great beds of limestone in this region are not utilized in the construction of good roads. With the exception of the National Pike and a few roads in the vicinity of the larger coke plants, there are no macadamized roads.

Cement.—At Uniontown the upper horizon of the Great limestone has been quarried extensively for cement, which was used in constructing the locks on Monongahela River. The bed has a thickness of 10 feet, and it immediately underlies the Uniontown coal.

Glass sand.—The best rock for glass sand in this part of Pennsylvania is the Homewood sandstone, which is used for this purpose on Youghiogheny River, where it cuts through the Fayette anticline west of Connellsville and also in the Chestnut-Laurel ridge. A crushing plant was formerly in operation near the waterworks in

Masontown and Uniontown.

South Connellsville, but work is suspended. The only crusher in operation at present is located on Dunbar Creek just above the furnace. The Homewood is quarried on the north side of the valley, and the quarry face extends from the bottom to the top of the ridge.

Sand for glass making has been obtained from deposits in the abandoned channels of Monongahela River, but at present none of these are being utilized.

Rock ballast.—The rock of the uppermost beds of the Pocono sandstone, including the siliceous limestone, is crushed for railroad ballast on Youghiogheny River above Connellsville. Two plants are in operation, one located at railroad level about a mile above the waterworks, and the other on the hillside farther up the stream and about 400 feet above railroad grade. The quarry face at the lower plant has a height of about 50 feet, and it is overlain by bright-red shale of the Mauch Chunk formation. The rock is strongly calcareous, but only in its uppermost layers does it resemble a limestone. At the upper plant an extensive quarry has been opened along the face of the hill and the crushed rock is lowered to the railroad on an inclined tram road.

This bed of rock is utilized for ballast at several places along the Chestnut-Laurel ridge. Two crushing plants are in operation in the Loyalhanna gap near Latrobe, and extensive operations of a similar character are carried on in the Conemaugh gap on the main line of the Pennsylvania Railroad.

IRON ORE.

The discovery of iron ore in this region dates back to before 1792, when the first furnace for its reduction was built in the vicinity of Fairchance. For nearly one hundred years after the establishment of this furnace the iron industry which flourished in this part of the State depended upon native ores for its support. These ores were obtained principally from the shale bed closely underlying the Pittsburg coal and from the uppermost shale beds of the Mauch Chunk formation. The ore was extensively stripped, and at the present time the hillsides are seamed and gashed along the outcrop of these beds in the Uniontown region.

The advent of rich Lake Superior ores effectually ended the supremacy which this section held in the manufacture of iron. The native ores were abandoned, and at the present time their existence is almost forgotten. Of all the furnaces built in this region Dunbar alone is still in existence, and long ago it ceased to use the native ores.

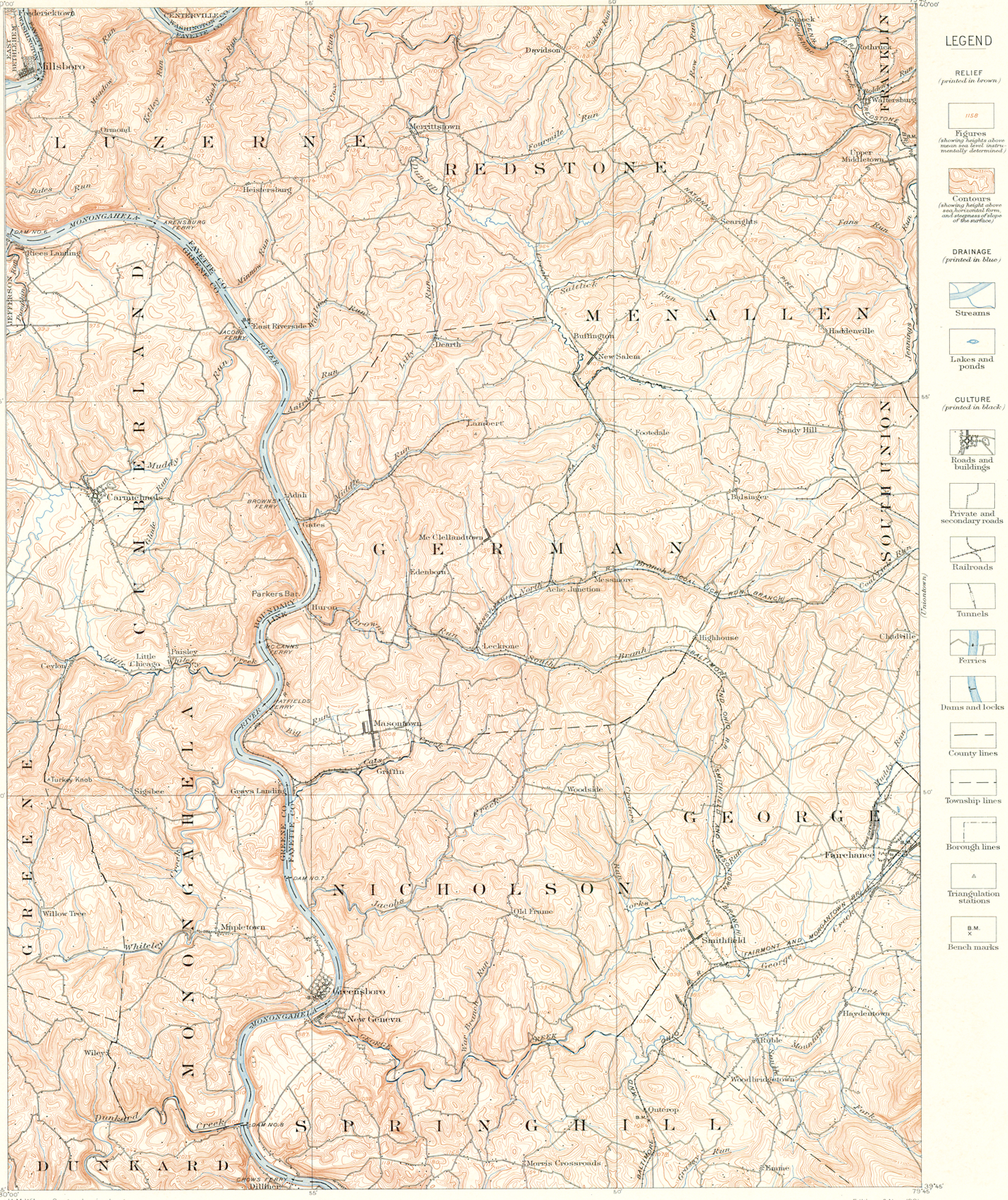
The subject is full of historic interest, but it has been treated in great detail in Professor Stevenson's report, to which reference is made for a fuller account of the character and occurrence of the ores and the history of the development of the industry.

May, 1902.

U.S. GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR
STATE OF PENNSYLVANIA
GEORGE W. MC NEES, SIMON HARROLD
FRED D. BARKER, COMMISSIONERS

TOPOGRAPHIC SHEET

PENNSYLVANIA
MASONTOWN QUADRANGLE



H.M. Wilson, Geographer in charge.
Control by S.S.Gannett, Sledge Tatum, and A.C.Roberts.
Topography by Frank Sutton, R.D.Cummin, and H.C.Frick Coke Co.
Surveyed in 1899 in cooperation with the State of Pennsylvania.

Scale $\frac{1}{62500}$

Contour interval 20 feet.
Datum is mean sea level.

Edition of Nov. 1901.

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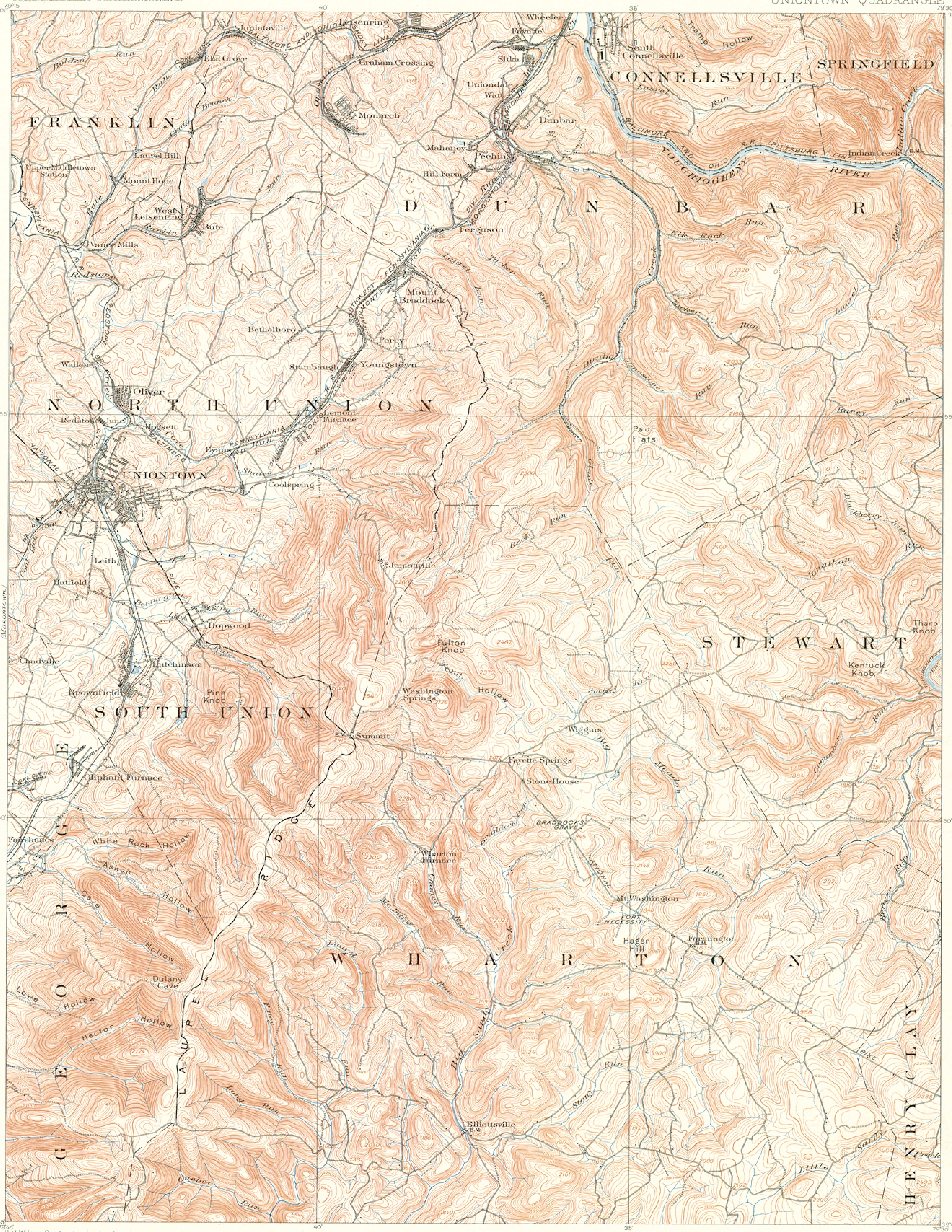
TOPOGRAPHIC SHEET

PENNSYLVANIA
(FAYETTE COUNTY)
UNIONTOWN QUADRANGLE



LEGEND

RELIEF
(printed in brown)

2320
Figures
(showing heights above mean sea level instrumentally determined)

Contours
(showing height above sea horizontal form, and steepness of slope of the surface)

DRAINAGE
(printed in blue)

Streams

Lakes ponds and reservoirs

Springs

CULTURE
(printed in black)

Roads and buildings

Private and secondary roads

Railroads

Bridges

Dams

Township lines

Borough lines

Triangulation stations

B.M.
×
Bench marks

H.M. Wilson, Geographer in charge.
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1 ½ 0 1 2 3 4 5 Miles

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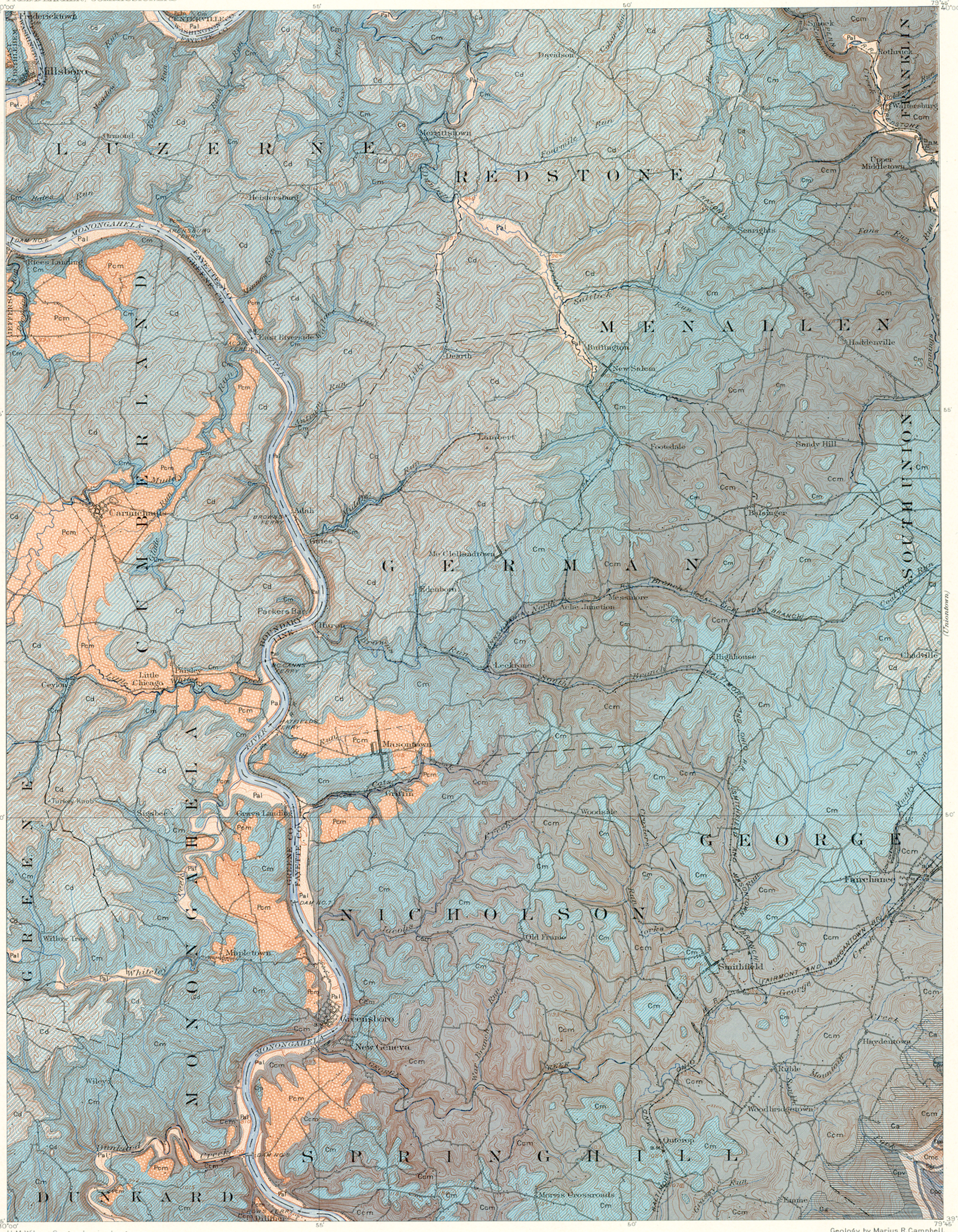
AREAL GEOLOGY SHEET

PENNSYLVANIA
MASONTOWN QUADRANGLE



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Edition of Mar. 1902.

Geology by Marius R. Campbell.
Assisted by John D. Irving
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Surveyed in 1900.

LEGEND

SURFICIAL ROCKS

(Areas of Surficial rocks are shown by patterns of dots and circles.)

PLEISTOCENE

- **Pal** — Alluvium *(in flood plains of present streams)*
- **Pcm** — Carmichael clay *(clay, sand, and bowlders on terraces and in abandoned channels of the larger streams)*

SEDIMENTARY ROCKS

(Areas of Sedimentary rocks are shown by patterns of parallel lines.)

CARBONIFEROUS

Pennsylvanian series

- **Cd** — Dunkard formation *(sandy shale and coarse sandstone with thin limestone and beds of coal, many of workable size)*
- **Cm** — Monongahela formation *(shale, limestone, and occasionally coarse sandstone; Pittsburg coal at the bottom, Waynesburg coal at the top, and coal beds of local importance between)*
- **Ccm** — Conemaugh formation *(sandstone, shale, and limestone with a few small coal beds)*
- **Ca** — Allegheny formation *(shale, sandstone, and clay with several workable coal beds; Upper Freeport coal at the top)*
- **Cpv** — Pottsville sandstone *(coarse massive white sandstone or conglomerate with some shale and usually a coal bed at the middle)*

Mississippian series (Unioutown)

- **Cmc** — Mauch Chunk shale *(red and green shale and thin-bedded green sandstone)*
- **Cgr** — Greenbrier limestone lentil *(thin blue fossiliferous limestone in the Mauch Chunk shale)*
- **Cpo** — Pocono sandstone *(coarse sandstone grading into very sandy limestone at the top and usually containing sandy shale)*

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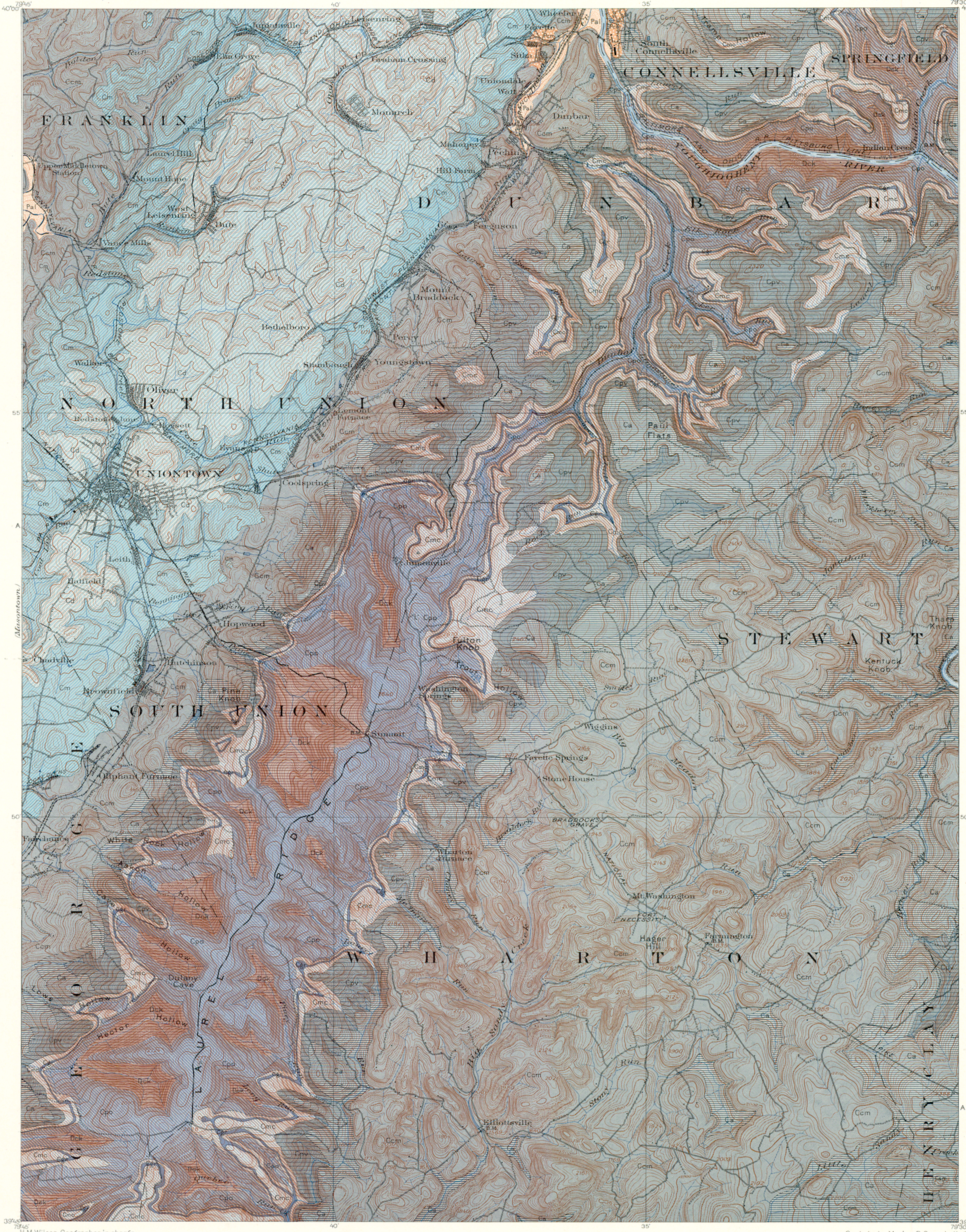
AREAL GEOLOGY SHEET

PENNSYLVANIA
(FAYETTE COUNTY)
UNIONTOWN QUADRANGLE



LEGEND

SURFICIAL ROCKS

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SEDIMENTARY ROCKS

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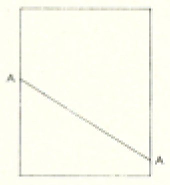
DEVONIAN

- **Dck** — Catskill formation *(green and red shale and green sandstone)*

Section



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Scale $\frac{1}{62500}$

Contour interval 20 feet.
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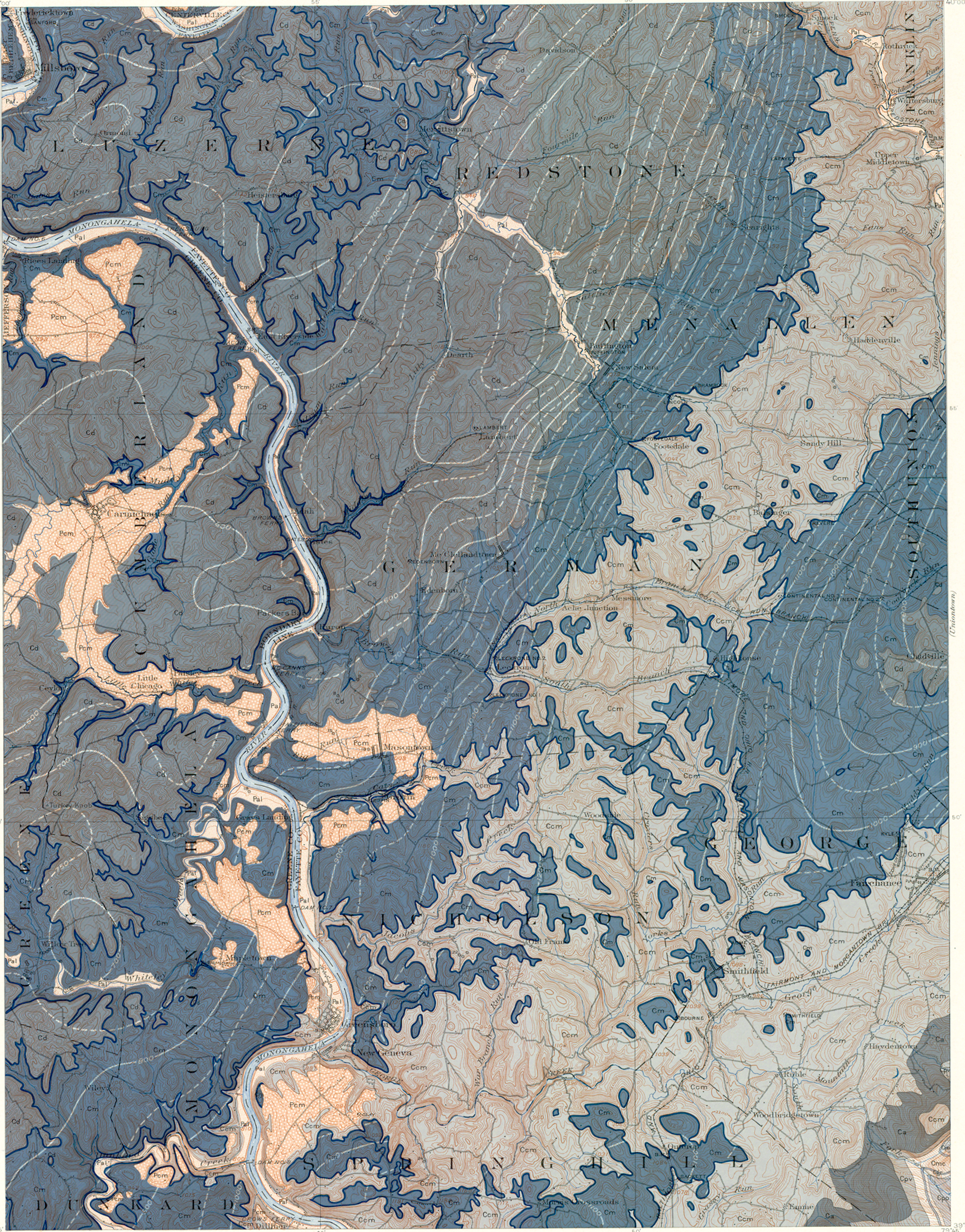
ECONOMIC GEOLOGY SHEET

PENNSYLVANIA
MASONTOWN QUADRANGLE



LEGEND

SURFICIAL ROCKS

(Areas of Surficial rocks are shown by patterns of dots and circles.)

PLEISTOCENE

- **Pal** — Alluvium *(in flood plains of present streams)*
- **Pcm** — Carmichael clay *(clay, sand, and bowlders on terraces and in abandoned channels of the larger streams)*

SEDIMENTARY ROCKS

(Areas of Sedimentary rocks are shown by patterns of parallel lines.)

CARBONIFEROUS

Pennsylvanian series

- **Cd** — Dunkard formation *(sandy shale and coarse sandstone with thin limestone and beds of coal, many of workable size)*
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- **Cpv** — Pottsville sandstone *(coarse massive white sandstone or conglomerate with some shale and usually a coal bed at the middle)*

Mississippian series *(Uniontown)*

- **Cmc** — Mauch Chunk shale *(red and green shale and thin-bedded green sandstone)*
- **Cgr** — Greenbrier limestone lentil *(thin blue fossiliferous limestone in the Mauch Chunk shale)*
- **Cpo** — Pocono sandstone *(coarse sandstone grading into very sandy limestone at the top and usually containing sandy shale)*

Coal mines
CLAY *Pottery clay*
Wells drilled for gas and oil

Known productive formations

- *Coal beds* *(outcrops of coal beds which are probably of workable thickness)*
- **Cm** — *Coal* *(Monongahela formation contains the Pittsburg, Waynesburg and other coal beds)*
- **Cd-Ca** — *Coal* *(Dunkard formation includes the Washington and other coal beds of local importance; Allegheny formation contains the Freeport and Kittanning coal beds)*
- **Ccm-Cpv** — *Coal* *(Conemaugh formation and Pottsville sandstone contain thin coal beds)*
- 600 — *Contour lines showing lay of coal beds* *(the lines indicate position of the Pittsburg coal. Elevation above sea level is shown by figures on contour lines)*

LIST OF WELLS.

1 Hugh Thompson. (Gas)
2 Thompson. (Gas)
3 County Farm. (Dry)
4 Parshal. (Gas)
5 T. A. Hoover. (Oil)
6 Hess. (Gas)
7 J. E. McWilliams. (Gas)
8 J. V. Hoover. (Gas)
9 Gilmore. (Gas)
10 Lardin. (Gas)
11 Louck. (Brine)
12 David Coffman. (Gas)
13 Keener-Durr North. (Gas)
14 Keener-Durr South. (Gas)
15 J. B. Sterling. (Gas)
16 E. W. Sterling. (Oil)
17 S. T. Gray. (Gas)
18 Shay. (Gas)
19 Blackshire. (Oil)
20 Gregg Farm. (Oil)
21 Williams and Reppert. (Gas)
22 David Gans. (Gas)
23 Smithfield. (Dry)
24 Stoner. (Gas)

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ECONOMIC GEOLOGY SHEET

PENNSYLVANIA
(FAYETTE COUNTY)
UNIONTOWN QUADRANGLE

LEGEND

SURFICIAL ROCKS

(Areas of Surficial rocks are shown by patterns of dots and circles.)

PLEISTOCENE

- Pal — **Alluvium** (in flood plains of present streams)
- Pcm — **Carmichael clay** (clay, sand, and bowlders on terraces and in abandoned channels of the larger streams)

SEDIMENTARY ROCKS

(Areas of Sedimentary rocks are shown by patterns of parallel lines.)

CARBONIFEROUS

Pennsylvanian series

- Cd — **Dunkard formation** (sandy shale and coarse sandstone with thin limestone and beds of coal, many of workable size)
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- Ccm — **Conemaugh formation** (sandstone, shale, and limestone with a few small coal beds)
- Ca — **Allegheny formation** (shale, sandstone, and clay with several workable coal beds, Upper Freeport coal at the top)
- Cpv — **Pottsville sandstone** (coarse massive white sandstone or conglomerate with some shale and usually a coal bed at the middle)

Mississippian series

- Cmc — **Mauch Chunk shale** (red and green shale and thin-bedded green sandstone)
- Cgr — **Greenbrier limestone lentil** (thin blue fossiliferous limestone in the Mauch Chunk shale)
- Cpo — **Pocono sandstone** (coarse sandstone grading into very sandy limestone at the top and usually containing sandy shale)

DEVONIAN

- Dck — **Catskill formation** (green and red shale and green sandstone)

Section

A A

Coal mines
BALLAST *Rock crushed for road ballast*
SANDSTONE *Sandstone crushed for glass sand*
CLAY *Pottery clay*

Known productive formations

- *Coal beds* (outcrops of coal beds which are probably of workable thickness)
- Cm — *Coal* (Monongahela formation contains the Pittsburg, Waynesburg and other coal beds)
- Cd-Ca — *Coal* (Dunkard formation includes the Washington and other coal beds of local importance; Allegheny formation contains the Freeport and Kittanning coal beds)
- Ccm-Cpv — *Coal* (Conemaugh formation and Pottsville sandstone contain thin coal beds)
- 800 — *Contour lines showing lay of coal beds* (west of Laurel Ridge the lines indicate position of the Pittsburg coal; east of the ridge they indicate position of the Upper Freeport coal. Elevation above sea level is shown by figures on contour lines)

H. M. Wilson, Geographer in charge.
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H. C. Frick Co. / Cummin

Scale $\frac{1}{62500}$

1 ½ 0 1 2 3 4 Miles

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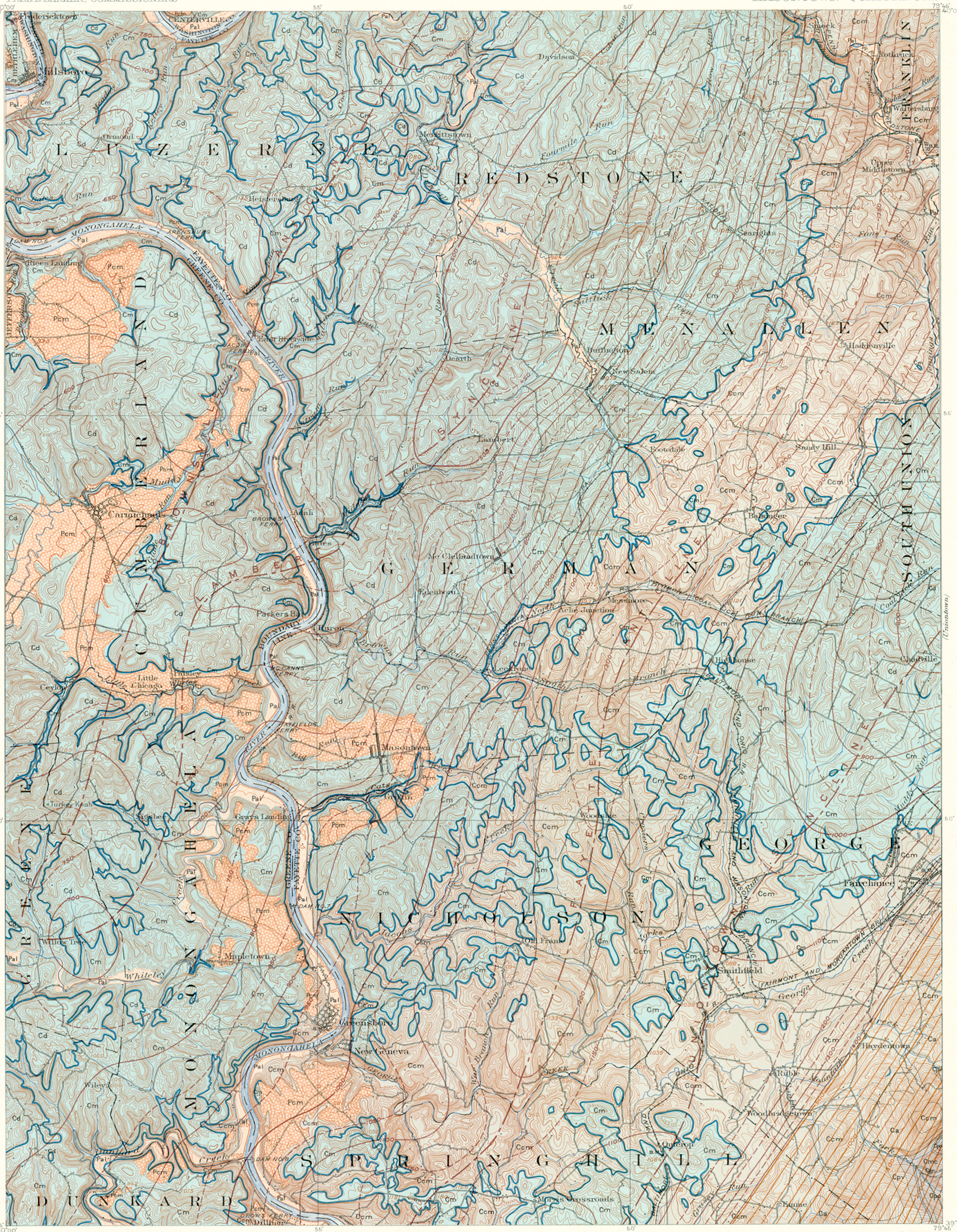
GEOLOGIC STRUCTURE SHEET

PENNSYLVANIA
MASONTOWN QUADRANGLE



LEGEND

SURFICIAL ROCKS

PLEISTOCENE

- **Pal** — Alluvium (in flood plains of present streams)
- **Pcm** — Carmichael clay (clay, sand, and bowlders on terraces and in abandoned channels of the larger streams)

SEDIMENTARY ROCKS

CARBONIFEROUS

Pennsylvanian series

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- **Cpv** — Pottsville sandstone (coarse massive white sandstone or conglomerate with some shale and usually a coal bed at the middle)

Mississippian series

- **Cmc** — Mauch Chunk shale (red and green shale and thin-bedded green sandstone)
- **Cgr** — Greenbrier limestone lentil (thin blue fossiliferous limestone in the Mauch Chunk shale)
- **Cpo** — Pocono sandstone (coarse sandstone grading into very sandy limestone at the top and usually containing sandy shale)

Coal beds (outcrops of coal beds which are probably of workable thickness)

Contour lines drawn upon the floor of the Pittsburg coal (where the coal has been removed by erosion the lines are determined by the calculated position of the bed. Contour interval 50 feet. Datum is mean sea level)

Contour lines drawn upon the upper surface of the Pottsville sandstone (where the sandstone has been removed by erosion the lines are determined by the calculated position of the formation. Contour interval 100 feet. Datum is mean sea level)

The axes of the folds are represented by heavy broken lines drawn along the lowest parts of the synclines and the highest parts of the anticlines.

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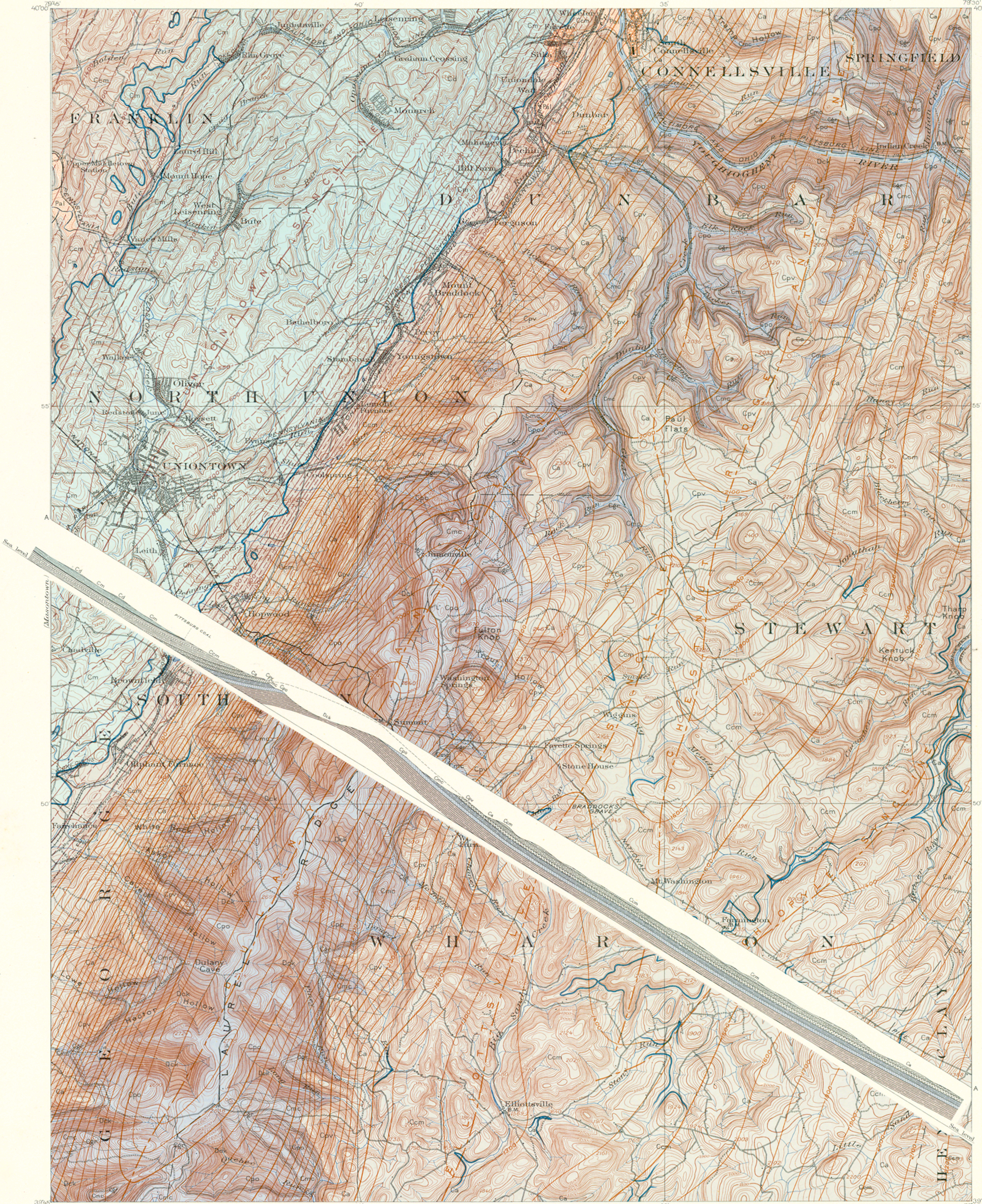
PENNSYLVANIA
(FAYETTE COUNTY)
UNIONTOWN QUADRANGLE



LEGEND

SURFICIAL ROCKS

SHEET SYMBOL

PLEISTOCENE

Pal — Alluvium (in flood plains of present streams)

Pcm — Carmichael clay (clay, sand, and bowlders on terraces and in abandoned channels of the larger streams)

SEDIMENTARY ROCKS

SHEET SYMBOL / SECTION SYMBOL

CARBONIFEROUS

Pennsylvanian series

Cd / Cd — Dunkard formation (sandy shale and coarse sandstone with thin limestone and beds of coal, many of workable size)

Cm / Cm — Monongahela formation (shale, limestone, and occasionally coarse sandstone; Pittsburg coal at the bottom, Waynesburg coal at the top, and coal beds of local importance between)

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Cpv / Cpv — Pottsville sandstone (coarse massive white sandstone or conglomerate with some shale and usually a coal bed at the middle)

Mississippian series

Cmc / Cmc — Mauch Chunk shale (red and green shale and thin-bedded green sandstone)

Cgr — Included in Mauch Chunk shale on section — Greenbrier limestone lentil (thin blue fossiliferous limestone in the Mauch Chunk shale)

Cpo / Cpo — Pocono sandstone (coarse sandstone grading into very sandy limestone at the top and usually containing sandy shale)

DEVONIAN

Dck / Dck — Catskill formation (green and red shale and green sandstone)

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Contour lines drawn upon the floor of the Pittsburg coal (where the coal has been removed by erosion the lines are determined by the calculated position of the bed. Contour interval 50 feet. Datum is mean sea level)

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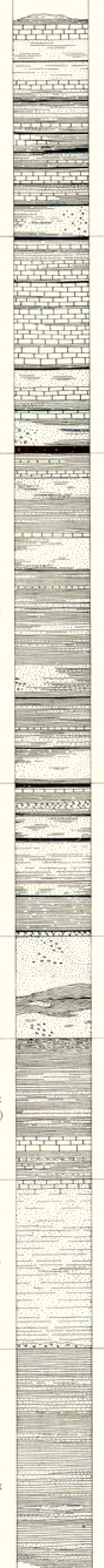
COLUMNAR SECTION SHEET 1

GENERALIZED SECTION FOR MASONTOWN-UNIONTOWN QUADRANGLES.

SCALE: 1 INCH = 200 FEET.

Period.	Formation Name.	Symbol.	Columnar Section.	Thickness in Feet.	Names of Members.	Character and Distribution of Members.	General Character of Formations.
CARBONIFEROUS — PENNSYLVANIAN	Dunkard formation.	Cd		400+	Upper Washington limestone. Washington coal. Waynesburg "A" coal. Waynesburg sandstone.	Blue to black limestone, weathering white. Best development in areas lying west of this territory. It has been identified in Cumberland Township, Greene County, but not in Lambert syncline. Thick bed, but usually too badly broken by partings to be of value. Present in Lambert syncline and in the high land west of Monongahela River. Thin bed, generally of good quality. Coarse sandstone. Poorly developed in Lambert syncline and in northern part of Uniontown syncline.	The rocks of this formation, with the exception of the Waynesburg sandstone at the base and the shaly sandstones beneath the Upper Washington limestone, are soft and shaly, particularly so in the Lambert syncline, where only a few thin beds of sandstone occur for a distance of 240 feet above the Waynesburg coal. Contains a number of coal beds, which are generally thin and unimportant.
	Monongahela formation.	Cm		380±	Waynesburg coal. Uniontown coal. Great limestone. Sewickley coal. Redstone coal. Pittsburg sandstone. Pittsburg coal.	Generally present throughout this territory, but west of Fayette anticline badly broken by partings. Thin and unimportant. Blue limestone with calcareous shale beds. Generally present. Burned into lime for agricultural purposes. Persistent bed. Best development in the vicinity of Greensboro, where it is known as the Mapletown coal. Thin bed of small value. Locally developed in southern and western part of territory. Six to 9 feet of available coal of great value.	The most important coal-bearing formation of southwestern Pennsylvania. The rocks are decidedly calcareous, but beds of sandstone locally develop in thickness until they become prominent members of the formation. The Pittsburg sandstone is the most notable lentil of this character.
	Conemaugh formation.	Ccm		590±	Connellsville sandstone. Morgantown sandstone. Saltsburg sandstone. Hager coal. Farmington coal. Mahoning sandstone.	Variable bed of coarse sandstone from 40 to 60 feet below the Pittsburg coal. Coarse sandstone, sometimes conglomeratic. Best horizon marker in this formation. Generally persistent, but in places replaced by sandy shale. Coarse sandstone. Best development in Ligonier Valley. Small bed in Ligonier Valley. Thin bed in the vicinity of Farmington. Coarse sandstone. Generally present, but occasionally replaced by sandy shale.	Chiefly shales of various colors, green and red the most pronounced, interstratified with beds of coarse sandstone which are fairly persistent, but which occasionally lose their distinctive character.
	Allegheny formation.	Ca		270±	Upper Freeport coal. Bolivar fire clay. Lower Freeport coal. Kittanning group. Brookville-Clarion [coal.	Thick bed, badly broken by partings. Best developed along Laurel Ridge. Five to 15 feet of flint clay in Ligonier Valley. Thin bed. Group of three coal beds. The highest is of considerable importance in Ligonier Valley. Prominent bed along Laurel Ridge, underlain by valuable bed of flint fire [clay.	This formation is less sandy than either of the contiguous formations. It is composed largely of shale, but in places the Freeport sandstone is well developed above the Upper Kittanning coal, and another sandstone is present below the same horizon. Three prominent coal beds occur in this formation.
	Pottsville sandstone.	Cpv		180±	Homewood sandstone. Mercer coal. Connoquenessing sandstone.	Massive sandstone, or fine conglomerate. Prominent on Laurel Ridge and along Youghiogheny River. Forms "Elk Rocks" in Stewart Township. Thin, irregular bed, best exposed along the railroad below Ohiopyle. Coarse, irregularly bedded sandstone.	Generally coarse, hard sandstone or conglomerate inclosing a thin irregular bed of shale. Equivalent to the uppermost beds of the Pottsville formation in the type locality.
MISSISSIPPIAN	Mauch Chunk shale. (Greenbrier limestone lentil.)	Cmc (Cgr)		250 (25)	Greenbrier limestone.	Blue fossiliferous limestone, extensively burned into lime for fertilizing. Best exposures along Laurel Ridge.	Red and green shales with beds of greenish sandstone inclosing a lentil of blue fossiliferous limestone, which is the thin edge of the great Greenbrier limestone of Virginia.
	Pocono sandstone.	Cpo		300+	Siliceous limestone.	Blue sandy limestone, grading downward into calcareous sandstone. Crushed for ballast.	Sandstone varying from thin-bedded, flaggy rock to coarse, irregularly bedded conglomerate. Bed of siliceous limestone at the top.
DEVONIAN	Catskill formation.	Dck		400+			Olive-green shale and greenish sandstones.

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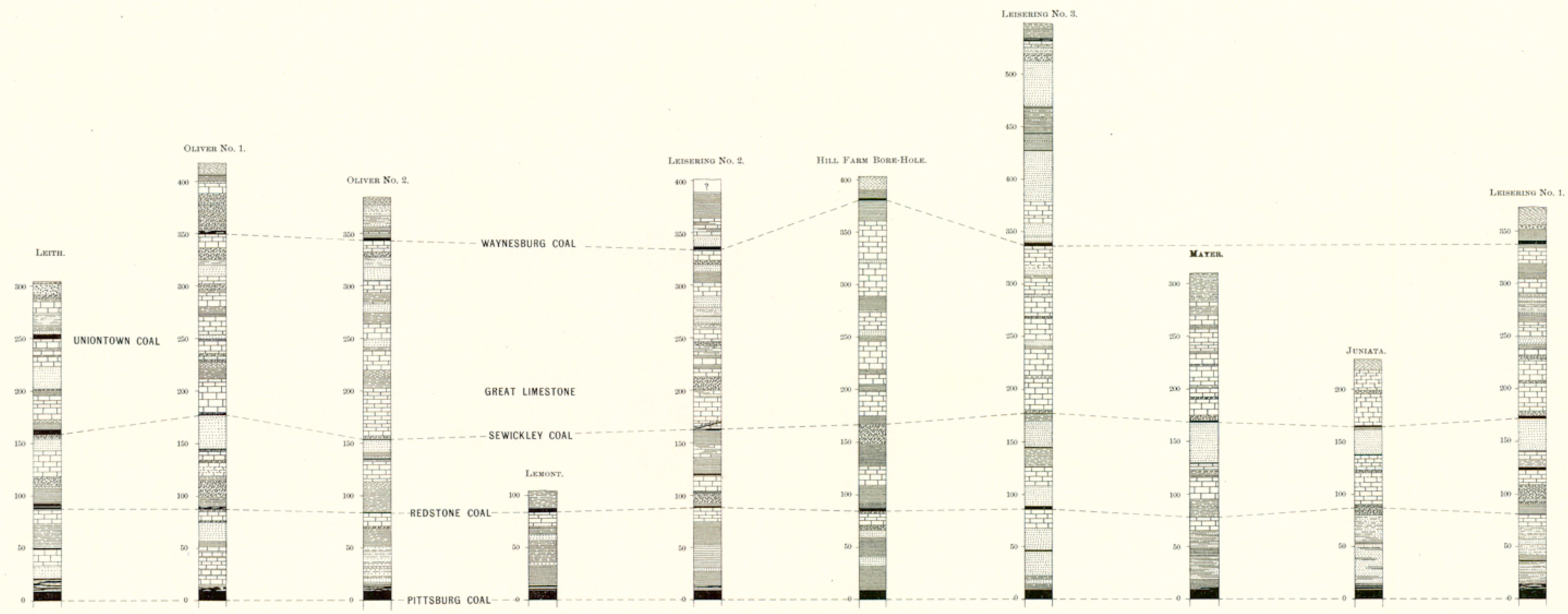
COLUMNAR SECTION SHEET 2

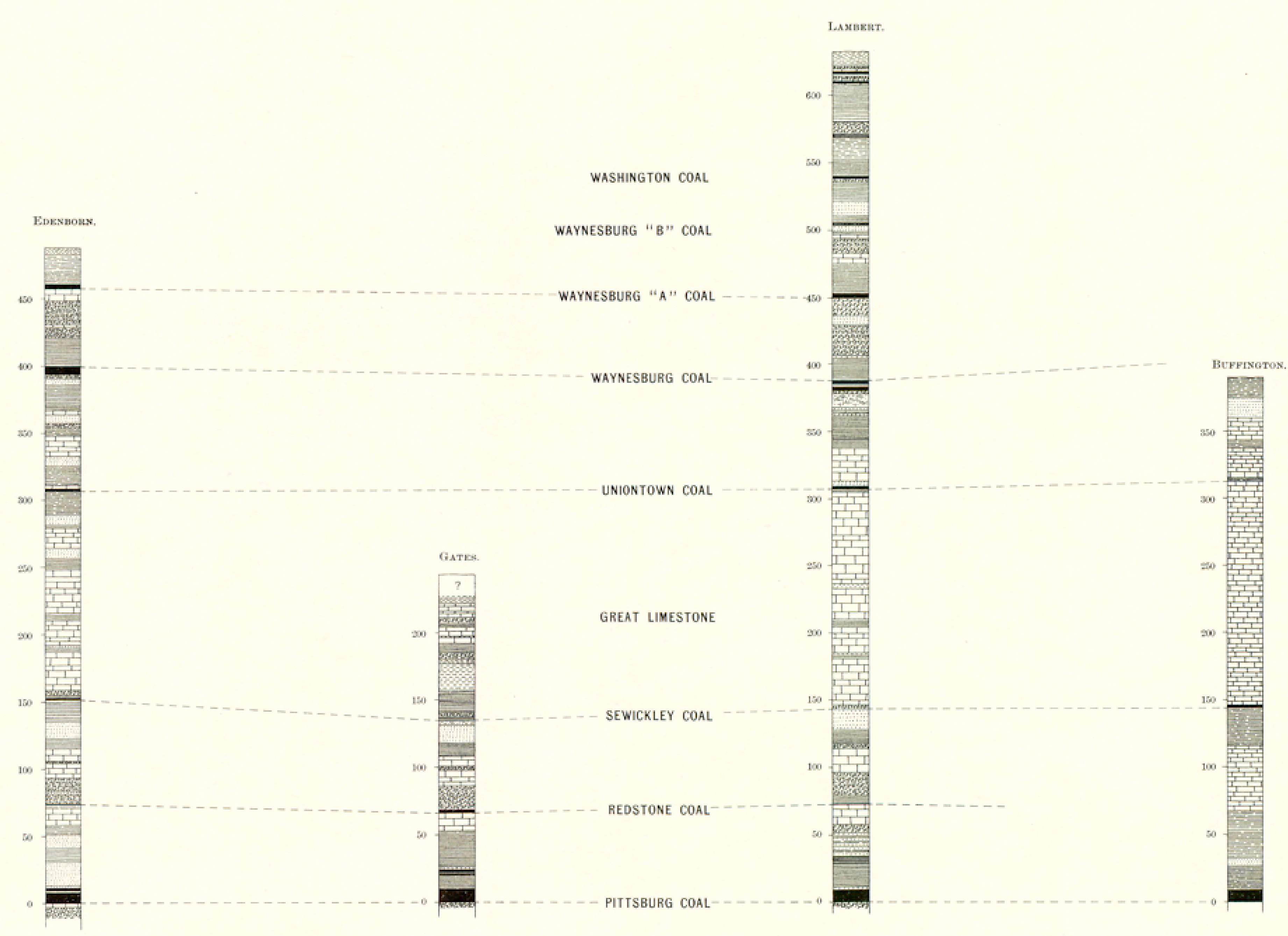
MINE-SHAFT SECTIONS IN THE UNIONTOWN SYNCLINE, MASONTOWN-UNIONTOWN QUADRANGLES.

SCALE: 1 INCH = 100 FEET.



MINE-SHAFT SECTIONS IN THE LAMBERT SYNCLINE, MASONTOWN QUADRANGLE.

SCALE: 1 INCH = 100 FEET.



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U. S. GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR
STATE OF PENNSYLVANIA
GEORGE W. MCNEES, SIMON HARROLD,
FRED. D. BARKER, COMMISSIONERS

ILLUSTRATION SHEET

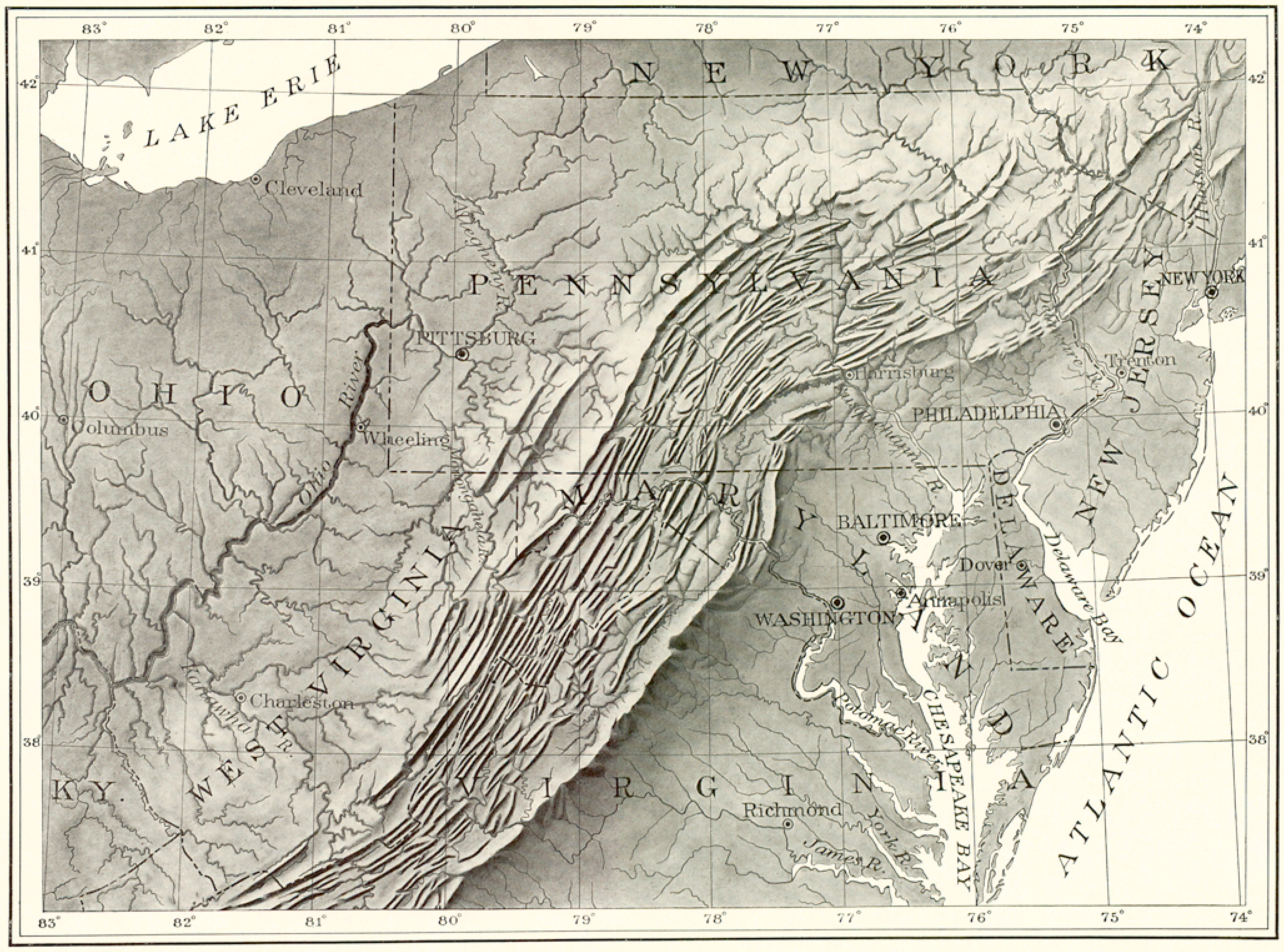

FIG. 27.—RELIEF MAP OF THE NORTHERN APPALACHIAN MOUNTAINS.

The Masontown and Uniontown quadrangles are situated on the plateau lying west of the belt of valley ridges, in the southwestern part of Pennsylvania.

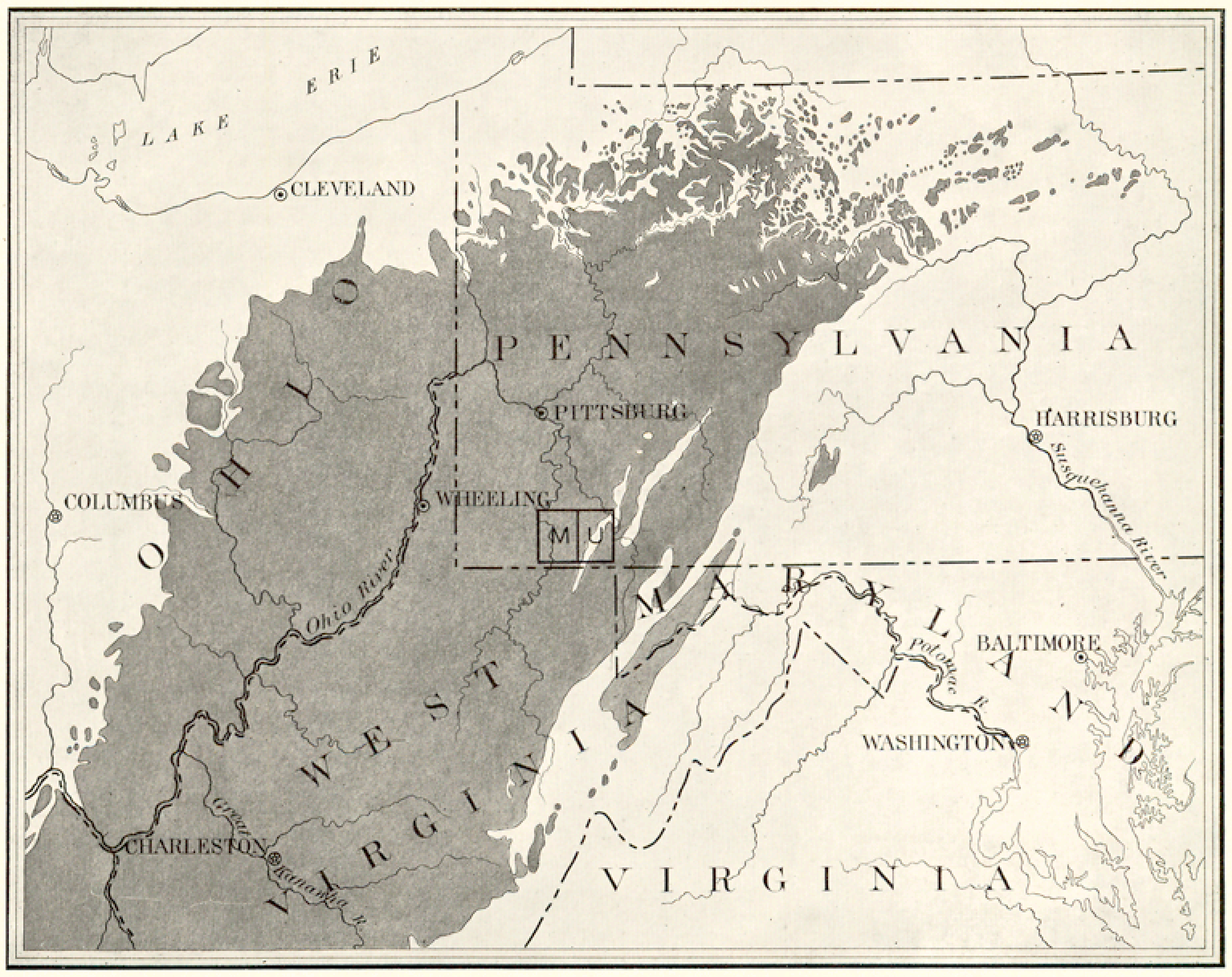

FIG. 28.—MAP SHOWING THE EXTENT OF THE NORTHERN PART OF THE APPALACHIAN COAL FIELD.

The position of the Masontown and Uniontown quadrangles within the coal field is shown by rectangles.

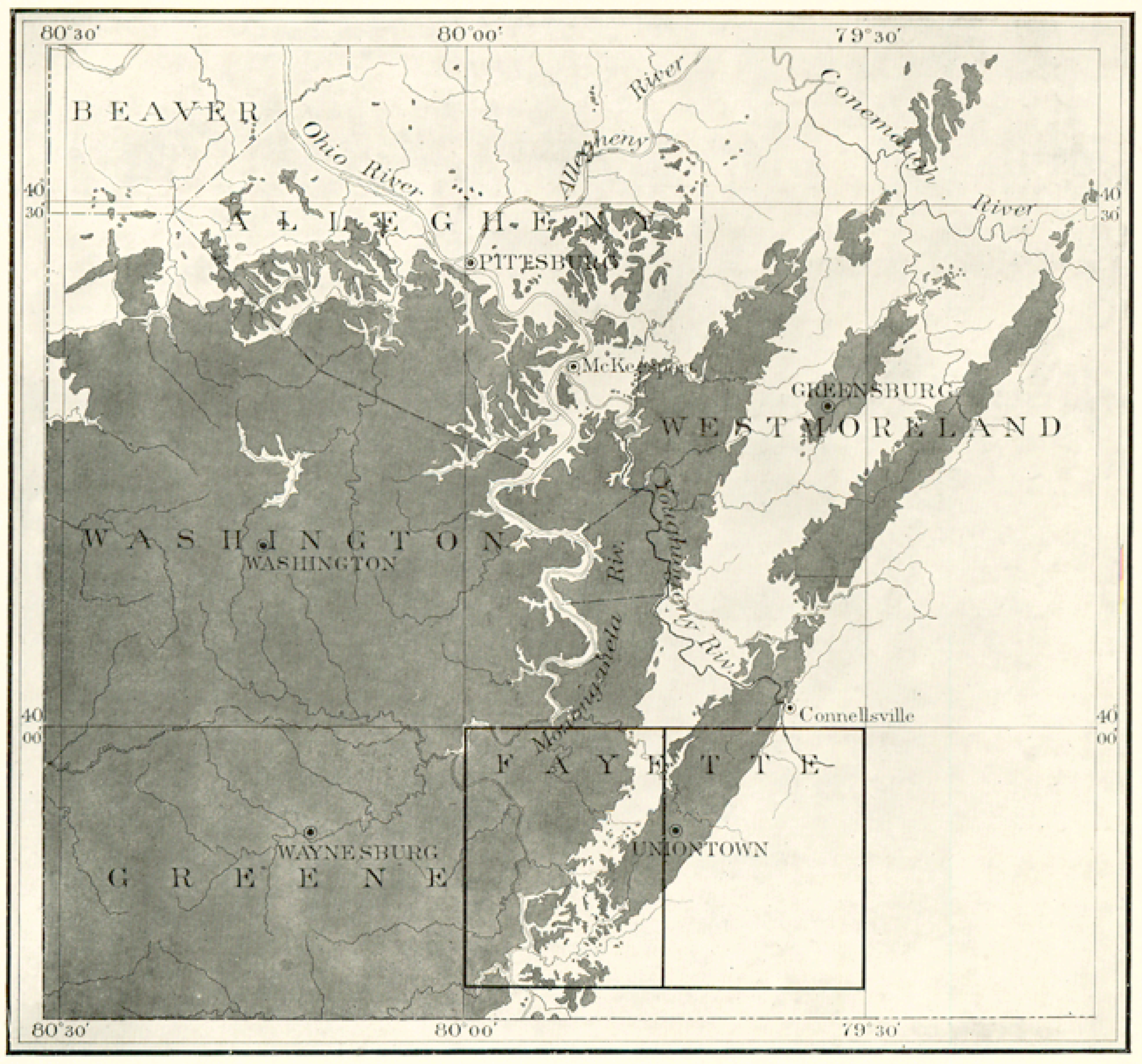

FIG. 29.—MAP SHOWING THE AREA OF THE PITTSBURG COAL IN PENNSYLVANIA.

The Masontown and Uniontown quadrangles are situated on its eastern border.

redeposited as beds or trains of sand and clay, thus forming another gradation into sedimentary deposits. Some of this glacial wash was deposited in tunnels and channels in the ice, and forms characteristic ridges and mounds of sand and gravel, known as osars, or eskers, and kames. The material deposited by the ice is called glacial drift; that washed from the ice onto the adjacent land is called modified drift. It is usual also to class as surficial rocks the deposits of the sea and of lakes and rivers that were made at the same time as the ice deposit.

AGES OF ROCKS.

Rocks are further distinguished according to their relative ages, for they were not formed all at one time, but from age to age in the earth's history. Classification by age is independent of origin; igneous, sedimentary, and surficial rocks may be of the same age.

When the predominant material of a rock mass is essentially the same, and it is bounded by rocks of different materials, it is convenient to call the mass throughout its extent a *formation*, and such a formation is the unit of geologic mapping.

Several formations considered together are designated a *system*. The time taken for the deposition of a formation is called an *epoch*, and the time taken for that of a system, or some larger fraction of a system, a *period*. The rocks are mapped by formations, and the formations are classified into systems. The rocks composing a system and the time taken for its deposition are given the same name, as, for instance, Cambrian system, Cambrian period.

As sedimentary deposits or strata accumulate the younger rest on those that are older, and the relative ages of the deposits may be discovered by observing their relative positions. This relationship holds except in regions of intense disturbance; sometimes in such regions the disturbance of the beds has been so great that their position is reversed, and it is often difficult to determine the relative ages of the beds from their positions; then *fossils*, or the remains of plants and animals, are guides to show which of two or more formations is the oldest.

Strata often contain the remains of plants and animals which lived in the sea or were washed from the land into lakes or seas or were buried in surficial deposits on the land. Rocks that contain the remains of life are called fossiliferous. By studying these remains, or fossils, it has been found that the species of each period of the earth's history have to a great extent differed from those of other periods. Only the simpler kinds of marine life existed when the oldest fossiliferous rocks were deposited. From time to time more complex kinds developed, and as the simpler ones lived on in modified forms life became more varied. But during each period there lived peculiar forms, which did not exist in earlier times and have not existed since; these are characteristic types, and they define the age of any bed of rock in which they are found. Other types passed on from period to period, and thus linked the systems together, forming a chain of life from the time of the oldest fossiliferous rocks to the present.

When two formations are remote one from the other and it is impossible to observe their relative positions, the characteristic fossil types found in them may determine which was deposited first.

Fossil remains found in the rocks of different areas, provinces, and continents afford the most important means for combining local histories into a general earth history.

Colors and patterns.—To show the relative ages of strata, the history of the sedimentary rocks is divided into periods. The names of the periods in proper order (from new to old), with the colors and symbol assigned to each, are given in the table in the next column. The names of certain subdivisions and groups of the periods, frequently used in geologic writings, are bracketed against the appropriate period names.

To distinguish the sedimentary formations of any one period from those of another the patterns for the formations of each period are printed in the appropriate period-color, with the exception of the one at the top of the column (Pleistocene) and the one at the bottom (Archean). The sedimentary formations of any one period, excepting the Pleistocene and the Archean, are distinguished from one another by different patterns, made of parallel straight lines. Two tints of the period-color are used: a pale tint is printed evenly over the whole surface representing the period; a dark tint brings out the different patterns representing formations. Each formation is furthermore given

Period.		Symbol.	Color.
Cenozoic	Pleistocene	P	Any colors.
	Neocene (Pliocene, Miocene)	N	Buffs.
	Eocene, including Oligocene	E	Olive-browns.
Mesozoic	Cretaceous	K	Olive-greens.
	Juratrias (Jurassic, Triassic)	J	Blue-greens.
Paleozoic	Carboniferous, including Permian	C	Blues.
	Devonian	D	Blue-purples.
	Silurian, including Ordovician	S	Red-purples.
	Cambrian	Є	Pinks.
	Algonkian	A	Orange-browns.
	Archean	Æ	Any colors.

a letter-symbol composed of the period letter combined with small letters standing for the formation name. In the case of a sedimentary formation of uncertain age the pattern is printed on white ground in the color of the period to which the formation is supposed to belong, the letter-symbol of the period being omitted.

The number and extent of surficial formations, chiefly Pleistocene, render them so important that, to distinguish them from those of other periods and from the igneous rocks, patterns of dots and circles, printed in any colors, are used.

The origin of the Archean rocks is not fully settled. Many of them are certainly igneous. Whether sedimentary rocks are also included is not determined. The Archean rocks, and all metamorphic rocks of unknown origin, of whatever age, are represented on the maps by patterns consisting of short dashes irregularly placed. These are printed in any color, and may be darker or lighter than the background. If the rock is a schist the dashes or hachures may be arranged in wavy parallel lines. If the metamorphic rock is known to be of sedimentary origin the hachure patterns may be combined with the parallel-line patterns of sedimentary formations. If the rock is recognized as having been originally igneous, the hachures may be combined with the igneous pattern.

Known igneous formations are represented by patterns of triangles or rhombs printed in any brilliant color. If the formation is of known age the letter-symbol of the formation is preceded by the capital letter-symbol of the proper period. If the age of the formation is unknown the letter-symbol consists of small letters which suggest the name of the rocks.

THE VARIOUS GEOLOGIC SHEETS.

Areal geology sheet.—This sheet shows the areas occupied by the various formations. On the margin is a *legend*, which is the key to the map. To ascertain the meaning of any particular colored pattern and its letter-symbol on the map the reader should look for that color, pattern, and symbol in the legend, where he will find the name and description of the formation. If it is desired to find any given formation, its name should be sought in the legend and its color and pattern noted, when the areas on the map corresponding in color and pattern may be traced out.

The legend is also a partial statement of the geologic history. In it the symbols and names are arranged, in columnar form, according to the origin of the formations—surficial, sedimentary, and igneous—and within each group they are placed in the order of age, so far as known, the youngest at the top.

Economic geology sheet.—This sheet represents the distribution of useful minerals, the occurrence of artesian water, or other facts of economic interest, showing their relations to the features of topography and to the geologic formations. All the formations which appear on the historical geology sheet are shown on this sheet by fainter color patterns. The areal geology, thus printed, affords a subdued background upon which the areas of productive formations may be emphasized by strong colors. A symbol for mines is introduced at each occurrence accompanied by the name of the principal mineral mined or of the stone quarried.

Structure-section sheet.—This sheet exhibits the relations of the formations beneath the surface.

In cliffs, canyons, shafts, and other natural and artificial cuttings, the relations of different beds to one another may be seen. Any cutting which exhibits those relations is called a *section*, and the same name is applied to a diagram representing the relations. The arrangement of rocks in the earth is the earth's *structure*, and a section exhibiting this arrangement is called a *structure section*.

The geologist is not limited, however, to the natural and artificial cuttings for his information concerning the earth's structure. Knowing the manner of the formation of rocks, and having traced out the relations among beds on the surface, he can infer their relative positions after they pass beneath the surface, draw sections which represent the structure of the earth to a considerable depth, and construct a diagram exhibiting what would be seen in the side of a cutting many miles long and several thousand feet deep. This is illustrated in the following figure:

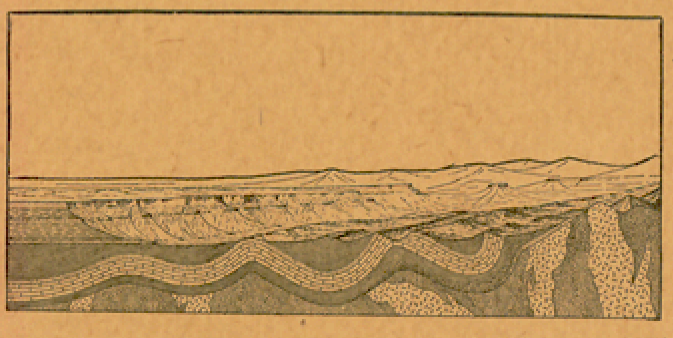

Fig. 2.—Sketch showing a vertical section in the front of the picture, with a landscape beyond.

The figure represents a landscape which is cut off sharply in the foreground by a vertical plane, so as to show the underground relations of the rocks.

The kinds of rock are indicated in the section by appropriate symbols of lines, dots, and dashes. These symbols admit of much variation, but the following are generally used in sections to represent the commoner kinds of rock:

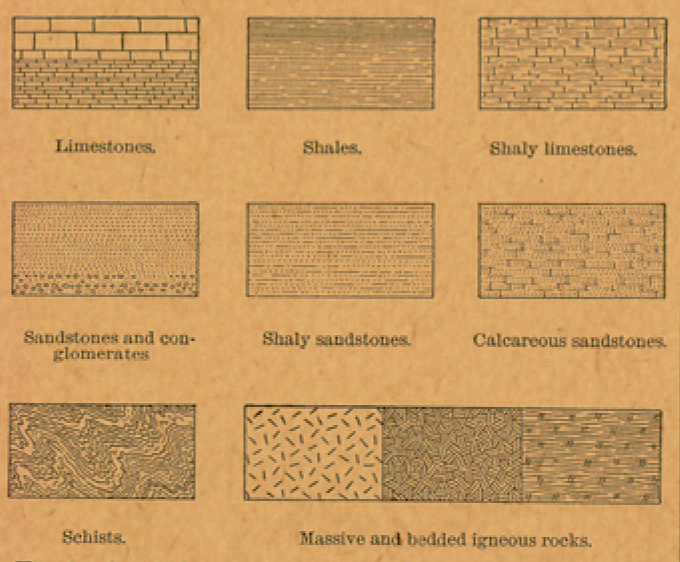

Fig. 3.—Symbols used to represent different kinds of rock.

The plateau in fig. 2 presents toward the lower land an escarpment, or front, which is made up of sandstones, forming the cliffs, and shales, constituting the slopes, as shown at the extreme left of the section.

The broad belt of lower land is traversed by several ridges, which are seen in the section to correspond to beds of sandstone that rise to the surface. The upturned edges of these beds form the ridges, and the intermediate valleys follow the outcrops of limestone and calcareous shales.

Where the edges of the strata appear at the surface their thickness can be measured and the angles at which they dip below the surface can be observed. Thus their positions underground can be inferred. The direction that the intersection of a bed with a horizontal plane will take is called the *strike*. The inclination of the bed to the horizontal plane, measured at right angles to the strike, is called the *dip*.

When strata which are thus inclined are traced underground in mining, or by inference, it is frequently observed that they form troughs or arches, such as the section shows. The arches are called *anticlines* and the troughs *synclines*. But the sandstones, shales, and limestones were deposited beneath the sea in nearly flat sheets. That they are now bent and folded is regarded as proof that forces exist which have from time to time caused the earth's surface to wrinkle along certain zones. In places the strata are broken across and the parts slipped past one another. Such breaks are termed *faults*.

On the right of the sketch the section is composed of schists which are traversed by masses of igneous rock. The schists are much contorted and their arrangement underground can not be inferred. Hence that portion of the section delineates what is probably true but is not known by observation or well-founded inference.

In fig. 2 there are three sets of formations, distinguished by their underground relations. The first of these, seen at the left of the section, is the set of sandstones and shales, which lie in a horizontal position. These sedimentary strata are now high above the sea, forming a plateau, and their change of elevation shows that a portion of the earth's mass has swelled upward from a lower to a higher level. The strata of this set are parallel, a relation which is called *conformable*.

The second set of formations consists of strata which form arches and troughs. These strata were once continuous, but the crests of the arches have been removed by degradation. The beds, like those of the first set, are conformable.

The horizontal strata of the plateau rest upon the upturned, eroded edges of the beds of the second set at the left of the section. The overlying deposits are, from their positions, evidently younger than the underlying formations, and the bending and degradation of the older strata must have occurred between the deposition of the older beds and the accumulation of the younger. When younger strata thus rest upon an eroded surface of older strata the relation between the two is an *unconformable* one, and their surface of contact is an *unconformity*.

The third set of formations consists of crystalline schists and igneous rocks. At some period of their history the schists were plicated by pressure and traversed by eruptions of molten rock. But this pressure and intrusion of igneous rocks have not affected the overlying strata of the second set. Thus it is evident that an interval of considerable duration elapsed between the formation of the schists and the beginning of deposition of the strata of the second set. During this interval the schists suffered metamorphism; they were the scene of eruptive activity; and they were deeply eroded. The contact between the second and third sets, marking a time interval between two periods of rock formation, is another unconformity.

The section and landscape in fig. 2 are ideal, but they illustrate relations which actually occur. The sections in the structure-section sheet are related to the maps as the section in the figure is related to the landscape. The profiles of the surface in the section correspond to the actual slopes of the ground along the section line, and the depth from the surface of any mineral-producing or water-bearing stratum which appears in the section may be measured by using the scale of the map.

Columnar section sheet.—This sheet contains a concise description of the rock formations which occur in the quadrangle. It presents a summary of the facts relating to the character of the rocks, the thicknesses of the formations, and the order of accumulation of successive deposits.

The rocks are described under the corresponding heading, and their characters are indicated in the columnar diagrams by appropriate symbols. The thicknesses of formations are given in figures which state the least and greatest measurements. The average thickness of each formation is shown in the column, which is drawn to a scale—usually 1000 feet to 1 inch. The order of accumulation of the sediments is shown in the columnar arrangement: the oldest formation is placed at the bottom of the column, the youngest at the top, and igneous rocks or surficial deposits, when present, are indicated in their proper relations.

The formations are combined into systems which correspond with the periods of geologic history. Thus the ages of the rocks are shown, and also the total thickness of each system.

The intervals of time which correspond to events of uplift and degradation and constitute interruptions of deposition of sediments are indicated graphically and by the word "unconformity."

CHARLES D. WALCOTT,
Director.

Revised January, 1902.

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