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CHARLES D. WALCOTT, DIRECTOR

ECONOMIC GEOLOGY

OF THE

KITTANNING AND RURAL VALLEY QUADRANGLES, PENNSYLVANIA

BY

CHARLES BUTTS

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ECONOMIC GEOLOGY OF THE KITTANNING AND RURAL VALLEY QUADRANGLES, PENNSYLVANIA.

By Charles Butts.

INTRODUCTION.

The field work upon which this bulletin is based was done in the autumn of 1901 and the summer and autumn of 1902 under the general supervision of Marius R. Campbell. The work in the Kittanning quadrangle was mainly done by Lester H. Woolsey and the writer in 1901, and that in the Rural Valley quadrangle almost wholly by the writer in 1902.

In addition to the data collected in the field much has been derived from published reports of the Second Geological Survey of Pennsylvania, particularly the reports of W. G. Platt on Armstrong County, I. C. White and H. M. Chance on Butler County, and John F. Carll on the oil regions. Many valuable well records have been furnished by the oil and gas companies operating in the region and by well contractors, and information pertaining to their properties has been given by the coal-mining companies, quarrymen, and those connected with the clay industries of the area. For all such material, which adds greatly to the value of this report, the author acknowledges his obligations.

TOPOGRAPHY.

LOCATION.

As will be seen on the key map (fig. 1), these quadrangles lie in central-western Pennsylvania and extend from latitude 41° on the north to 40° 45′ on the south, and from longitude

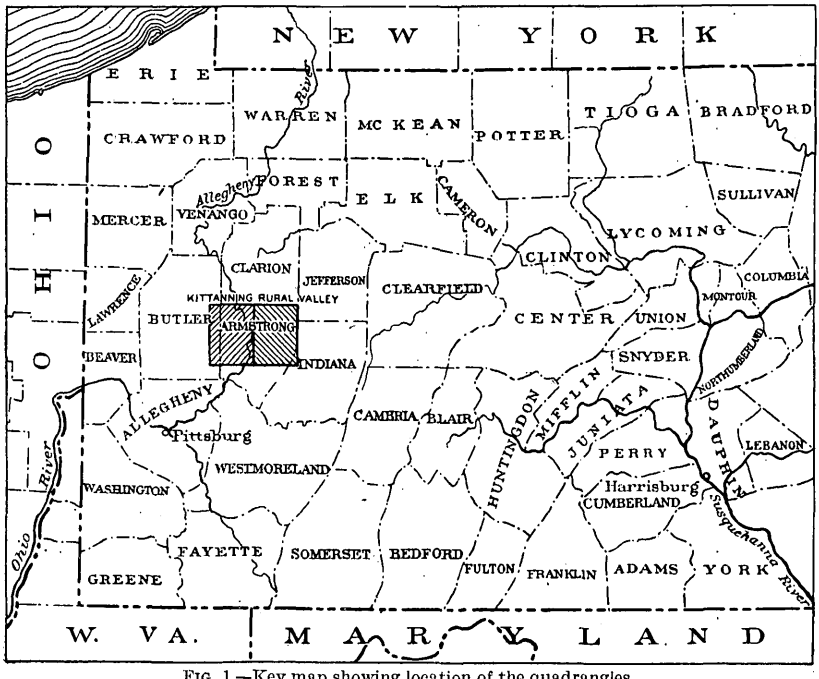

FIG. 1.—Key map showing location of the quadrangles.

79° 15′ on the east to 79° 45′ on the west. Each quadrangle includes one-sixteenth of a square degree, and their combined area is about 460 square miles. They lie almost wholly in Armstrong County, but the Kittanning quadrangle includes a narrow strip of Butler County and that portion of both quadrangles north of Redbank Creek lies in Clarion County. The quadrangles are named from the principal towns within their boundaries.

The latitude and longitude of the quadrangle boundaries have been determined from stations located on some of the prominent hilltops of the region. These stations have been connected by triangulation with astronomical stations at Washington, Cumberland, Grafton, and Pittsburg, and the accuracy of the work has been checked by a carefully measured base line on the Pennsylvania Railroad north of Latrobe.

TRIANGULATION STATIONS.

All surveys for the maps of this bulletin are based on six triangulation stations located within the quadrangles and six other stations in close proximity thereto. The locations of the stations within the quadrangles are shown on the topographic maps by small triangles, but the following sketch (fig. 2) shows the relative position of all these points. The stations are marked by stone posts 8 by 8 inches in cross section. In the center of the top of

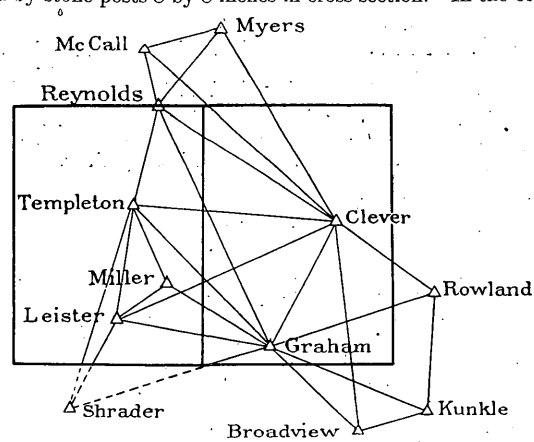

FIG. 2.—Sketch map showing location of triangulation stations on which the survey of the quadrangles is based.

each post is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania." For the convenience of engineers who may wish to secure accurate control over their surface surveys, the following list of stations, with full details regarding the angles by which their positions have been determined, is given.[a] There is also given a list of permanent and temporary bench marks, with their elevations, which were established in the course of the spirit leveling by which control over the surface relief of the quadrangle was secured.

STATIONS WITHIN THE QUADRANGLES.

CLEVER, ARMSTRONG COUNTY.

On a high cultivated ridge, with scattering dead trees, in Wayne Township, about 1 mile west of Belknap and 1 mile east of Snydersville (Muff post-office), on land belonging to G. H. Clever, of Belknap.

Station mark: A sandstone post 39 by 8 by 8 inches, set 27 inches in the ground, in center of top of which is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania."

Reference marks: Live chestnut tree, magnetic bearing S. 84° E., 45½ feet distant. Dead chestnut tree, N. 4° E., 121 feet distant. Fence on line between properties of G. H. Clever and Jeremiah Bowser bears due south, 3 feet distant.

[a] The list has been compiled from Bull. U. S. Geol. Survey No. 181.

[Latitude 40° 53′ 35.63″. Longitude 79° 19′ 25.41″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Graham	29	26	30.0	117	12	06.0	4.0951985
Leister	65	59	54.4	209	22	57.3	4.1909592
Templeton	93	16	57.6	245	48	30.3	4.4288814
Reynolds	120	59	58.2	273	06	31.1	4.3508735
McCall	130	01	44.6	300	50	42.0	4.3643865
Myers	147	47	30.2	309	51	31.4	4.4550873
Rowland	297	06	56.5	327	41	28.6	4.3829142
Broadview	353	06	02.8	173	07	19.6	4.3608128

GRAHAM, ARMSTRONG COUNTY.

About 1 mile east of Blanket Hill post-office, on a bare ridge of cultivated land owned by the Graham heirs and rented by W. A. Blose.

Station mark: A sandstone post 36 by 8 by 8 inches, set 32 inches in the ground, in the center of top of which is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania."

Reference marks: Chestnut tree 24 inches in diameter, magnetic bearing S. 23° W., distant 415 feet. Dead chestnut tree 18 inches in diameter, S. 86° W., distant 257 feet.

[Latitude, 40° 46′ 17.28″. Longitude, 79° 24′ 50.74″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Shrader	73	49	24.6	253	39	11.0	4.3613318
Leister	98	40	56.3	278	33	05.5	4.2328320
Miller	120	00	41.6	299	55	18.5	4.1263694
Templeton	135	00	42.7	314	53	49.7	4.3203059
Reynolds	154	18	20.5	334	12	37.9	4.4504542
Clever	209	22	57.3	29	26	30.0	4.1909592
Rowland	247	12	03.4	67	20	45.1	4.3072670
Kunkle	291	35	03.6	111	43	17.4	4.2810749
Broadview	311	40	54.2	131	45	43.1	4.1436489

LEISTER, ARMSTRONG COUNTY.

Six miles southwest of Kittanning, in North Buffalo Township, on a round knob, cleared on southeast side and timbered on northwest side. The land belongs to Sarah Jane Gray, of McHaddon.

Station mark: A sandstone post 40 by 8 by 8 inches, set 35 inches in the ground, in the center of top of which is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania."

Reference mark: Oak tree 18 inches in diameter, magnetic bearing N. 30° W., 77½ feet distant.

[Latitude, 40° 47′ 40.31″. Longitude, 79° 36′ 51.50″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Shrader	29	48	10.1	209	45	46.8	4.0155564
Templeton	189	42	25.0	9	43	23.3	4.0930300
Miller	232	08	42.0	52	11	10.0	3.8272558
Clever	245	48	30.3	65	59	54.4	4.4288814
Graham	278	33	05.5	98	40	56.3	4.2328320

MILLER, ARMSTRONG COUNTY.

In East Franklin Township, about 2 miles northwest of Kittanning, on a flat, cultivated hill owned by James Miller. It is 100 yards west of his brick house.

Station mark: A stone post 36 by 8 by 8 inches, set 34 inches in the ground, in the center of top of which is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania."

[Latitude, 40° 49′ 53.90″. Longitude, 79° 33′ 05.12″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Leister	52	11	10.0	232	08	42.0	3.8272558
Templeton	158	21	39.5	338	20	09.8	3.9397410
Graham	299	55	18.5	120	00	41.6	4.1263694

TEMPLETON, ARMSTRONG COUNTY.

About 1½ miles north of Middlesex (Cowansville post-office), in Sugar Creek Township, on a bare ridge with timber on the northwest side. The land is owned by Widow Templeton.

Station mark: A sandstone post 42 by 8 by 8 inches, set 30 inches in the ground, in the center of the top of which is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania."

Reference mark: A wild cherry tree, 7 inches in diameter, magnetic bearing N. 8° W., 164 feet distant.

[Latitude, 40° 54′ 16.17″. Longitude, 79° 35′ 22.26″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Leister	9	43	23.3	189	42	25.0	4.0930300
Shrader	18	52	03.4	198	48	43.8	4.3503890
Reynolds	193	21	32.2	13	22	43.0	4.0389218
Clever	273	06	31.1	93	16	57.6	4.3508735
Graham	314	53	49.7	135	00	42.7	4.3203059
Miller	338	20	09.8	158	21	39.5	3.9397410

STATIONS WITHOUT THE QUADRANGLE.

BROADVIEW, INDIANA COUNTY.

About 2½ miles north of Shelocta and three-tenths mile east of Armstrong-Indiana County line, on a high, bare hill, with some timber on the southwest slope. The land is owned by John Russell.

Station mark: A stone post 42 by 8 by 8 inches, set 38 inches in the ground, in the center of top of which is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania."

[Latitude, 40° 41′ 16.95″. Longitude, 79° 17′ 28.00″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Graham	131	45	43.1	311	40	54.2	4.1436489
Clever	173	07	19.6	353	06	02.8	4.3608128
Kunkle	253	14	15.6	73	17	40.3	3.8862700

KUNKLE, INDIANA COUNTY.

On land owned by Philip Kunkle, about 2 miles north of Creekside post-office, near western end of a high ridge having scattering trees on the eastern end.

Station mark: A stone post 42 by 6 by 6 inches, set 36 inches in the ground on solid rock, in the center of top of which is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania."

[Latitude, 40° 42′ 28.78″. Longitude, 79° 12′ 14.09″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Broadview	73	17	40.3	253	14	15.6	3.8862700
Graham	111	43	17.4	291	35	03.6	4.2810749
Rowland	183	45	23.0	3	45	50.3	4.1737351

MYERS, CLARION COUNTY.

About 3 miles southeast of Sligo, in Toby Township, near the main road between Clarion and East Brady, and about halfway between the two places, on a bare knob of cultivated land belonging to V. R. Myers, of Sligo.

Station mark: A sandstone 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 marks: Chestnut tree, magnetic bearing S. 65° E., 303 feet distant. Chestnut tree S. 55° W., 115 feet distant. Chestnut tree N. 84° W., 203 feet distant.

[Latitude, 41° 04′ 37.67″. Longitude, 79° 28′ 36.80″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Reynolds	39	10	40.8	219	07	25.6	4.0414047
McCall	76	45	26.6	256	41	14.5	3.9639954
Clever	327	41	28.6	147	47	30.2	4.3829142

M'CALL, CLARION COUNTY.

On a bare flat knob about 1½ miles north of Bela post-office, 8 feet north of an east and west fence on land belonging to William T. McCall.

Station mark: A sandstone post 36 by 8 by 8 inches, set 32 inches in the ground, in the center of top of which is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania."

Reference marks: Chestnut tree 18 inches in diameter, magnetic bearing N. 85° W., 185 feet distant. Chestnut tree 18 inches in diameter, S. 81° E.

[Latitude, 41° 03′ 29.14″. Longitude, 79° 35′ 00.49″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Myers	256	41	14.5	76	45	26.6	3.9639954
Clever	309	51	31.4	130	01	44.6	4.4550873
Reynolds	342	32	21.0	162	33	17.7	3.8277738

REYNOLDS, CLARION COUNTY.

On a round bare knob about 4½ miles northeast of East Brady on road to Rimersburg. The land belongs to the heirs of Alex. Reynolds, of Kittanning, and is occupied by George Leonard.

Station mark: A sandstone post 36 by 10 by 10 inches, set 33 inches in the ground, in the center of top of which is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania."

Reference marks: Chestnut tree with broken top, magnetic bearing S. 58° W., 98 feet distant. Wild cherry tree, 4 inches in diameter, N. 73° W., 51 feet distant.

[Latitude, 42° 00′ 01.14″. Longitude, 79° 33′ 34.13.″]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Templeton	13	22	43.0	193	21	32.2	4.0389218
McCall	162	33	17.7	342	32	21.0	3.8277738
Myers	219	07	25.6	39	10	40.8	4.0414047
Clever	300	50	42.0	120	59	58.2	4.3643865
Graham	334	12	37.9	154	18	20.5	4.4504542

ROWLAND, INDIANA COUNTY.

On a high hill about 4 miles north of Plumville, in North Mahoning Township, and near the line between North and South Mahoning townships. On land owned by W. S. Rowland.

Station mark: A stone post 40 by 6 by 6 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, 30° 50′ 31.39″. Longitude, 79° 11′ 32.36″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Kunkle	3	45	50.3	183	45	23.0	4.1737351
Graham	67	20	45.1	247	12	03.4	4.3072670
Clever	117	12	06.0	297	06	56.5	4.0951985

SHRADER, ARMSTRONG COUNTY.

(Not occupied.)

On a bare ridge in South Buffalo Township, 3 miles northeast of Freeport, on land owned by A. C. Shrader, of Freeport.

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° 42′ 48.68″. Longitude, 79° 40′ 30.96″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Templeton	198	48	43.8	18	52	03.4	4.3503890
Leister	209	45	46.8	29	48	10.1	4.0155564
Graham	253	39	11.0	73	49	24.6	4.3613318

SPIRIT LEVELS.

All bench marks set in the course of this work were stamped with the word "PITTSBURG" and the date "1899," in addition to the figure of elevation, thus referring them to the central datum tablet for this group of levels, which is set in the foundation of the Seventh Avenue Hotel in Pittsburg, the adjusted elevation of which is accepted as being 738.527[a] feet above mean sea level at Sandy Hook. This elevation comes through five lines of precise levels, namely, through United States Coast and Geodetic Survey levels from Sandy Hook and from Old Point Comfort to Hagerstown and Grafton; through United States Coast and Geodetic Survey and United States Army Engineers levels from Dobbs Ferry to Albany, and from Albany via Oswego and the lakes to Erie; through United States Geological Survey levels from Albany to Dunkirk; and through Pennsylvania Railroad precise levels from Sandy Hook via Harrisburg to Pittsburg.[b]

Determined points in the Kittanning quadrangle.

	Feet.
East Brady; bronze tablet set in east abutment wing wall of steel highway bridge, marked "PITTSBURG 852, 1899"	852.645
Phillipston; top of stone milepost front of station, marked "P. 66, O. C. 66-$\frac{5}{10}$"	853.5
Phillipston, 2 miles south of; top of stone milepost, marked "P. 64, O. C. 68-$\frac{5}{10}$"	849.2
Redbank; top of west rail front of station	846.3
Redbank; bronze tablet set in north abutment of Allegheny Valley Railway bridge, 600 feet south of station, west side of abutment, marked "PITTSBURG 844, 1899"	844.746
Redbank, 13 miles south of; top of stone milepost, marked "P. 62, O. C. 70-$\frac{5}{10}$"	843.4
Riverview; top of rail, front of station	835.5
Rimer; top of west rail, front of station	832.3
Rimer, 0.5 mile south of; top of stone milepost, marked "P. 59 and O. C. 73-$\frac{5}{10}$"	831.7

[a] Readjusted elevation is 738.383.
[b] Twenty-first Ann. Rept. U. S. Geol. Survey, pt. 1, 1900, p. 420.

	Feet.
Rimer, 2 miles southeast of; bronze tablet set in north abutment west side of iron bridge, marked "PITTSBURG 820, 1899"[a]	820.810
Rimer, 3.5 miles south of; top of stone milepost, marked "P. 56 and O. C. 76-$\frac{5}{10}$"	824.0
Rimer, 3.8 miles south of; top east rail at railroad crossing	821.6
Mahoning; top of east rail front of station	818.9
Templeton; top of west rail front of station	819.2
Templeton, 0.6 mile south of; top of west rail at railroad crossing	818.4
Templeton, 1.9 miles south of; top of west rail at railroad crossing	813.8
Templeton, 1.6 miles south of; top of west rail at railroad crossing	814.8
Templeton, 2.4 miles south of; top of west rail at railroad crossing	814.0
Templeton, 2.7 miles south of; top of stone milepost, marked "P. 51 and O. C. 81.5"	815.5
Mosgrove; bronze tablet set in north abutment east end of railroad bridge, 900 feet north of station, marked "PITTSBURG 806, 1899"	807.227
Mosgrove, 0.6 mile south of; top of stone milepost, marked "P. 49, O. C. 83-$\frac{5}{10}$"	807.9
Cowanshannock; top of east rail front of station	805.5
Cowanshannock, 1.5 miles south of; top of stone milepost, marked "P. 46, O. C. 86-$\frac{5}{10}$"	807.6
Neal; top of west rail on last crossing south of station	805.4
Wick City; top of west rail at crossing at pottery works	805.4
Kittanning; top of east rail front of station	806.5
Kittanning; bronze tablet set on front face northwest corner of public school on corner of McKain and Vine streets, marked "PITTSBURG 803, 1899"	803.500
Garrett Run; top of west rail front of station	796.2
Manorville; top of east rail front of station	796.1
Graff; top of west rail front of station	790.5
Ford City; top of east rail front of station	784.9
Ford City, 0.5 mile south of; top of stone milepost, marked "P. 40, O. C."	784.7
Rosston; top of west rail front of station	786.7
Rosston, 0.2 mile south of; bronze tablet set in east abutment of bridge over river, marked "PITTSBURG 786, 1899"	786.940

Kittanning along highway west to West Winfield, thence north to Chicora and east to East Brady.[b]

	Feet.
Weskit; in hay-scales platform, nail	1,037.2
McHaddon; in front of post-office, ground	1,335.0
West Winfield; 100 feet west of railroad tracks, in foundation of trestle, aluminum tablet marked "950 PGH 1900"	949.940
Fenelton; 375 feet west of station, in foundation of water tank, aluminum tablet marked "1068 PGH 1900"	1,068.572
Chicora; corner of Main street and Central avenue, directly opposite Union Hall, in sandstone post, aluminum tablet marked "1,246 PGH 1900"	1,245.543
Chicora, 6.5 miles northeast of; at intersection of Somerville road, old stone house, on window sill, chisel-mark projection	985.73
Rocketts Bridge; bridge floor	972.0
Bradys Bend; bridge below bend, floor	925.0

Determined points in the Rural Valley quadrangle.

	Feet.
Kittanning, 1 mile east of; north side of road, nail in stump	999.42
Kittanning, 2 miles east of; south side of road, rock, chiseled mark	1,145.55
Kittanning, 3 miles east of; south side of road, rock, chiseled mark	959.07
Kittanning, 3.33 miles east of; south side of road, pipe line, marked	988.00
Kittanning, 3.75 miles east of; at road south; rock, chiseled mark	985.65
Kittanning, 4.5 miles east of; 50 feet east of road northeast, north side of road, rock, chiseled mark "1026"	1,026.19
Stone House Hotel, 0.75 mile west of; east side of road, rock, chiseled mark	1,049.50
Kittanning, 6 miles east of; Stone House Hotel, in southeast corner stone, aluminum tablet, marked "1011 PITTSBURG"	1,010.491
Stone House Hotel, 1 mile east of; bridge, south side of road by rock, chiseled mark	1,022.74
Stone House Hotel, 1.5 miles east of; at road, chiseled mark "1116"	1,115.41
Stone House Hotel, 2 miles east of; south side of road by small wooden bridge, rock, chiseled mark	1,069.97
Yatesboro; railroad at west end of, top of rail	1,120.7
Yatesboro; railroad crossing in; top of rail	1,129.3

[a] This is bench mark 821 of Rural Valley sheet.
[b] Unpublished data; the error distributed in this line is excessive.

	Feet.
Yatesboro, 0.5 mile east of; south side of road, chiseled mark	1,123.94
Rural Valley; bridge in, southeast wing wall of, in coping stone, copper tablet, marked "1112 PITTSBURG"	1,111.610
Rural Valley, 3 miles north of; 600 feet south of schoolhouse, rock, chiseled mark	1,185.25
Dayton, 2.75 miles southwest of; west side of road, rock, chiseled mark	1,399.03
Rural Valley, 8 miles north of; at road to west, nail in root of oak tree	1,275.52
Dayton, 1.5 miles west of; Buffalo, Rochester and Pittsburg Railroad overhead bridge, on southeast, top of coping stone, chiseled mark	1,275.47
Dayton, 0.5 mile west of; road crossing, top of north rail at	1,322.5
Dayton, 0.25 mile west of; road crossing, top of south rail at	1,327.9
Dayton; 900 feet west of station, Buffalo, Rochester and Pittsburg Railroad bridge over small stream, northwest wing wall of, on second coping stone, aluminum tablet, marked "1326 PITTSBURG"	1,326.118
Eddyville, 2.5 miles south of; at crossroad, rock, chiseled mark	1,256.90
Eddyville, 2 miles south of; iron bridge over Mahoning Creek, on southeast abutment, chiseled mark "1019"	1,018.69
Eddyville, 1.5 miles south of; east side of road, rock, chiseled mark	1,200.53
Eddyville; iron bridge over Big Mahoning, on bridge seat, southeast wing wall, aluminum tablet, marked "992 PITTSBURG"	992.284
Eddyville, 0.25 mile northeast of; iron bridge over Pine Run, floor of	999
Putneyville, 1 mile east of; bridge over Sugar Camp Run, floor of	954
Putneyville; iron bridge over Mahoning Creek, northwest wing wall, coping stone, chiseled mark	940.42
Putneyville, 1.5 miles west of; north side of road, under oak tree, rock, chiseled mark	908.01
Putneyville, 3 (2½) miles west of; at cross rails, summit, rock, chiseled mark	1,027.82
Macks Bridge (over Mahoning Creek, 6 miles east of Mahoning), 0.5 mile east of; south side of road, rock, chiseled mark (1001 on map)	942.55
Mahoning, 6 miles east of; iron bridge over Mahoning Creek known as Macks Bridge; on southeast bridge seat, chiseled mark	863.50
Mahoning, 4 miles east of; opposite mill by road north, nail in root of tree	841.61
Mahoning, 2 miles east of; iron bridge, southwest wing wall, coping stone, chiseled mark	833.17
Mahoning; Allegheny Valley Railroad, opposite station, top of rail	818.7
Rimer 2 miles southeast of; railroad bridge, northwest abutment, bronze tablet, marked "PITTSBURG 820, 1899"	820.810

DRAINAGE.

The streams that drain a region exercise an important influence upon its economic development. Their valleys afford sites for the location of towns and open a way to communication with the surrounding country, either by water or rail. Along the valleys the strata are exposed and the beds containing valuable minerals are made accessible. The area discussed in this report has been particularly well favored in these respects. Allegheny River has cut a deep valley from north to south through the middle of the region, and this facilitates the exportation of its various mineral and manufactured products. East of the river and along the northern side of the quadrangles the valley of Redbank Creek affords passage to a railroad and exposes valuable beds of coal, clay, and limestone. Farther south Mahoning Creek, with its tributaries, Scrubgrass, Little Mudlick, and Pine creeks, likewise makes accessible the mineral deposits of a wide strip of territory extending to the eastern limit of the Rural Valley quadrangle. Still farther south the edges of the coal and limestone beds are exposed by both forks of Pine Creek, along the south fork of which runs the Buffalo, Rochester and Pittsburg Railroad, another important artery of communication with the outside world. Cowanshannock Creek and Garrett Run make accessible the coals of a large tract of country. North Branch of Plum Creek opens a way into the southeastern corner of the region. West of the river Buffalo Creek and Glade Run are the most important streams. The former is followed along the upper part of its course by the Buffalo, Rochester and Pittsburg Railroad and along the lower part by the Winfield Railroad, which reaches the quarries and brick works at West Winfield. All the important coal beds of the region are exposed along the valley of Glade Run from the Lower Kittanning, which outcrops at its mouth, to the Upper Freeport, which outcrops on the hillsides from its mouth to its source. Huling Run, Sugar Creek with its tributaries, and Little Beaver Run make accessible a considerable territory in the northern part of the Kittanning quadrangle.

RELIEF.

The surface of the region is hilly, but the upland slopes are generally moderate and easily cultivated. The valleys are narrow and the streams have developed very scanty flood plains. Occasionally farming land occurs in these valleys, but frequently the bluffs reach the water's edge and there is no level land. The walls of the larger valleys are almost invariably steep and in places precipitous; in others they are strewn with large bowlders, and, being thus ill suited to cultivation, they are generally forested. The upper courses of the minor streams are not so deeply trenched, and they are often bordered by rather gently sloping and arable land. Farming is necessarily confined almost exclusively to the uplands, and the stranger traveling along the valleys would little suspect the presence of well-cultivated fields just over the brows of the bluffs that restrict the range of his vision.

GEOLOGY.

STRUCTURE.

GENERAL STATEMENT.

The rocks of these quadrangles were originally deposited as sediments in an approximately horizontal position at the bottom of the sea or other bodies of water. Subsequently the rocks were elevated to their present position, and the strata were thrown into low folds forming anticlines and synclines.

METHOD OF REPRESENTING STRUCTURE.

The geologic structure of this region is represented on the map by means of contours. These are lines imagined to be drawn at regular vertical intervals upon the top of the Vanport ("Ferriferous") limestone as a reference surface through points having the same elevation above sea level. Many such points are determined, and lines are drawn connecting them. The contour interval is 50 feet; that is to say, for example, a line is drawn connecting all points of the reference surface 1,000 feet above the sea, and the adjacent lines are drawn through points at 950 and 1,050 feet above the sea, and so on.

In many cases the altitude of the points on the limestone is determined by direct observation on the outcrop; in others it is determined by borings that penetrate the limestone; in still others the elevation of some other stratum is observed, and the elevation of the limestone is calculated from the known interval between the two strata.

These contours are greatly generalized and only approximate. There are several sources of error affecting their determination. All observations are based upon the topographic map, and while there are many bench marks determined by lines of precise leveling by which observations may be checked, observations at other points may be based upon a local datum that is possibly out by several feet. Again, nearly all elevations, as those of outcrops or of well mouths, are determined by aneroid barometer, and such determinations are always liable to errors of greater or less extent. The probable failure in many cases to measure accurately the depth of the limestone in deep wells is another source of error. Still another is the variation in the thickness of the intervening rocks in those cases where the elevation of the limestone is calculated from observations on other strata. In so far as the actual interval between the observed stratum and the limestone differs from that at the nearest point of measurement, which interval is assumed at the point of observation, the determination of the altitude of the limestone at that point will be erroneous.

Notwithstanding these sources of error, it is believed that the actual altitude of the limestone will not differ more than a contour interval from that shown by the contours at any point, and that the structure as represented on the map closely approximates the truth. This method of representing structure has the advantage that it is possible by it to show the lay of the rocks over all parts of the area contoured. The position, form, and extent of the anticlines and synclines, the dip of the rocks, and the absolute altitude of the reference surface are readily delineated.

The great advantage of having the structure so completely shown is that it becomes possible to determine the approximate depth of any stratum, such as a coal seam, provided that the interval between the limestone and the given stratum is known at any point. This can be done as follows: Determine by the surface contours the elevation of the given point and by the structure contours the elevation of the Vanport limestone at that point; the difference between the two elevations will be the depth of the limestone below the surface, or, in case the limestone has been eroded, the elevation of its horizon. To the number thus obtained add the interval if the given stratum is below the limestone, or from that number subtract the interval if the given stratum is above the limestone. If the depth to a stratum is required at a point where the limestone has been eroded, subtract from the given interval the difference in elevation between the surface and the horizon of the limestone at the point. The determination of such facts should be of great benefit to prospectors in sinking diamond-drill holes and to mining companies in enabling them to determine the most advantageous locations of shafts and openings and to estimate the probable cost of drilling or of sinking shafts. It should also be of value to drillers for gas and oil who wish to locate their wells with regard to the structure, since it seems probable that the greater accumulations of these substances occur on and adjacent to the anticlines. From the intervals given in the discussion of the oil and gas sands, it will be possible to determine by the method already described the approximate depth to any gas or oil sand at any point in the quadrangles.

FORMER VIEWS OF STRUCTURE.

It seems well to preface the detailed description of the structure by an outline of the same as made out by previous surveys, and particularly by the Second Geological Survey of Pennsylvania. Platt[a] described in this territory a number of anticlines and synclines lying in regular order from northwest to southeast, as follows:

The Millerstown anticline, near the northwest corner; the Bradys Bend syncline, passing through Bradys Bend; the Bradys Bend anticline, passing near the mouth of Redbank Creek; the Lawsonham syncline, passing through Lawsonham; the Kellersburg anticline, passing through Kellersburg; the Stewartson Furnace anticline, a short axis in the vicinity of Dee; the Centerville syncline; the Anthonys Bend anticline, passing through Anthonys Bend, Redbank Creek; the Fairmount syncline, passing through Fairmount on Redbank Creek north of the quadrangles; the Greendale anticline, passing through Greendale; the Brookville anticline, at the head of Little Mudlick Creek; the Leechburg syncline; the Glade Run anticline, following Glade Run south of Mahoning Creek; the Apollo syncline, passing near Rural Valley; and the Port Barnet anticline, in the vicinity of Smeltzer. The axes of the anticlines and synclines are described and mapped as following straight courses about N. 30° E. Chance[b] differs from Platt in his description of the structure in the northwest corner of the Kittanning quadrangle. He describes the Millerstown as a short anticline lying southeast of Chicora, but not extending to the northeast beyond Donegal Township. Apparently what Platt describes as the Millerstown anticline, lying a little beyond the northwest corner of the quadrangles, is the same as Chance's Martinsburg anticline.

The results of the present survey, as far as regards structure, differ materially from those outlined above. The structure of the region will be described in detail, proceeding in regular order from northwest to southeast.

NORTHWEST CORNER OF THE KITTANNING QUADRANGLE.

The structure here is not pronounced, and its determination is based almost wholly upon the position of the Vanport ("Ferriferous") limestone as given in many well records. A low syncline apparently passes through Chicora to Karns and connects by a broad, shallow depression around the northeast end of the Millerstown anticline with the Bradys

[a] Platt, W. G., Second Geol. Survey Pennsylvania, Rept. H5, pp. xxxviii-xlvi, and maps, p. xxvi.
[b] Chance, H. M., Second Geol. Survey Pennsylvania, Rept. V, p. 10.

Bend syncline in the northwest corner of Sugar Creek Township. From the syncline through Chicora and Karns the strata rise gently northwestward to the Martinsburg anticline. The point of an anticline enters the northern part of Bradys Bend Township and extends southwestward into the southeast corner of Fairview Township. No name has been applied to either syncline or anticline, since little is known of them outside of the quadrangle.

MILLERSTOWN ANTICLINE.

The determination of the position and extent of this anticline by the present survey agrees fully with the description given by Chance.[a] Its axis crosses Buffalo Run about 2 miles southeast of Chicora and runs about N. 40° W. As shown in a number of wells, the elevation of the limestone on the axis is about 1,050 feet near the margin of the quadrangle. That the rocks dip slightly from this locality toward Chicora is proved by the facts that the Upper Freeport coal at that place is 1,260 feet above sea and that in the northwest corner of the Kittanning quadrangle the limestone is about 260 feet below the coal, which makes the elevation of the limestone at Chicora 1,000 feet. The regular dip of the rocks to the northeast and southeast toward the Bradys Bend syncline is shown by the position of the Vanport limestone in many wells along the axis of the syncline. The Millerstown anticline is separated from the point of the anticline to the north in Bradys Bend Township by the shallow depression connecting the Bradys Bend syncline and the shallow syncline at Chicora, as shown in many wells by elevations on the limestone of 1,000 feet or a little less.

BRADYS BEND SYNCLINE.

Platt described the axis of this syncline as crossing the boundary between Butler and Armstrong counties on Buffalo Creek and extending in a straight line northeast through Bradys Bend, but evidence now in hand shows that this axis lies west of the position thus assigned to it. Many oil wells on the Riley and Hickey farms northwest of Fenelton show the limestone to be about 900 feet above the sea. From these localities the limestone rises regularly northwestward, as shown by many wells, to the axis of the Millerstown anticline. In the southeast corner of Donegal Township, on the Goldlinger and Maley farms, about 1½ miles east of the Hickey wells, three wells give the elevation of the limestone at 1,050 feet. The axis of the syncline, then, lies west of the latter locality, probably in the vicinity of the Hickey farm. Another line of evidence also leads to the conclusion that the axis lies considerably west of Platt's location. The Upper Freeport coal is near water level on the western margin of the quadrangle. It can be traced down Little Buffalo Run, rising constantly southeastward; half a mile west of Fenelton it is more than 100 feet above the stream. About a mile southeast of Fenelton the Lower Kittanning coal lies 40 to 50 feet above the creek, and at Nichola the Vanport limestone is about 50 feet above the creek. These facts show conclusively that the rocks are rising eastward along Buffalo Creek from the western margin of the quadrangle, and that the axis of the Bradys Bend syncline enters the quadrangle from the southwest about 1 mile southwest of Fenelton, passing thence, as shown by numerous well records, in a nearly straight line one-half mile west of Rattigan and entering Armstrong County in the northwest corner of Sugar Creek Township, in the neighborhood of the Pontius and Reep farms, where the elevation of the limestone is 1,000 feet above sea. In the vicinity of Adams well records show the elevation of the limestone to be about 1,100 feet and the stratigraphic evidence points to a regular rise of the rocks toward that place from the northwest corner of Sugar Creek Township. From Adams the axis bends sharply eastward and passes through East Brady, as is shown by the fact that the limestone at a number of points near the mouths of Holder and Snyders runs has an altitude of from 1,020 to 1,030 feet. From this locality it rises on the north to 1,060 feet at the mouth of Pine Run, 1,110 feet one-half mile up Pine Run, and 1,100 feet one-half mile north of the village

[a] Second Geol. Survey Pennsylvania, Rept. V, p. 10

of Bradys Bend, just off the quadrangle; on the south it rises to 1,065 feet in the apex of the river bend 1 mile below East Brady. Farther down the river, one-half mile west of Phillipston, two points on the limestone were noted at 1,025 and 1,020 feet. This indicates a transverse wrinkle in the syncline running from East Brady toward Phillipston, which may have influenced Platt in locating the axis at the latter point. From this locality southeastward numerous observations on the limestone and other beds show a constant rise toward the Kellersburg anticline. About one-half mile northeast of Phillipston the elevation of the limestone was determined, from an observation on the Lower Kittanning coal, to be 1,075 feet. Almost due north of this point on the bluff of the Allegheny the altitude of the limestone is 1,055 feet. Still west and north nearly one-half mile the limestone lies at 1,075 feet. On the north side of the river, north of East Brady and just off the quadrangle, the elevation is 1,095 feet, and in the bluff on the east side of the river just south of the margin of the quadrangle the limestone is at 1,100 feet above sea. These observations locate the axis definitely along the neck between the bends of the river east of Bradys Bend. From this point eastward the position of the axis is more obscure. Near the head of a ravine entering Redbank Creek about a mile above its mouth old ore pits and presumably the limestone occur at an elevation of 1,100 feet. This point is about a mile north of the mouth of the creek. North of this the limestone was not seen, but the Lower Kittanning coal could be traced for some distance, rising perceptibly. Southward the strata also rise and the limestone was observed north of the mouth of Redbank Creek at 1,160 feet, while 1 mile up the creek it has an elevation of 1,200 feet. Still farther east the limestone was observed at 1,150 feet three-fourths mile southwest of Lawsonham, just east of the boundary between the quadrangles. From this point the strata rise southeastward, but the exact position of the axis is unknown, as the county to the north has not been surveyed. It seems probable, however, that it passes a short distance north of Lawsonham.

KELLERSBURG ANTICLINE.

This is the principal structural feature of the quadrangles. It corresponds in part with Platt's Bradys Bend anticline and in part with his Kellersburg anticline. Its axis very nearly coincides with that of the Bradys Bend anticline, as mapped by Platt, from the southwest corner of the Kittanning quadrangle to the southeastern part of Sugar Creek Township, but from this locality onward the location of the anticline by the present survey differs greatly from that given by Platt. It is desirable, therefore, to present the evidence upon which the determination here made is based.

The limestone on the axis of the Kellersburg anticline rises very regularly from an elevation of 950 feet in the southwestern part of the Kittanning quadrangle to a point about 1 mile southeast of Fosters Mills, where two wells reveal it at altitudes of 1,310 and 1,330 feet. Midway on the road between Cowansville and Browns Crossroads the Freeport sandstone lies at 1,500 feet above sea, and, since this stratum is about 200 feet above the limestone, the latter lies at 1,300 feet. From this place the strata dip to the north, west, and south, as shown by observations on the limestone and coal beds. One-half mile southeast of Browns Crossroads the altitude of the limestone is 1,240 feet, as shown in a well; at Sherrett its altitude is 1,244, and abundant observations show a constant dip from this point to Phillipston, and a dip of nearly 100 feet to the mouth of Redbank Creek. From the southeast part of Sugar Creek Township to a point about midway between Rimer and Morrows Corner, however, the limestone dips very gradually eastward to below 1,250 feet. This determination is based mainly on the evidence of coal beds. The Upper Freeport coal, whose horizon on the axis of the anticline in Sugar Creek Township must be at least 1,550 feet above the sea, since it is at least 50 feet above the Freeport sandstone, just catches the knobs at 1,500 feet in the vicinity of Peach Hill, thus showing a descent of 50 feet. Allowing an interval of 250 feet between this coal and the limestone, the latter would have an altitude of 1,250 feet near Peach Hill. North of this locality, at a point about 1 mile north of Rimer, the Lower Kittanning coal was struck in a test

well at an elevation of 1,230 feet, showing that the elevation of the limestone at that point is about 1,200 feet. Numerous observations on coal beds and on the limestone direct show that the elevation of the limestone in the northern parts of Washington and Madison townships is 1,200 feet or less. Southward in the vicinity of Morrows Corner the Lower Kittanning coal lies at about 1,170 feet above sea level; and the limestone is at about 1,050 feet one-half mile north of Adrian. The evidence presented above clearly shows that the rocks dip both north and south from a line passing nearly east and west through the above-mentioned point between Rimer and Morrows Corner, and that that line is therefore to be taken as the anticlinal axis which thus connects the Bradys Bend and Kellersburg anticlines.

From the point on the anticline between Rimer and Morrows Corner the axis can be traced without difficulty by means of abundant exposures of the limestone and openings on the Lower Kittanning coal, through Kellersburg, across Redbank Creek between Climax and St. Charles and off the quadrangles northeast of Climax, where the limestone was observed at about 1,360 feet. Numerous observations on the limestone west of Climax, where revealed by old ore strippings and in natural exposures show that it dips regularly from this axis to the southeast until it disappears in the bluff at the southern point of Anthonys Bend, at an altitude of 1,130 feet.

At a point about 2 miles a little north of east of Climax the limestone is quarried at 1,360 feet elevation. Just southeast of New Bethlehem an old ore pit shows its altitude to be 1,110 feet. Between the two points observations indicate regular dip of the limestone. These observations show conclusively that there is neither anticline nor syncline in this region, as mapped by Platt and named the Anthonys Bend anticline and Centerville syncline. The northern extension of the Kellersburg anticline beyond the quadrangles is unknown, but it is a fair presumption that it is continuous with the Anthonys Bend anticline in Clarion County. It is clear, then, that instead of three anticlines with straight axes there is in reality but one anticline with a strongly curving axis, which is very appropriately named the Kellersburg anticline.

BOGGSVILLE SYNCLINE.

Platt mapped the Lawsonham syncline as extending from the head of Cornplanter Run, in a straight line, through Worthington and Cowansville to Lawsonham. Evidence presented in describing the Kellersburg anticline shows that while there is a sag in the anticline north of Morrows Corner the anticlinal structure so predominates in the region that a syncline could not properly be regarded as crossing there. To the northeast there is, however, a transverse buckle in the rocks, which passes in the direction of Lawsonham, and to the southwest there is a distinct syncline, which dies out on the southeastern limb of the Kellersburg anticline near Limestone Run, south of Adrian. This syncline occupies in a general way the position of the south end of the Lawsonham syncline, but Platt located its axis farther west. The Vanport limestone crops out at West Winfield at an altitude of 1,000 feet; near Boggsville it was noted in two wells at altitudes of 680 and 733 feet, showing a dip of 300 feet between the two places. This dip is confirmed by the records of many other wells in this vicinity and also by the fact that the Upper Freeport coal, which has an altitude of 1,240 feet at West Winfield, dips southeastward to an altitude of 920 feet near Boggsville. The strata probably begin to rise southeastward from Boggsville, for wells just off the margin of the quadrangle south of Slate Lick show the limestone at 750 feet above the sea. These facts locate the axis of this syncline pretty definitely near Boggsville, and it is therefore named the Boggsville syncline. This syncline in the southern part of the quadrangle is broad and flat-bottomed, and the position of its axis is rather indefinite. Its location as mapped is based upon an occasional well record and upon careful and thorough stratigraphic tracing in the region. Near Walkchalk the syncline narrows suddenly, and its axis is well determined by the opposing dips of the rocks. Its course north of Walkchalk was determined by observations on the Upper and Lower Freeport coals and by well records and observations on outcrops of the limestone along Limestone Run.

McHADDON ANTICLINE.

This low anticline, whose axis enters the Kittanning quadrangle 2 miles southwest of North Buffalo village, runs in general nearly parallel to the axis of the Boggsville syncline and dies out near the mouth of Limestone Run. Here it merges with the Kellersburg anticline and ceases to be a separate feature. The name is applied because the axis runs near McHaddon.

FAIRMOUNT SYNCLINE.

As mapped by Platt the axis of this syncline follows the river from the southern margin of the Kittanning quadrangle to the mouth of Garrett Run and continues thence in nearly straight line to Redbank Creek near Fairmount. In a general way this location agrees with that of the present survey, but the details differ to some extent. The axis is not straight. From the mouth of Garrett Run it trends about N. 30° E. to Scrubgrass Creek, then swings gradually eastward to a course about N. 60° E., which it follows to about 1 mile east of Mahoning Furnace, where it curves northward and leaves the Rural Valley quadrangle in a nearly north course. The position of this axis is well determined by the opposing dips of traceable coal beds, and at the point where it crosses Scrubgrass Creek it is fixed within narrow limits by the opposite dips of the rocks in the bed of the creek and on the valley walls. From this point to the northern margin of the quadrangle the bottom of the syncline appears to flatten out and the position of the axis is not so well established. Observations on the limestone along Mahoning Creek, and on Redbank Creek, where it is exposed between Fairmount and Oak Ridge, and also on the Upper Freeport coal in a a number of banks and in the Fairmount Company's mines, all serve to indicate that the axis can not be far from the position shown on the map.

A peculiarity of this syncline is the oval depression on the axis on Pine Creek at the mouth of Bullock Run. This is formed by a low cross anticline which crosses the syncline south of Hays Run. The existence of this anticline is proven by stratigraphic tracing, as well as by the fact that two wells on the Starr farm just south of Rayburn Run found the limestone at 870 feet, while along the synclinal axis north of Pine Creek the elevation decreases to 800 feet, and southward it constantly decreases to below 700 feet on the southern margin of the quadrangle.

GREENDALE ANTICLINE.

Southeastward from the axis of the Fairmount syncline the rocks rise to the crest of the Greendale anticline as far north as Mahoning Creek and to the crest of the Brookville anticline north of that creek. The axis of the Greendale anticline enters the Rural Valley quadrangle from the south about 1½ miles southwest of Blanket Hill and follows in general the northeastward course mapped by Platt through Greendale to a point about 1½ miles southwest of Muff. From this point Platt continued it in a straight line to the head of Scrubgrass Creek, where he represented it as dying out. Numerous observations in the Upper Freeport coal, however, show a regular dip both northwestward and southeastward from a line passing from this point through Muff toward Belknap. Along the road from one-half mile southwest of Muff to the high knob at the locality known as Concord Church, the records of nearly a dozen wells show the elevation of the limestone to be nearly 1,400 feet; northwest toward Goheenville wells show a regular dip of the limestone to the altitude of 1,050 feet, and southeast toward Echo a similar dip to 1,000 feet. Following the line indicated above northeastward to Belknap, the Lower Kittanning coal occurs at an elevation of about 1,420 feet, and still northeastward along the same line the coal has been opened near the road intersection at the H. S. Pontius farm and at an intermediate point, at both of which its altitude is 1,420 feet. Still farther northeastward on the road following the top of the bluff of Mahoning Creek, at a point nearly south of the mouth of Glade Run, the limestone has been quarried at an altitude of 1,440 feet. From the line thus traced out the strata dip in both directions, as proved by abundant observations on the outcrop

of the limestone and the Lower Kittanning and Upper Freeport coals, as well as by the elevations of the limestone shown in a number of wells on both sides of the anticline. Platt described the Glade Run anticline as beginning in the vicinity of Echo and running northeastward through Wayne Township to the vicinity of the mouth of Glade Run. No trace of such an anticline was detected near Echo during the present survey, and it is well established by the facts cited above that there is but one anticline in the region which curves in harmony with the Kellersburg anticline; it is appropriately named the Greendale anticline.

BROOKVILLE ANTICLINE.

In the northeast corner of the Rural Valley quadrangle lies the southwest point of the Brookville anticline, in substantially the position mapped by Platt. This anticline plunges rapidly southwestward and disappears as a distinguishable feature near the mouth of Little Mudlick Creek.

The Brookville anticline is separated from the Greendale anticline by a narrow depression running eastward from the Fairmount syncline in the vicinity of Putneyville and passing off the quadrangle at McWilliams. The existence of this depression is well established by observations on the limestone and the Lower Kittanning coal.

APOLLO SYNCLINE.

Platt described the Leechburg syncline as lying next east of the Greendale anticline, extending northeastward and separating it from the Glade Run anticline, and then leaving Armstrong County east of the Brookville anticline. In the survey of the Elders Ridge quadrangle no trace of this syncline could be detected, and it certainly does not extend into the Rural Valley quadrangle. (See Elders Ridge folio.) The Apollo syncline, however, described and mapped by Platt as lying west of the Leechburg syncline and separated therefrom by the Apollo anticline in southern Armstrong County, has been traced into the southern part of the Rural Valley quadrangle.[a] The axis of this syncline enters the quadrangle about 1 mile east of the western boundary of Plum Creek Township and extends northeastward, passing about one-half mile southeast of Blanco and becoming indistinct in the flat-lying strata in the vicinity of Rural Valley. There appears to be a very shallow synclinal depression between Smeltzer and Bryan that is in line with the direction of this syncline and may be regarded as an extension of it.

ROARING RUN ANTICLINE.

Platt mapped this anticline as ending on the north at a point south of the Rural Valley quadrangle and a short distance north of Crooked Creek. It is shown in the Elders Ridge folio, however, that this is a strongly marked and easily traceable feature in the Elders Ridge quadrangle to the south and its continuation as far north as Blanco, in the Rural Valley quadrangle, can be made out from well records. The axis of the anticline enters the quadrangle about 1½ miles west of the axis of the Apollo syncline. The position of the limestone in the Espey well on the axis of the Apollo syncline one-half mile southeast of Blanco is about 860 feet above the sea, and a little more than a mile to the southeast it occurs in the Bell and Wagoner wells at about 1,000 feet above the sea, showing a sharp rise of 150 feet. The rise of the strata, however, can not continue much if any beyond this point, for if it did the Upper Freeport coal would crop out on the hillside to the southeast; it does not, and there is evidence that it lies at considerable depth west of Green Oak, showing that the rocks dip rapidly southeastward from the Roaring Run axis. On evidence furnished by the wells this anticline is believed to curve sharply westward near its point and, like the Apollo syncline, to become lost about 1 mile northeast of Blanco in the nearly horizontal strata along the valley of upper Cowanshannock Creek.

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[a] Second Geol. Survey Pennsylvania, Rept. V, p. 10.

SOUTHEAST CORNER OF THE RURAL VALLEY QUADRANGLE.

As intimated above, the rocks of the southeast corner of the quadrangle lie nearly flat, and owing to the scarcity of well records and to the absence of traceable beds the structural details can not be made out with as much certainty as could be wished. This applies to the region roughly bounded by the 850-foot structure contour along the bases of the Roaring Run and Greendale anticlines. It is believed that the rocks south of Cowanshannock Creek dip regularly toward a depression which extends from Green Oak to the vicinity of Gastown, in the Elders Ridge quadrangle. A number of wells in the vicinity of Atwood show a slight anticlinal structure in that vicinity which may be more pronounced in the territory to the east. The Moore well (485) at Smeltzer, several diamond-drill holes, and the Brush Creek coal bed show a similar anticlinal structure along the North Branch of Cowanshannock Creek. This is possibly the vanishing southwest end of the Port Barnet anticline mapped by Platt. Both of these anticlines are very low and of little importance within this quadrangle.

DIP OF THE ROCKS.

The dips throughout these quadrangles are generally low. The highest are found on the southeast flank of the Kellersburg anticline and probably do not exceed 3° to 4°.

PITCHING AXES.

A notable feature of the anticlines and synclines of the region is the general southwestward pitch of the axes. Within the limits of the quadrangles the axis of the Bradys Bend syncline on the Vanport limestone pitches from 1,150 to 900 feet above sea level, that of the Kellersburg anticline from 1,400 to 950 feet, that of the Fairmount syncline from 1,070 to 650 feet, and that of the Greendale anticline from 1,440 to 1,000 feet. The pitch, however, is not always uniform. The crests of the anticlines in some places run nearly level for long distances, as that of the Greendale anticline in the vicinity of Belknap and Muff, and that of the Kellersburg northeast of Kellersburg and near Craigsville and West Winfield. In other cases they exhibit elevations like the Kellersburg anticline east of Fosters Mills and the Greendale anticline south of Pine Creek. The regular southwestward pitch of the Fairmount axis is interrupted by the cross anticline south of Hays Run already described.

COURSE OF STRUCTURE LINES.

Another notable feature of the structure of the quadrangles is the deviation of the anticlinal and synclinal axes from straight lines. In general each axis is composed of reversed curves. The failure to recognize these facts and the assumption that the folds follow straight northeast-southwest courses led to serious errors in previous attempts to determine and map the structure and to no little confusion to those engaged in drilling for gas and oil.

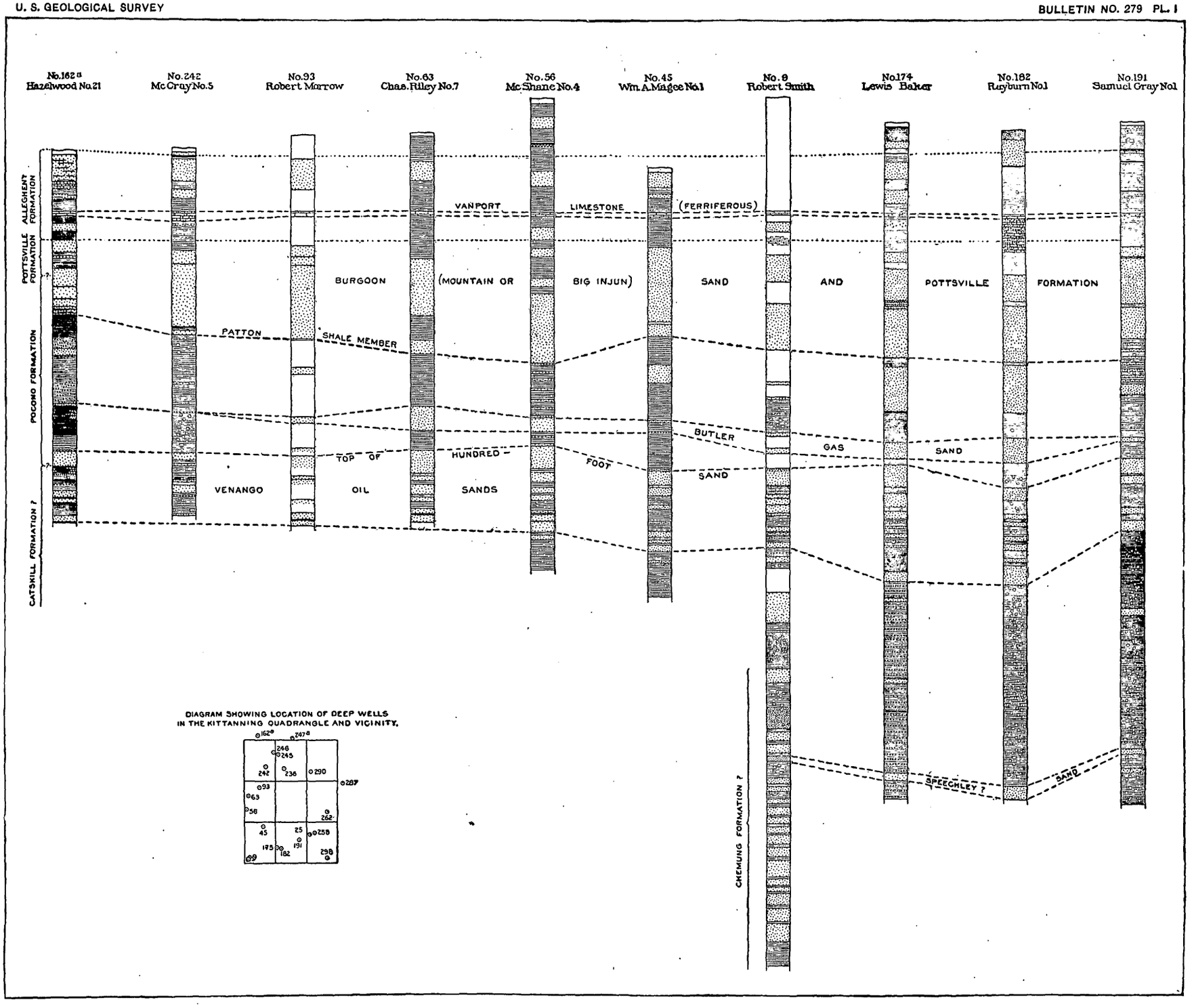
STRATIGRAPHY.

The rocks of which we have knowledge in these quadrangles are treated under two heads, viz, rocks not exposed at the surface and those that outcrop. The former are revealed in deep wells sunk for gas or oil; the latter can be studied directly.

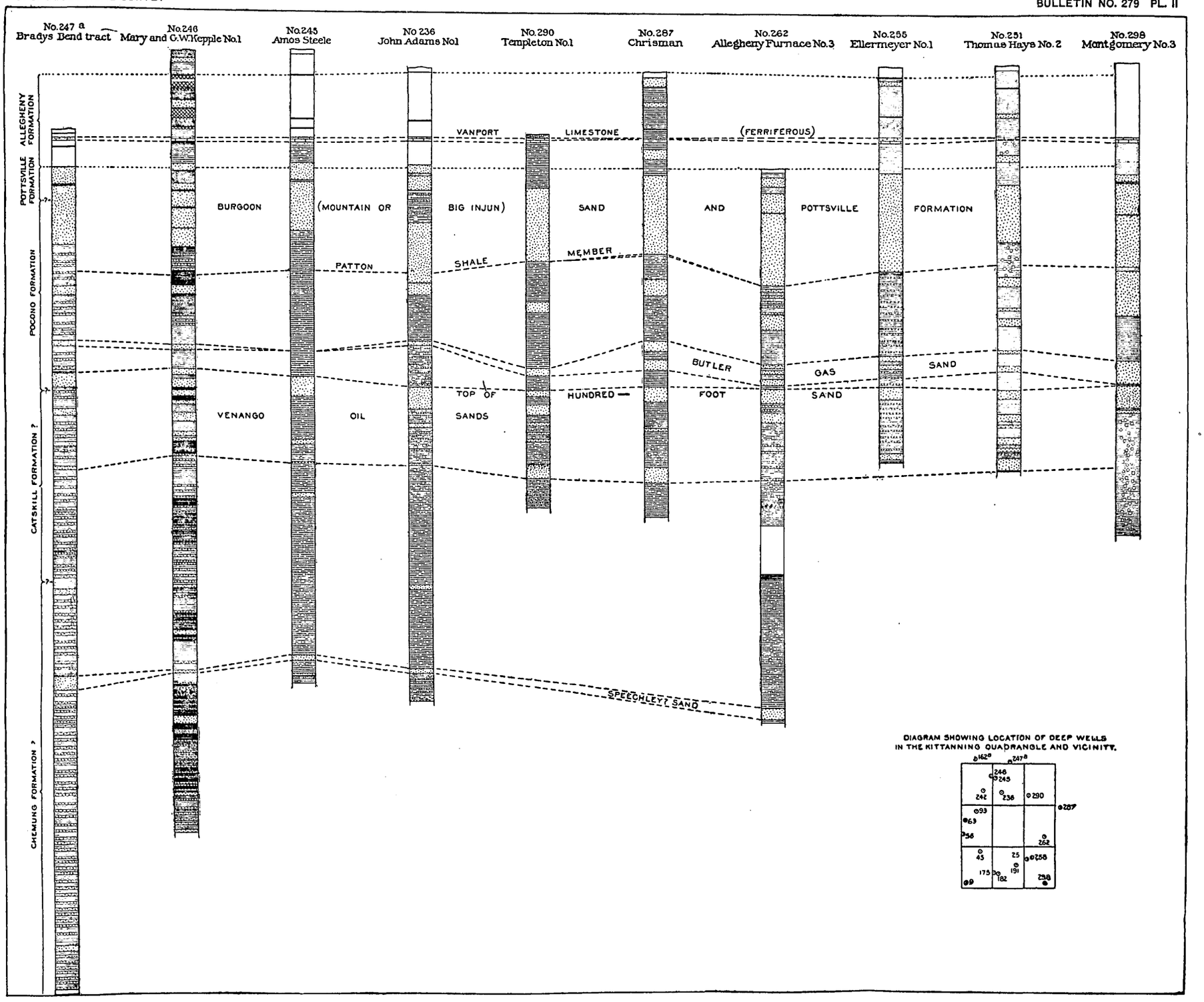
ROCKS NOT EXPOSED.[a]

Sources of knowledge.—Our knowledge of these rocks is derived entirely from the records of deep wells bored for gas or oil and is more or less imperfect. In many cases records have been carelessly kept; strata important from a geologic standpoint, such as bands of red rock or a bed of limestone, have been overlooked or not recorded; and frequently only the oil or gas sands have been noted, thus leaving great blanks in the logs. The methods of measurement introduce some errors. While measurements to the oil and gas sands are mostly made by steel line and are accurate, the depth and thickness of other beds are generally estimated by counting the turns of the cable on the bull-wheel shaft, and errors in computing the length of rope by this method easily occur. In very deep wells the stretching of the cable might

[a] See Pls. I-IV.



DEEP-WELL SECTIONS IN KITTANNING QUADRANGLE AND VICINITY.



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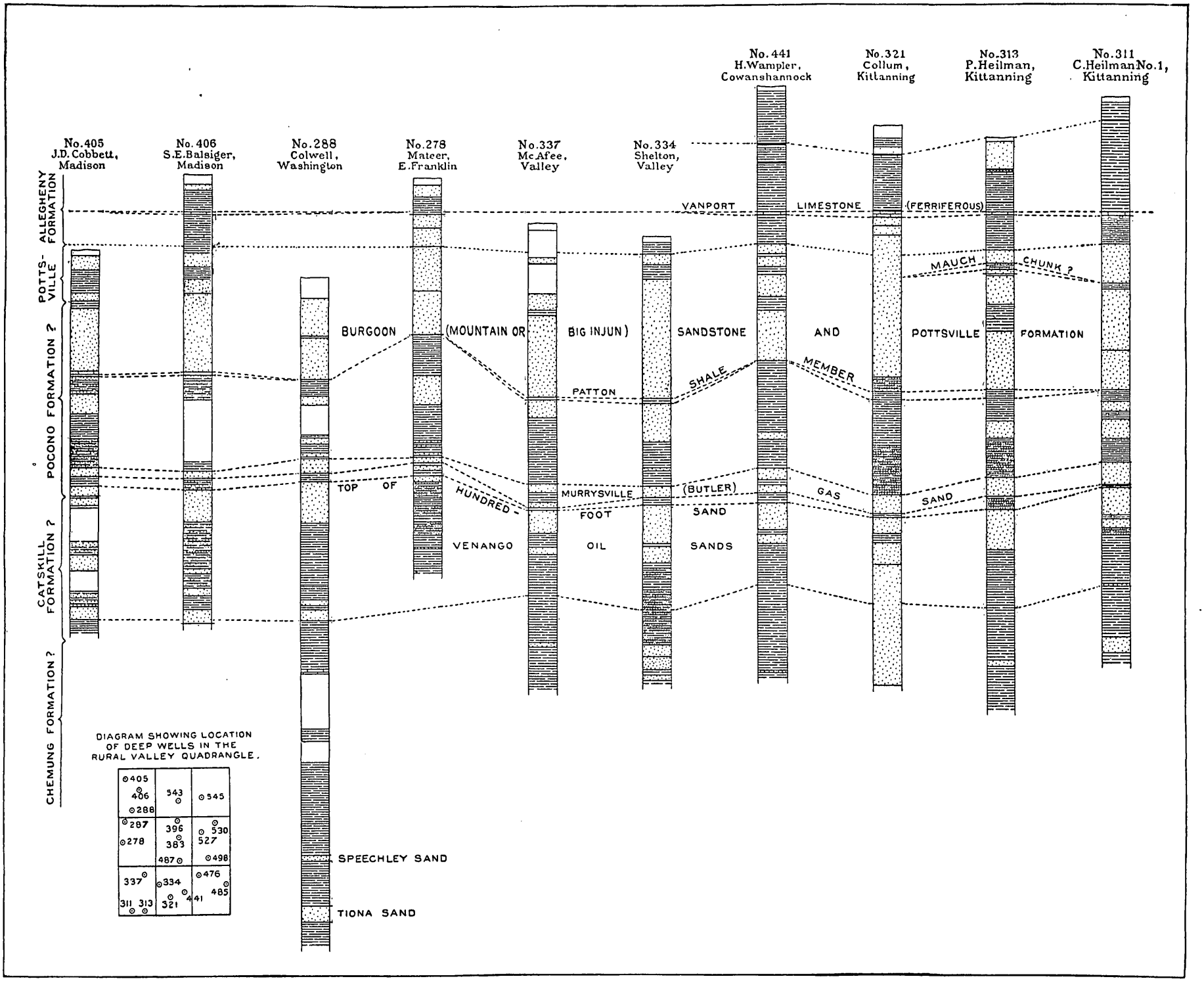
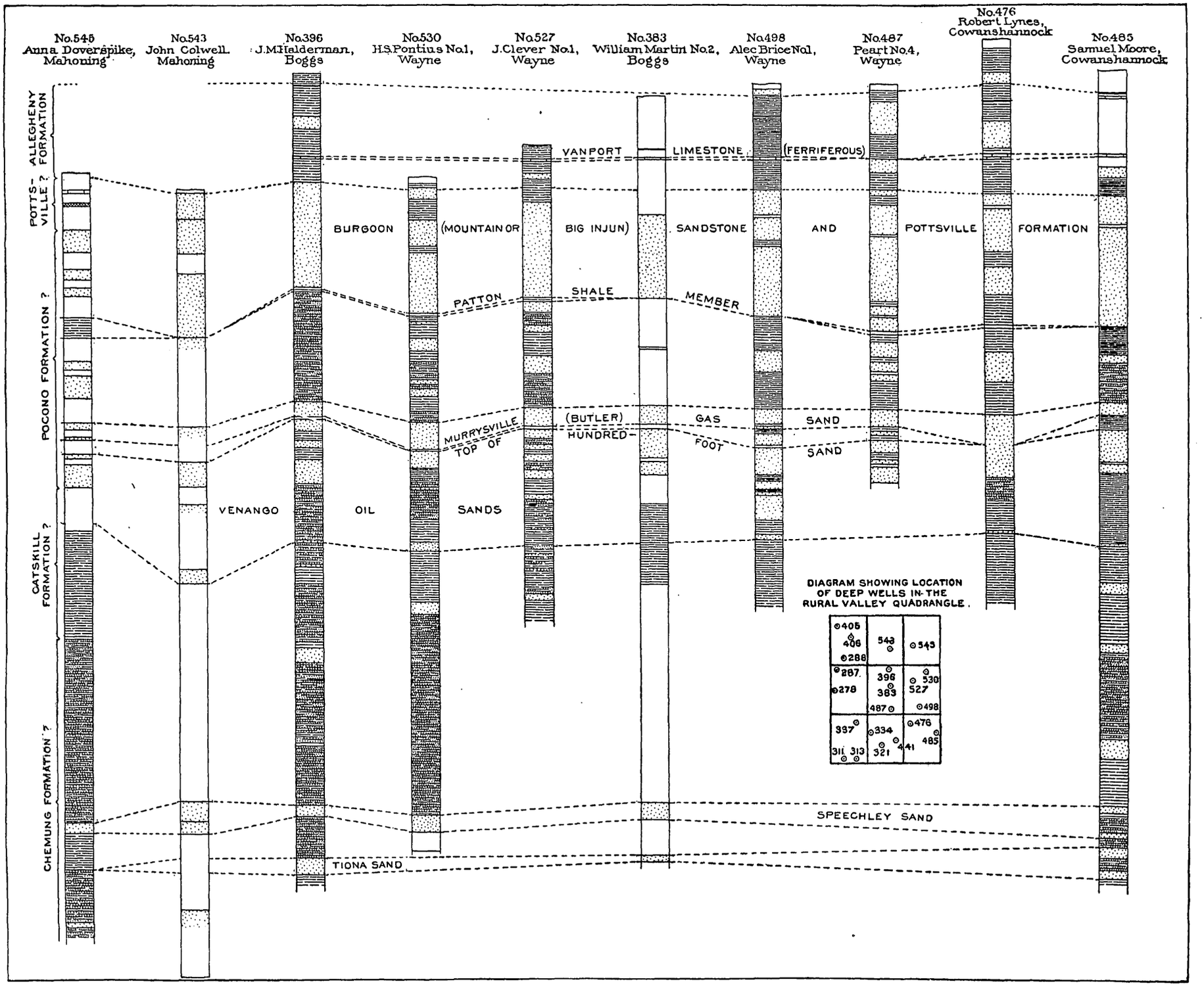


DEEP-WELL SECTIONS IN RURAL VALLEY QUADRANGLE.



DEEP-WELL SECTIONS IN RURAL VALLEY QUADRANGLE.

lead to errors of considerable magnitude. The difficulty of identifying the character of rocks by the relative ease with which the drill penetrates them or by the drillings brought up in the sand pump is also probably a fruitful source of error, especially with observers having no scientific training. To this fact may be and probably often are due in part the lithologic variations recorded for wells in contiguous territory. It may thus happen that important beds that are not recorded are not really absent from the section, but have been overlooked, and this may account for the absence of red beds or beds of limestone from the logs of some wells and their presence in those of others near by. Again, a heavy sandstone in one well might change to a highly arenaceous shale or shaly sandstone in an adjacent well and thus be recorded as slate or shale. At best, observations on rocks in deep-well sections must be confined almost wholly to their lithologic character; only in very rare instances can anything be learned of their fossil contents, a knowledge of which is almost indispensable to the correct determination of the age and stratigraphic position of the rocks.

Thickness.—The greatest depth to which the drill has penetrated below the lowest horizon of exposed rocks in the quadrangles is about 3,100 feet. The deepest wells in this region of which we possess records are the Robert Smith well (No. 9, Pl. I) and a well which was drilled by Mr. Joseph Simpson just off the northern margin of the Kittanning quadrangle, north of Bradys Bend village. The Simpson well (Pl. II), which is over 3,500 feet deep, starts just above the Vanport limestone and, as the lowest horizon of exposed rocks is about 400 feet below the limestone, the well penetrates about 3,100 feet below any rocks exposed in the region. The Smith well is also over 3,500 feet deep but starts at a higher horizon and hence does not reach so low a horizon as the Simpson well. The Kepple well (No. 246, Pl. II) penetrates 2,800 feet below the Vanport limestone and 2,400 feet below the lowest exposed rocks. The Colwell well (No. 543, Pl. IV) at Mahoning Furnace is over 2,700 feet deep and penetrates over 2,800 feet below the Vanport limestone. There are a number of other wells in the quadrangles that penetrate to about the same horizon.

General character.—These unexposed rocks fall naturally into three well-differentiated groups. In general there are, from the top downward, first, 700 to 800 feet of gray shale and sandstone; second, 300 to 700 feet of strata characterized by the presence of varying amounts of red rocks, presumably red shale, and third, prevailingly dark shale with thin sandstone layers, and occasional thicker beds of sandstone to the bottom of the deepest wells. The facts stated above are well illustrated in Pls. I–IV, which show typical well sections of the region.

GRAY SHALE AND SANDSTONE.

This group contains several members of sufficient importance to warrant separate description. With the exception of these members the group is composed mainly of gray sandy shale.

Burgoon ("Mountain") sandstone.—At the top of this group lie about 100 to 175 feet of heavy sandstone, which form the lower part of the "Mountain" or "Big Injun" sand of the driller, the upper 225 feet of which are exposed in the Allegheny Valley on the arch of the Kellersburg anticline. It is proposed to use the geographic name Burgoon sandstone for this stratum, on account of its exposure along Burgoon Creek in the region of the Allegheny Front west of Altoona.[a]

Patton shale.—In many wells a thin band of red shale occurs just below the base of the Burgoon sandstone. This is a widely distributed stratum, and merits attention on account of its importance as a horizon marker. This bed was first described by Richardson (Indiana folio), and named by him the Patton shale on the assumption that it is the same as the red shale that outcrops at Pattons Station on Redbank Creek, in Jefferson County.

Lower sands (gas sands).—In some of the well sections shown on Pls. I to IV a sandstone noted about 150 feet below the Burgoon sandstone is called the "First" sand, but it is by no means certain that the first sand of one well is the same as the first sand of another. This sandstone is sometimes regarded as the equivalent of the Pithole grit of Venango

[a] See Ebensburg folio: Geologic Atlas U. S., folio 133, U. S. Geol. Survey, 1906.

County and the Berea grit of Ohio, but there is no conclusive evidence that that horizon is represented in this region. The bottom of this group of gray shales and sandstones is prevailingly sandy and several beds are distinguished. These are the Murrysville gas sand, about 300 feet below the Burgoon sand; the "Second" or Hundred-foot sand, about 450 feet below the Burgoon sand; and the Thirty-foot sand, just below the Hundred-foot sand. The Hundred-foot and Thirty-foot sands occur at the top of the Venango oil sands of the oil regions.

RED BEDS.

Below the gray rocks occur several hundred feet of strata characterized by greater or less amounts of what the drillers call red rocks, presumably red shale. The proportion of red rocks and the extent of the interval in which they occur vary much in different well records, as can be seen on the well sections. In some records no red rocks are noted; in most, the part of the section through which they are recorded is from about 200 to 350 feet in thickness. In the Kepple well (No. 246) they are noted at intervals through an exceptional distance of 700 feet. These red beds also vary greatly in total thickness and distribution. In some wells they occur as scattered beds of greater or less thickness, separated by beds of dark shale and sandstone; in others they occur as an unbroken mass 300 feet thick; in still others no red beds are noted. It seems hardly credible that they are absent in such wells. It is far more probable that they occur as thin beds which were either not observed or not recorded.

Oil sands.—Associated with the red beds in this region lie the coarse oil-bearing sandstones, known as the Stray, Third, and Fourth oil sands, and the overlying thin sandstones, known as the Blue Monday and Bowlder sands.

DARK SHALES AND THIN SANDSTONES.

The remaining 1,500 to 2,000 feet of strata, making up the third group and extending to the bottom of the deepest well, are mainly composed of gray shales interbedded with thin sandstone layers, to which the drillers apply the name "slate and shells," the sandstone layers being the shells. Occasionally throughout this group thicker strata of sandstone occur, but these are rarely noted as reaching 50 feet in thickness.

Speechley and Tiona sands.—In the midst of the third group and from 500 to 700 feet below its top occurs a group of these sands, the upper members of which are known as the Speechley and the lower as the Tiona sands.

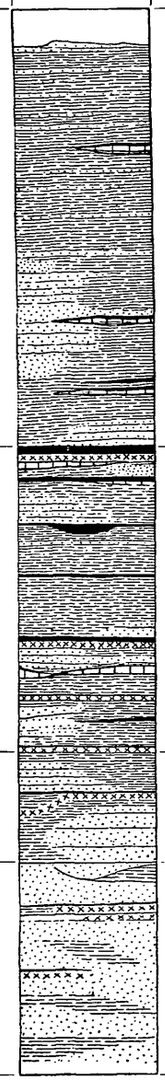
GENERAL CORRELATION.

The correlation of the rocks not exposed has been fully discussed in the Kittanning folio, and the discussion need not be repeated here. It will suffice to state that the rocks of group 1 are regarded as Pocono, those of group 2 as Catskill, and those of group 3 as Chemung. This grouping, however, can be regarded as only approximate and tentative.

EXPOSED ROCKS.

CARBONIFEROUS SYSTEM.

General statement.—Most of the rocks described in this region belong to the Carboniferous system. There are, however, certain old gravels of possible Tertiary age and certain deposits belonging to the Quaternary. The Carboniferous rocks are divided into two series, the Mississippian series below and the Pennsylvanian series above. The former series is best developed in the Mississippi Valley. As a general rule it is not coal bearing, but in certain parts of the Appalachian region it includes workable coal beds of limited extent. The Pennsylvanian series includes the coal-bearing rocks or Coal Measures of the Appalachian coal fields, and is typically developed in Pennsylvania. Both series are made up of a number of separate formations, which in turn are composed of various members of local importance. In this area the Mississippian series is represented by the Pocono formation, and the Pennsylvanian by the Pottsville, Allegheny, and Conemaugh formations. A generalized section of these rocks as they occur in the region is shown in Pl. V.

System.	Series.	Formation.	Symbol.	Section.	Thickness.	Names of members.	Character and distribution of members.	General character of formation.
Carboniferous.	Pennsylvanian.	Conemaugh	Ccm		*Feet.* 450+	Ames ("Crinoidal") limestone	Grayish green, fossiliferous; 2 feet thick. Hills north of Slate Lick.	Prevailingly shale of clayey or sandy composition. Thick, coarse sandstone on the hills in southwestern part of area. Mahoning sandstone at the bottom. Thin coal seams and limestone.
						Red shale	Hills northeast of Slate Lick.	
						Saltsburg sandstone	Coarse, evenly thick bedded; excellent quarry rock. Hills in southwest corner of Kittanning quadrangle.	
						Bakerstown coal	Thin, worthless. Southwest corner of quadrangle.	
						Limestone. Red shale. Coal. Black shale. Coal. Limestone. } Brush Creek coals	Thin, generally worthless. Underlying limestone rare. Southern half of quadrangles.	
						Mahoning sandstone	Up to 50 feet thick; in many places coarse, thick bedded, or massive; locally a thin bed of fine-grained flags; generally present in some form.	
		Allegheny	Ca		340–360	Upper Freeport coal	Generally present and of minable thickness; locally thin and poor.	Shaly, with heavy beds of sandstone and beds of limestone with associated iron ores. Several valuable coal seams and beds of fire clay. Source of all the valuable mineral products of the quadrangle, except oil and gas.
						Fire clay	Usually plastic; rarely flint; probably everywhere present under coal.	
						Upper Freeport limestone	Hard, blue; up to 20 feet thick.	
						Butler sandstone	Coarse, heavy; rarely present.	
						Lower Freeport coal	Generally thin; valuable seam along Glade Run and over large areas in the Rural Valley quadrangle.	
						Lower Freeport limestone	Thin and rarely present.	
						Freeport sandstone	30 to 50 feet thick; generally flaggy, but locally coarse and heavy.	
						Upper Kittanning coal	Generally thin and worthless; locally thick and valuable.	
						Middle Kittanning coal	Up to 5 feet thick; generally not of minable thickness.	
						Lower Kittanning coal	3 to 4 feet thick; present throughout most of the quadrangles.	
						Fire clay	Thick and valuable.	
						Kittanning sandstone	Up to 40 feet thick; coarse, heavy.	
						Vanport limestone	Up to 20 feet thick; gray, fossiliferous; thin seam of iron ore at top; in many places cut out by Kittanning sandstone.	
						Clarion coal	Generally thin; of valuable thickness only in southwestern part of area.	
						Fire clay	Valuable.	
						Clarion sandstone	Coarse, massive; rarely present.	
						Craigsville (?) coal	Locally developed, 3 feet thick or less; identity uncertain.	
						Brookville coal	Generally thin, worthless. Valuable in vicinity of Putneyville.	
						Brookville fire clay.		
		Pottsville	Cpv		120–140	Homewood sandstone	Variable; in many places partly replaced by shale; rarely coarse and massive.	Generally heavy sandstone. In many places shaly at top and at horizons of Mercer coal.
						Mercer coals and fire clay	Coals thin, worthless; fire clay valuable in vicinity of Climax.	
						Connoquenessing sandstone	Coarse, heavy, with beds of shale; hardly separable from underlying sandstone. Exposed along Allegheny River and in vicinity of Craigsville.	
		Unconformity						Unconformity
	Mississippian.	Pocono	Cpo		225+	Burgoon sandstone	Heavy bedded, gray. Found along the gorge of Allegheny River and along Redbank Creek.	Mostly a heavy sandstone to depth exposed in quadrangle, with small coals accompanied by shale near top. Runs into an unknown thickness of shale below.

GENERALIZED SECTION FOR KITTANNING QUADRANGLE.

Scale: 1 inch = 200 feet.

POCONO FORMATION.

General discussion.—Considerable difference of opinion has been expressed regarding the existence of Pocono rocks at the surface along the Allegheny Valley south of Clarion River. In the final report of the First Survey of the State the lowest rocks exposed in the valley were classed by Rogers [a] as belonging to the Pottsville (Seral formation), but in the Second Geological Survey W. G. Platt [b] recognized not only the Pocono sandstone, but also the Mauch Chunk shale as being exposed beneath the Pottsville. This determination was based largely upon the occurrence at McCrea Furnace, on Mahoning Creek, of a bed of siliceous limestone, which Mr. Platt correlated with the well-known bed of a similar character marking the top of the Pocono formation in the Chestnut Ridge region. Lesley, however, in a preface to the same volume, states that it is much more probable that this limestone occurs at the Mercer horizon than at that of the "Siliceous limestone," and that consequently all of the rocks below this horizon exposed along the Allegheny River are parts of the Pottsville

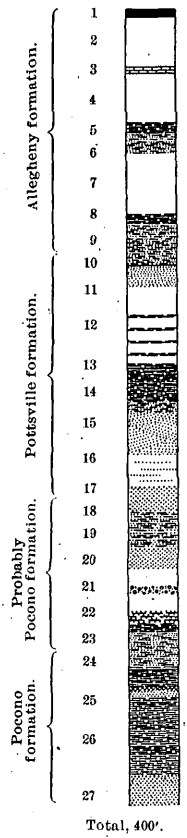


FIG. 3.—Section at Riverview mine, 2 miles below Redbank.

formation, which, he says, consists of three sandy members separated by two shale intervals, as it does in Beaver Valley, the type locality. The accompanying section (fig. 3) shows the character of the rocks under consideration as they are exposed at the Riverview mine, 2 miles south of Redbank.

On purely lithologic grounds it is extremely difficult, if not impossible, to subdivide these rocks into formations and correlate them with divisions recognized in other parts of the field; and the different interpretations that have been put upon them doubtless must be attributed to the absence of well-marked beds.

[a] Rogers, H. D., Geology of Pennsylvania, vol. 2, p. 585. [b] Rept. H5.

The section shown in fig. 3 is fairly representative of the rocks of this debatable interval and may be considered as typical of this region, except that the Pocono part shows more shale than occurs in some other sections.

The section includes the Lower Kittanning coal and the Vanport limestone, two of the best horizon markers in the region. The top of the Pottsville formation is clearly marked at a distance of 94 feet below the top of the limestone by the Homewood sandstone, which generally is massive in this region, but in this particular section is thin bedded and inconspicuous. This bed is underlain by about 65 feet of shale, which contains several small coal seams and carries a good Mercer flora. The strata underlying the Mercer beds are more difficult to classify, but the first sandstone (Nos. 15, 16, and 17), about 49 feet thick, carries impressions of Pennsylvanian plant stems which show that it belongs to the Pottsville formation, while its position indicates that it is doubtless equivalent to a part or the whole of the Connoquenessing sandstone.

Below the bed just described fossils are few and generally poorly preserved; so far as observed, there are no indications of Pottsville plants below the Connoquenessing sandstone. Good Pocono plants were found from railroad grade up for a distance of 80 feet, but between this horizon and the base of the Connoquenessing sandstone no fossils have been found and it is impossible to say with certainty to which series these rocks belong. The rocks, however, in this intermediate zone resemble the underlying Pocono sandstone more closely than they do the Pottsville, and therefore the base of the Connoquenessing sandstone will be regarded provisionally as the base of the Pottsville formation.

In the eastern part of Pennsylvania, where sedimentation apparently was uninterrupted from Devonian to late Carboniferous time, the Pocono formation consists of a sandy series more than 1,000 feet thick. It is overlain by a great thickness of Mauch Chunk red shale, and this in turn is overlain by the heavy conglomerates of the Pottsville formation. In the Allegheny Valley the Pocono becomes somewhat thinner, the Mauch Chunk is probably absent, and from evidence presented in the discussion of the Pottsville formation it is shown that the interval occupied by the Mauch Chunk in the east is, in this region, represented by an unconformity, and that the general absence of the Mauch Chunk formation, and probably of the upper part of the Pocono also, is due to a period of erosion before the deposition of the Pottsville rocks of the Allegheny Valley.

Character and distribution.—Since the Connoquenessing sandstone rests unconformably upon the Pocono formation, it follows that the beds in actual contact are different in different sections. The unconformity is so slight, the exposures in general so poor, and the beds in contact so often sandstones of nearly identical character that it is impossible to trace the contact between the two formations. As assumed in the section, fig. 3 (p. 27), the plane of division lies about 230 feet below the Vanport limestone. It will be assumed that it holds approximately this position throughout the quadrangles, and the Pocono formation has been mapped and will be described on that basis. The top of the Pocono at the point where Allegheny River crosses the axis of the Kellersburg anticline would accordingly lie at an elevation of about 1,060 feet, making a maximum thickness of 260 feet of Pocono rocks exposed in the quadrangles.

So far as exposed the Pocono formation is composed mainly of a heavy gray to greenish sandstone, the "Mountain" or "Big Injun" sand of the driller, here called the Burgoon sandstone. While the sandstone is prevailingly a heavy and nearly continuous mass, in places it is broken by beds of shale of varying extent and thickness. The section shown in fig. 3 (p. 27) presents the latter phase of the formation, while the section at the mouth of Redbank Creek, where it consists of about 150 feet of coarse, thick-bedded to massive sandstone, passing without a break into the Connoquenessing sandstone above, presents the former and probably more common phase. On the bluff of the Allegheny above Mahoning two or three thin coal seams occur.

The exposures of the Pocono are confined to Allegheny Valley and to the valleys of Redbank and Mahoning creeks. The top of the formation, rising toward the axis of the Kellersburg anticline, emerges from below water between Templeton and Mahoning, reaches

an elevation of 260 feet above the river on the arch of the anticline, and then descends gradually almost to water level near Phillipston, whence it continues, probably just above the river, to the northern margin of the Kittanning quadrangle. The Pocono is above water along almost the whole length of Redbank Creek within the quadrangles. The top of the formation is about 150 feet above water at the mouth of the creek; it descends nearly to water level at Lawsonham; thence it rises to a height of about 100 feet in the vicinity of Leatherwood and to 200 feet on the arch of the Kellersburg anticline between St. Charles and Climax, from which point it descends rapidly and goes under water near the south point of Anthonys Bend. It reappears on the east side of the bend near the tunnel and continues a few feet above the creek to the northern margin of the Rural Valley quadrangle. It is finely displayed at the east end of the tunnel between Lawsonham and Leatherwood, in the bluff south of the latter place, and above the railroad at the east end of the Climax tunnel. On Mahoning Creek it is exposed for a short distance above its mouth and also along the upper part of the creek within the quadrangle from McCrea Furnace, 1 mile south of Eddyville, to the eastern margin. It is brought up here by the Greendale anticline, and its top reaches an elevation of about 160 feet above the creek.

MAUCH CHUNK FORMATION.

In Report H5 of the Second Geological Survey of Pennsylvania, Platt refers certain dark shales exposed in the midst of heavy sandstone in the bluff above Templeton to the Mauch Chunk formation. These shales, however, present no resemblances to the Mauch Chunk shales elsewhere and to all appearances they are lenticular beds of merely local extent, included in the Burgoon sandstone. The only rock in the quadrangles, so far as known, whose character indicates that it belongs to this formation, is a thin bed of red sandstone occurring in the Peter Heilman well No. 2 (313), near the southern margin of the Rural Valley quadrangle. By examining the section of this well shown in Pl. III it will be seen that this bed occurs at the horizon of the Mauch Chunk, and this fact, together with its color, affords grounds for referring it doubtfully to that formation.

Unconformity at base of Pottsville.—As previously noted, the Mauch Chunk formation, which separates the Pocono and Pottsville formations in other parts of the State, is absent from the Allegheny Valley. In southern Indiana and northern Westmoreland counties the Mauch Chunk shows in many well sections, ranging in thickness from a few to more than a hundred feet. It has a thickness of 150 feet in Packsaddle Gap, near Bolivar; of 250 feet in northern and eastern Fayette County, where it includes the Greenbrier limestone; of 180 feet along the Allegheny Front; of 1,100 feet at Broad Top; and of over 2,000 feet at Mauch Chunk. It appears, therefore, that at the close of the Mauch Chunk period an uplift occurred involving western Pennsylvania and extensive areas farther west, which continued until all of the Mauch Chunk had been eroded from northern Armstrong County and surrounding regions. Not only is the Mauch Chunk absent in this section, but the absence of the Loyalhanna ("Siliceous") limestone shows that some of the upper part of the Pocono is also lacking. According to Platt[a] a fragment of this limestone is preserved at McCrea Furnace, on Mahoning Creek above Eddyville, in the eastern part of Armstrong County. Platt's determination was strongly opposed, however, by Lesley,[b] who regarded the limestone in question as more probably representing the Mercer limestone. The writer also has reached the conclusion that the limestone is Mercer, both on stratigraphic grounds and on the evidence of fossil plants collected from the sandstone closely underlying the limestone and determined by David White to be of Pottsville age. Neither is the Loyalhanna limestone known west of the river, though two or three doubtful references to a limestone of similar character occur in some drill records of Butler County.

These facts show that there is an unconformity between the Pocono and Pottsville formations in this region, and this conclusion is further strengthened by the fact that the Pottsville is here but a comparatively thin bed about 140 feet thick, while, like the Mauch

[a] Platt, W. G , Second Geol. Survey Pennsylvania, Rept. H5, p. 144. [b] Op. cit.

Chunk, it thickens to the east, reaching 1,200 feet in the southern anthracite basins of eastern Pennsylvania. It was formerly believed that the thin bed of Pottsville in the western part of the State represented the whole thickness of the formation in the anthracite regions, the difference being due to the difference in the rate of sedimentation; but it is now known to represent only the upper part of the great Pottsville formation of the anthracite regions. There was no uplift and dry-land period in eastern Pennsylvania, but deposition was uninterrupted at the close of Mauch Chunk time and continued until many hundred feet of sediments had accumulated. Toward the close of Pottsville time the eroded surface of the western part of the State became again submerged and was covered by sediments laid down during the latter part of that period. The submergence of the extreme western and northwestern parts of the State must have preceded by a considerable time that of the area under consideration, for in those regions the lowest members of the Pottsville formation are the Sharon coal and its underlying conglomerate, which have no representative in the Allegheny Valley.

A summary of the events outlined above would be as follows: (1) A long period of sedimentation, allowing the accumulation of over 2,000 feet of Mauch Chunk in the eastern part of the State and an unknown, but possibly great thickness in the western part; (2) the elevation and erosion of the areas above described in the western part of the State, and the contemporaneous accumulation of several hundred feet of Pottsville sediments in the anthracite region; (3) the submergence of a portion of the land surface to the west and northwest and the accumulation of the Sharon coal and its underlying conglomerate; (4) the submergence of the remaining dry land and the resumption of sedimentation throughout, toward, but some time before, the end of Pottsville time. It was during this latter period that such Pottsville rocks as occur in the Kittanning quadrangle were deposited.

POTTSVILLE FORMATION.

General description.—The Pottsville formation overlies the Pocono formation unconformably. In the section already given (fig. 3, p. 27) its top lies about 100 feet and its bottom about 220 feet below the Vanport limestone, making the thickness 120 feet, and it has been mapped as having a thickness of from 120 to 140 feet. It is composed in general of three members—the Connoquenessing and Homewood sandstones, separated in the middle of the formation by a stratum of shale 20 feet or more thick, which usually bears one or more thin seams of coal, the Mercer coal and shale. This general character is subject to many variations, however, as will appear in the description of the different members.

Connoquenessing sandstone.—This is the lowest member of the formation. It appears in every section immediately overlying the Pocono, and is a widespread stratum in western Pennsylvania. It is generally a coarse, gray or white, often highly siliceous, thick-bedded sandstone. In some places it is massive and conglomeratic, in others it is shaly or flaggy. It averages about 40 feet in thickness and generally fills most of the interval between the Pocono and the lowest of the Mercer coals.

Mercer shale.—This is a composite member, probably varying from 20 to 40 feet in thickness. It consists mostly of dark shale, which usually carries one or more thin coal seams. In Mercer County a workable seam occurs, and from that region the name was derived. The character of this member as it occurs in these quadrangles is well represented in the section below, which was measured at the Climax clay pits, near the south point of Anthonys Bend:

Section of Mercer shale, etc., at Anthonys Bend.

	Feet.
Sandstone } Homewood	15
Sandy shale } Homewood	
Coal, thin.	
Sandy shale	28
Coal	1½
Fire clay (Mercer or Mount Savage)	10
Connoquenessing sandstone.	

The fire clay rests upon the Connoquenessing sandstone. It is composed of both flint and plastic clay, and is correlated with the Mount Savage clay of Maryland. In the vicinity of McCrea Furnace a bed of sandy limestone occurs about 140 feet below the Vanport limestone and probably represents the Mercer limestone (see p. 27).

Homewood sandstone.—This is generally a heavy gray sandstone, though in places it changes to one of laminated or even shaly character. Its top lies about 100 feet below the Vanport limestone and its usual thickness is about 40 feet.

Distribution of Pottsville.—The top of the Pottsville, rising toward the McHaddon anticline, appears above river level opposite Wickboro, above Kittanning, reaches a height of about 100 feet above the water three-fourths mile below the mouth of Cowanshannock Creek, and then, dipping northeastward, descends below water near the boundary between the quadrangles. The upper layers of the Homewood sandstone have a laminated character where they rise above the river and in the bed of Cowanshannock Creek a short distance from its mouth. At the mouth of Limestone Creek the sandstone is thick and well exposed. The formation rises above the river again below Templeton and continues above to the northern margin of the quadrangles. At Templeton the Homewood is coarse and heavy and yields the blocks at the mouth of the ravine to the east. Along the road between Templeton and Mahoning the Mercer shale and the overlying heavy sandstone, with pockets of coal and stems of *Lepidodendra* at the base, are well exposed. Beyond this point the Pottsville sandstones form conspicuous ledges at various points along the river bluff. The Connoquenessing sandstone, coarse and heavy and overlying the equally coarse and heavy Pocono, is seen in the road leading up the bluff to the flat point between Redbank Creek and the river, and above it the Mercer shale is well exposed in the road. At the mouth of Sugar Creek, opposite East Brady, the Homewood sandstone has changed to shale, below which is the Mercer shale with two thin coal seams, and still lower the coarse and heavy Connoquenessing sandstone, extending down to the creek. A section made in a ravine still farther up the river shows the formation in the same character. In the vicinity of Craigsville the three members of the formation are exposed. The Homewood sandstone, rather flaggy, occurs in a ledge by the creek back of the Buffalo, Rochester and Pittsburg Railroad station; the Connoquenessing sandstone shows at Craigsville and in a railroad cut just above, near creek level, where it is white and thick bedded; the Mercer shale and the blossom of the Mercer coal show between the two sandstones in the road west of Craigsville. The same beds are exhibited on the road from Craigsville to Fosters Mills on both sides of Patterson Creek, but the Homewood sandstone seems to have passed into shale at that locality. On Redbank Creek the Pottsville is above water level from the mouth to New Bethlehem. The heavy white siliceous sandstone at the top of the railroad cut at the west end of the Climax tunnel is Connoquenessing. The Mercer and Homewood members are exposed in the bluff at the south end of Anthonys Bend, where the section given on page 30 was obtained. The heavy sandstone along the railroad track at New Bethlehem, just off the quadrangle, is probably Homewood. At the mouth of Mahoning Creek the bottom of the Pottsville is from 50 to 60 feet above the railroad track. The heavy sandstone ledge along the road up the creek, a short distance above the station, is probably Connoquenessing. The Homewood, rather heavy, shows near water level on Mahoning Creek for one-half mile below the mouth of Scrubgrass Creek. This sandstone is also exposed in the road near the head of the stream east of Kellersburg. The south end of the bridge at Mahoning Furnace rests upon a shaly to laminated sandstone which is probably Homewood. In the lower part of the bluff in the big bend of the Mahoning below Putneyville is a heavy white siliceous sandstone, the top of which is about 110 feet below the Vanport limestone and immediately above which is a coal bed that appears to be the Brookville coal; on these grounds the sandstone is regarded as Homewood. This sandstone shows on the north bluff of the Mahoning just below the intersection of the road from Eddyville with the road along the top of the bluff. The sandstone here is coarse and massive and about 15 feet are exposed. The Connoquenessing shows along the lower part of this road down to the level of Pine Creek. It is also exposed up Pine

Creek for some distance. In the road cut in the bluff east of the Mahoning at Eddyville, the Connoquenessing is well shown as a coarse, gray, heavy-bedded sandstone; at its top is a bed of shale several feet thick, containing a layer of black shale that probably represents one of the Mercer coals. The various members of the Pottsville are fairly well exhibited in the bluffs of Mahoning Creek and along the roads in the vicinity of McCrea Furnace, 1 mile above Eddyville. The sandstones are also well displayed in the gorge of Glade Run farther east.

ALLEGHENY FORMATION.

General description.—This is composed mainly of a succession of shales and sandstones about 350 feet thick and extending from the Pottsville formation below to the top of the Upper Freeport coal above. The workable coal seams from which it derived its former name, the Lower Productive Coal Measures, form its distinguishing feature. Besides coal it contains valuable beds of limestone and fire clay. A general outline of its various members will be given here, leaving to a subsequent chapter the more detailed description of those of economic importance. Several sandstone members are described below, which are locally developed as lenses of greater or less extent along the same horizon between the various coal seams. In addition to the sandstones noted, others of small extent may occur in any position. Where the intervals between the coals are not more or less completely occupied by these sandstones, they are filled with shale.

Distribution.—The Allegheny formation is exposed along nearly every valley in the quadrangles, and makes the surface over large areas along the Kellersburg anticline from Winfield to the northern margin of the region and along the Greendale and Brookville anticlines from Pine Creek to the northeast corner of the Rural Valley quadrangle. In the northwest corner of the Kittanning quadrangle the Allegheny formation is mostly concealed by the overlying Conemaugh rocks. It is also rather deeply buried throughout the Boggsville syncline, in the southeast corner of the Rural Valley quadrangle, in Plum Creek and Cowanshannock townships, and in the southeast corner of Wayne Township. Large tracts are well under the cover of the overlying rock in the interstream areas of the Fairmount syncline.

Brookville coal.—This is a generally worthless coal lying from 10 to 20 feet above the top of the Pottsville and separated therefrom by shale and fire clay. Its blossom shows at many points throughout the quadrangles, but it is thin except along the upper part of Mahoning Creek, within the Rural Valley quadrangle, where it reaches at points a thickness of 4 feet.

Craigsville coal.—On Buffalo Creek, 2 miles northwest of Craigsville, a coal 3 feet thick, 50 feet below the Vanport limestone, and 15 feet below the Clarion coal, which is also exposed, has recently been opened and worked. What appears to be the same coal has been opened on the hill one-half mile north by west of Craigsville, and is reported 3½ feet thick. The blossom of a coal 50 feet below the limestone shows about 1 mile north of Craigsville, along the road to Fosters Mills, and in the same locality the Brookville coal has been opened about 50 feet lower. At West Winfield streaks and pockets of coal occur in a heavy sandstone 40 feet below the limestone and 25 feet below the Clarion coal, and this probably lies at the same horizon as the coal in the vicinity of Craigsville. A small coal was observed in this position in the bluff of the Allegheny just above Templeton. It seems quite certain, therefore, that there is a coal at these places between the Brookville and Clarion coals. So far as the writer is aware, the three coals in this relation have not been observed elsewhere in these quadrangles. It does not seem possible to identify this with any previously described coal, so the name Craigsville is here used for it, on account of its good development at that place.

Clarion sandstone.—At the old mill on Cowanshannock Creek, 1 mile above its mouth, the following section (fig. 4) is exposed:

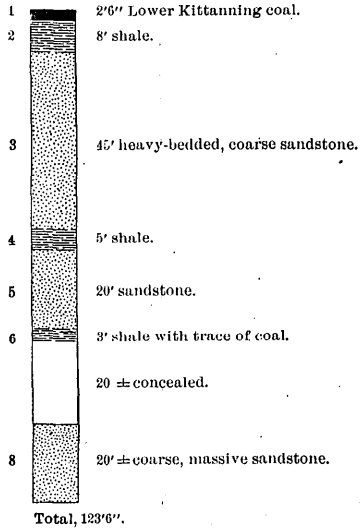


FIG. 4.—Section at old mill on Cowanshannock Creek, a mile above its mouth.

In this section the thickness of the concealed interval and of the sandstone (8) were estimated and may be considerably in error. The sandstone (8) shows in the bed of the creek and in a ledge washed by the water, whence have come the great bowlders of coarse white sandstone that fill the channel at the old mill. Near the mouth of the creek the Vanport limestone is about 50 feet below the Lower Kittanning coal. No trace of the limestone was detected in the above section, but its place is apparently occupied by the shale marked 4. The shale with traces of coal (6) probably represents the Clarion coal, and the sandstone (8) at the bottom of the section, which may occupy most of the concealed interval also, is probably the Clarion sandstone described in the Pennsylvania report on Armstrong County. Its bottom would lie at least 60 feet below the Vanport limestone and its thickness may reach 40 feet. An interesting feature of this section is the fact that the entire interval of over 100 feet below the Lower Kittanning coal is nearly filled with coarse, thick-bedded sandstone. A comparison of this section with others in the vicinity affords a good illustration of the variable nature of Coal Measures stratigraphy. At West Winfield a heavy sandstone extends from close below the Clarion coal to water level. Its bottom is not exposed, but it is at least 50 feet thick. At both the above localities the sandstone was identified as Pottsville by the geologists of the Second Survey,[a] who appear to have based their identification on its coarse, massive character. On account, however, of its relations to the Clarion coal and Vanport limestone, the writer prefers to regard it as Clarion.

The ledge of coarse, thick-bedded sandstone along the road just west of the south end of the bridge at Mahoning Furnace and that on the opposite bank 1½ miles below the bridge are probably Clarion, as is also the coarse white sandstone in the road one-half mile south of New Bethlehem. The great masses of coarse, massive sandstone in the ravine of Camp Run south of McCrea Furnace also came from this stratum, which outcrops near the top of the hill not far from the eastward turn of the road along the top of the bluff of the Mahoning. The size of the blocks shows that the sandstone is at least 20 feet thick. Here again Platt[b] identified it as Pottsville. Farther east, in the road near the schoolhouse at the head of Glade Run, is another exposure of this sandstone.

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 101; Rept. Q, p. 93. [b] Op. cit., Rept. H5.

Clarion clay.—This is a bed of plastic clay underlying the Clarion coal. It is present as a bed 6 to 8 feet thick at Kittanning, West Winfield, and in the vicinity of Templeton and Mahoning.

Clarion coal.—The position of this coal is 15 to 25 feet below the Vanport limestone and 50 to 70 feet above the Brookville coal. So far as known it probably rarely exceeds a foot in thickness throughout the quadrangles. At West Winfield, however, it is over 3 feet thick.

Vanport limestone.—This is universally known throughout western Pennsylvania as the Ferriferous limestone, because it bears on its upper surface the buhrstone ore that was once extensively used in the manufacture of iron. It has been an important guide in drilling operations, for when its position is known the driller can estimate the depth to the gas and oil sands.

The Vanport is a bluish-gray limestone of a good degree of purity, running generally over 90 per cent carbonate of lime. Its numerous fossils show that it is of marine origin. It runs quite uniformly 8 feet thick over most of these quadrangles, but at West Winfield, on Rough Run, it reaches a thickness of 22 feet. Many well records in the southwest part of the Kittanning quadrangle show as great a thickness. It is well exposed on Buffalo Creek for a mile above the junction of Rough Run, and it outcrops along the run for half a mile above West Winfield, where it has been laid bare in quarrying operations. The horizon of the limestone is exposed on Buffalo Creek and its tributaries along the arch of the Kellersburg anticline from 2 miles below Buffalo Mills to Nichola, and on Patterson Creek to the vicinity of Fosters Mills. The limestone rises above the river at Kittanning and is present to the mouths of Limestone Run and Cowanshannock Creek, from which locality to a point about 2 miles south of Templeton it can not be found on either side of the river and is probably wanting. At the last-mentioned point it reappears on both sides of the river and persists to the vicinity of Hooks, rising to a height of 400 feet above water on the axis of the Kellersburg anticline. From Hooks to north of Rimer it is absent on both sides of the river, and on the west side it is not known for a still greater distance. Along the remaining part of the Allegheny, on its small western tributaries entering above the mouth of Redbank Creek, and along the entire length of Redbank and Mahoning creeks within the quadrangles it is almost everywhere present as a bed about 8 feet thick. On Scrubgrass Creek above Goheenville and on North Fork of Pine Creek it is exposed for a distance of about 3 miles on the western limb of the Greendale anticline. On South Fork of Pine Creek its horizon is exposed across the arch of the Greendale anticline and it is probably present from Pine Furnace to one-half mile below Echo. On Cowanshannock Creek its horizon is raised above the stream by the anticline nearly the whole distance across Valley Township, where it can be traced about 8 feet thick from its western outcrop to a point about 1 mile west of Greendale; east of that point to Cowanshannock Township, where its horizon goes below the creek, nothing could be found or learned of it, and it appears to be absent.

Kittanning sandstone.—This occurs locally between the Vanport limestone and the Lower Kittanning coal. It is very heavy and coarse on Rough Run above West Winfield, where it is exposed in a quarry. The thickness laid bare is 40 feet, and apparently it is not fully exposed. The upper 45 feet of sandstone in the section at the old mill on the Cowanshannock is Kittanning.

At the point where the Greendale anticline crosses Cowanshannock Creek a heavy sandstone occurs below the Lower Kittanning coal that apparently cuts out the Vanport limestone. This sandstone yields large bowlders, and Platt [a] evidently was misled by their character, for he regards the sandstone as Pottsville, whereas in reality the Pottsville scarcely rises above water at this point, as is shown by the fact that the Upper Freeport coal is but 340 feet above the level of the creek. Furthermore, a fire clay that is probably Clarion shows in the road by the schoolhouse just west of Greendale, and near creek level

[a] Second Geol. Survey Pennsylvania, Rept. H5.

below the schoolhouse a thin coal occurs which corresponds exactly in position with the Brookville and probably is that bed.

This sandstone is especially prominent as a ledge 20 feet thick along the west side of the Allegheny from opposite Ewing to above Mosgrove. It occurs as a coarse, thick stratum immediately overlying the Vanport limestone at Pine Furnace and at the mouth of Beaver Run. It is very coarse and thick bedded at the top of the west bluff of the Allegheny opposite Rimer, where it is well displayed in the head of a ravine and in the road leading down to the river. It also closely overlies the limestone in the vicinity of Rock Run north of Redbank Creek.

Kittanning fire clay.—This is a bed of plastic clay of varying thickness occurring below the Lower Kittanning coal and probably present throughout the quadrangles.

Lower Kittanning coal.—This coal seam lies from 15 to 50 feet above the Vanport limestone, the more usual interval being from 30 to 40 feet. In the Kittanning quadrangle this coal appears to be present and from 3 to 4 feet thick wherever its horizon is exposed, and it probably underlies the entire quadrangle except in the limited areas from which it has been eroded by the streams. In the Rural Valley quadrangle it occurs with a thickness of 3 to 4 feet throughout most of Madison, Washington, and Rayburn townships, and also along Mahoning Creek and its tributaries east and south of Eddyville. In the intermediate territory occupied by the Fairmount syncline the coal appears to be thin. It is deeply buried in the southern part of the Rural Valley quadrangle and also in the area occupied by the Boggsville syncline in the Kittanning quadrangle and nothing definite is known of it in those areas, though in an occasional well record a coal 3 to 5 feet thick is reported at its horizon. Too much reliance should not be placed upon such report, however.

This coal is usually associated with shale and fire clay, but on Hays Run, at the mouth of Pine Creek, along the east side of the river for a mile or more above Mosgrove, and at Adrian it has a roof of coarse, heavy sandstone 20 feet thick. On Scrubgrass Creek below Gobcenville it is immediately overlain by black shale, above which is a heavy sandstone.

Middle Kittanning coal.—This coal lies from 30 to 50 feet above the Lower Kittanning coal, and the two are usually separated by shale, though, as noted in the preceding paragraph, a heavy sandstone occurs between them in places. This coal appears to be persistent throughout the quadrangles as a bed which is generally thin but may locally reach a thickness of 2 to 3 feet.

Upper Kittanning coal.—From 40 to 60 feet above the Middle Kittanning lies the Upper Kittanning coal. The interval is occupied by shale. This seam is usually a mere streak, but in many places swells suddenly to a local deposit of cannel and bituminous coal several feet thick. A good example of this occurs at Somerville, where the coal is mined. At the opening of the mine the seam consists of bituminous coal 2 feet thick; this soon increases to 5 feet, then the floor drops rapidly and cannel comes in beneath the bituminous coal until the seam becomes 12 feet thick. This thickness must be of small extent, for no trace of the seam is visible in the almost perpendicular bank of Holder Run, one-half mile below the mine, where it should outcrop. Cannel coal usually occurs in such deposits, and from this characteristic of the Upper Kittanning seam has originated the name "pot vein," commonly applied to it.

Freeport sandstone.—This occurs between the Upper Kittanning and Lower Freeport coals and often immediately overlies the former. It is a more persistent stratum than any of the other sandstone members of the Allegheny formation. In character it varies from laminated or flaggy and fine grained, as at Weskit, to coarse, massive, and conglomeratic, as in the vicinity of Worthington, where it is at least 50 feet thick. It is well developed along Buffalo Creek. At Boggsville it is the heavy sandstone at creek level at the east end of the village. Below the mouth of Marrowbone Run it rises as a ledge 20 feet or more above the water of Buffalo Creek. In the vicinity of Buffalo Mills, Worthington, and Craigsville its presence is made known by the large masses of a conglomeratic sandstone that strew the surface. At the head of the ravine running from Worthington to Buffalo Mills it is exposed 50 feet thick. In the hills northwest of Craigsville it is heavy and yields masses 15 to 20 feet high. Near

Fosters Mills it crops out in conspicuous ledges. It lies at the surface over the high, flat ridge in the southeastern part of Sugar Creek Township, and has been the controlling factor in the formation and preservation of that surface. The large bowlders of coarse sandstone and conglomerate at Somerville come from the Freeport sandstone, which also furnishes the bowlders along Buffalo Run 1 mile east of Rattigan. It is well developed on the high knobs in Madison Township south of Redbank Creek. It is particularly heavy and conspicuous, apparently 40 to 60 feet thick, at the head of a ravine south of Mahoning Creek, about 1 mile east of the northwest corner of Wayne Township. On the north side of Mahoning Creek, opposite the mouth of this ravine, great masses of sandstone occur near the top of the bluff which probably come from this stratum. The Freeport sandstone shows in good thickness in a ravine east of Templeton. It is coarse and heavy at the mouth of Bullock Run, where it rests upon the Upper Kittanning coal, and at Pine Furnace, where it is in contact with that coal or closely overlies it. The large blocks of coarse conglomeratic sandstone on the hillside above the old mill on Cowanshannock Creek near the margin of the Kittanning quadrangle come from the Freeport sandstone, which also outcrops on the west side of the hill high above the river. This sandstone shows along the bluff between Kittanning and Garrett Run. It is extensively exposed and quarried on Garrett Run about 1 mile above its mouth, where it is about 40 feet thick, and along the railroad between the southern margin of the quadrangles and Kellys station.

Lower Freeport limestone.—This bed is generally inconspicuous or absent throughout the quadrangles. It is described by I. C. White[a] as an impure ferruginous bed 5 feet thick on Rough Run. In the cut along the highway just north of Garrett Run it shows about 2 feet thick, and is apparently of the same character as on Rough Run.

Lower Freeport iron ore.—According to White[b] this occurs as a bed of limonite and carbonate mixed, lying just above the lower Freeport limestone and 4 feet below the Lower Freeport coal. It is developed so far as known only on Rough Run and in the western part of West Franklin Township.

The stratigraphic relationships of these beds are shown in the following section taken from White:[b]

Section of Lower Freeport iron ore.

	Feet.
1. Coal, Upper Freeport (reported)	3
2. Concealed	50
3. Massive sandstone (Butler sandstone)	15
4. Coal, Lower Freeport	0 to 2
5. Fire clay	4
6. Iron ore (Lower Freeport)	1½ to 6
7. Limestone (Lower Freeport)	5

Lower Freeport coal.—This coal lies from 40 to 50 feet above the Upper Kittanning. Where the Freeport sandstone is absent the interval is occupied by shale. The coal is variable in thickness and over the larger part of the quadrangles is probably less than 2 feet thick.

Butler sandstone.—A coarse, heavy sandstone occurs locally between the Lower and Upper Freeport coals. This is the Butler sandstone of I. C. White.[c] It occurs in the railroad cut on Buffalo Creek about 1 mile north of Boggsville. It overlies the Lower Freeport coal on both branches of Buffalo Creek in southern Donegal Township and at Walkchalk, where it appears to fill nearly the whole interval, which probably does not exceed 30 feet, between that coal and the Upper Freeport. In the vicinity of Bradys Bend it occurs as a thin-bedded sandstone 30 feet thick, as shown in the section below. In the river bluff south of the large island midway between Templeton and Mosgrove this sandstone is 10 feet thick, with the two coals above and below it exposed. At the road crossing near the head of Hays Run this stratum is exposed as a ledge of coarse, heavy sandstone 10 feet thick. It reaches its best development, however, in the vicinity of Deanville, where it is a coarse, gray conglomeratic sandstone at least 20 feet thick, underlying the Upper Freeport coal. It outcrops

[a] Second Geol. Survey Pennsylvania, Rept. Q, p. 94. [b] Loc. cit. [c] Op. cit. p. 47.

as a ledge 20 feet high on the brow of the bluff of the Mahoning south of Deanville and forms the spur at that place. On the hill northwest of Deanville it is particularly heavy. It occurs close beneath the Upper Freeport coal along the Indiana pike, where it crosses the head of the first run northwest of Blanket Hill, and is there coarse and heavy. At the head of Garrett Run it occurs in the same position but has a laminated character.

The interval between the Upper and Lower Freeport coals, however, is usually occupied mainly by shale. The Freeport fire clay immediately underlies the Upper Freeport coal. Below the fire clay the Freeport limestone occurs over considerable tracts, and below the limestone a bed of iron ore is known to exist over small areas. The following section (fig. 5), taken from Report H5 of the Second Geological Survey of Pennsylvania, will show the relations of these beds:

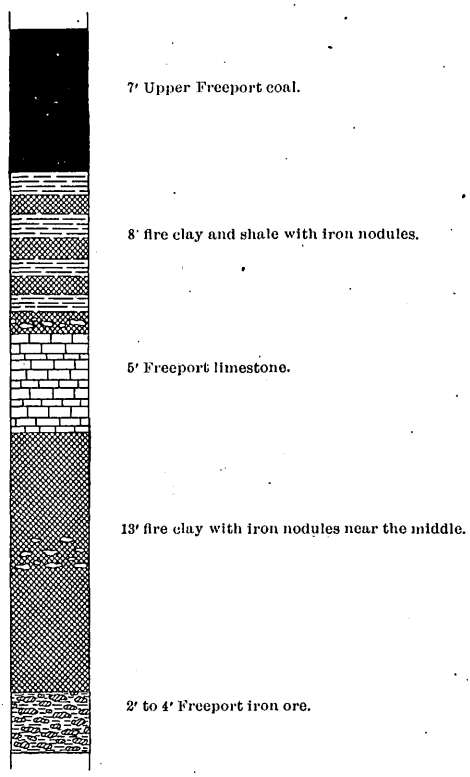


FIG. 5.—Section of Upper Freeport coal and associated clay and iron ore at Bradys Bend.

Upper Freeport fire clay.—The fire clay is usually plastic and from 3 to 5 feet thick, but south of Chicora a considerable area of flint clay occurs at this horizon. The clay is almost universally present immediately underneath the coal. At Bradys Bend a thick bed of clay occurs beneath as well as above the limestone, as shown in the section. This is probably an unusual occurrence.

Upper Freeport iron ore.—This is a purely local deposit, occurring 20 feet below the Upper Freeport coal and below the Freeport limestone. It is known only in the vicinity of Bradys Bend. At Bradys Bend it is described as a solid, compact, very argillaceous layer running about 2 feet thick, but occasionally reaching 4 feet, and having a layer of iron nodules below.

Upper Freeport limestone.—This stratum occurs from 6 to 10 feet below the Upper Freeport coal. It is not persistent, but occurs in detached areas throughout the quadrangles. It ranges up to 28 feet in thickness, but this maximum is attained only in the vicinity of

Manorville and Ford City and holds over but a small area. This limestone is generally nonfossiliferous. A few minute gasteropods have been reported from various places. It appears to be entirely destitute of marine fossils, and is probably of fresh-water origin. The extreme paucity of organic remains may indicate that it is not of organic origin. Possibly it was precipitated from fresh water charged with carbonate of lime in solution.

Upper Freeport coal.—From 20 to 60 feet above the Lower Freeport coal occurs the Upper Freeport coal, which is the top member of the Allegheny formation. Throughout the Kittanning quadrangle the interval between the two coals appears to vary from 30 to 40 feet, but in the Rural Valley quadrangle the variation is greater. On Hays Run, in the river bluff midway between Mosgrove and Templeton, and in the hill south of Dee, an interval of 20 feet was observed. Farther east, in the region from West Valley to Blanket Hill, an interval of 60 feet prevails. From New Bethlehem eastward, except in localities where the Butler sandstone is well developed, the interval is mainly 40 feet. The Upper Freeport coal is generally persistent where not eroded, and is from 3 to 4 feet thick. In some places it is thin, shaly, and worthless. This character is reported in the vicinity of Frenchs Corner and in eastern Donegal Township. On Sipes Run it could not be found, and is probably wanting. In the vicinity of Boggsville it is thin, and on Cornplanter Run it is variable, being cut out in places by the overlying Mahoning sandstone. In the river bluff west of Ford City it is only a thin layer where exposed. These areas of poor development are probably only local exceptions to the generally valuable character of the seam. It has been eroded from large tracts in both quadrangles along the axes of the anticlines, especially in the northern part, but it is present throughout the deeper part of the Fairmount syncline, except along the valleys of the larger streams crossing the syncline. In the Boggsville syncline and in the Rural Valley quadrangle southeast of the Greendale anticline the seam is present, but under deep cover.

Gallitzin coal.—This is an appropriate place to discuss the Gallitzin coal. Platt identified the coal at the Yatesboro No. 2 mine, which is said to be on the Patterson farm, as the Gallitzin, which he claimed occurs 50 feet above the Upper Freeport coal and has a considerable extent in the upper Cowanshannock Valley. The coal at the Yatesboro No. 2 mine, however, lies about 240 feet above the Vanport limestone, as shown by several gas wells in the locality. This is the usual distance between the limestone and the Upper Freeport coal in the Cowanshannock region, a fact that points strongly to the conclusion that the coal in question is Upper Freeport. Furthermore, Yatesboro No. 2 mine is at nearly the same elevation as Yatesboro No. 1, on the south side of the creek, and in strike with it. Yatesboro No. 1 mine is conceded to be in the Upper Freeport, and it is highly probable that the seam at Yatesboro No. 2 is the same. On these grounds Platt's identification is believed to be erroneous. No coal was observed in the region 50 feet above the Upper Freeport, but a thin seam occurs about 100 feet above, which is described farther on as the Brush Creek coal and which, in position relative to the Upper Freeport coal, corresponds with the Gallitzin coal of Cambria County.

CONEMAUGH FORMATION.

General character and distribution.—The Conemaugh formation extends from the Upper Freeport coal below to the bottom of the Pittsburg coal above. It was formerly known as the Lower Barren Measures on account of the fact that it is generally destitute of workable coals. In some parts of Pennsylvania, however, such coals of limited extent occur, sometimes associated with thin limestones. The great mass of the formation is composed of a succession of shale and sandstone strata, the shale being commonly, perhaps prevailingly, sandy. The sandstone is variable in thickness and occurrence. In some regions several strata may be developed, in others a smaller number, and in others there may be scarcely any sandstone from the bottom to the top of the formation. In such cases the formation is composed almost wholly of shale without any distinctive beds. The total thickness varies from 600 to 700 feet.

Within these quadrangles the Conemaugh formation is mostly composed of shale, with thin sandstone layers interbedded. In many places a heavy sandstone occurs near the base of the formation, and in the southwest corner of the Kittanning quadrangle a heavy sandstone occurs at a higher horizon and forms the surface of the elevated level areas there. The upper part of the formation has been eroded from the quadrangles. The greatest thickness of Conemaugh rocks remaining exists in the high hill contoured at 1,540 feet above the sea in the northwestern part of Plum Creek Township. About 400 feet remain in the high hill contoured at 1,600 feet in the southeast corner of Wayne Township and in the knob three-fourths of a mile north of Sistersville, in the Kittanning quadrangle. Nearly all of the Conemaugh formation has been removed from the Kellersburg arch from west of Buffalo Mills to the northern margin of the quadrangles, and only small patches remain on the Greendale anticline between Pine Creek and the high knob 1 mile northwest of Muff, beyond which point the formation is absent. Considerable areas of Conemaugh rocks exist in the northwest corner of the area along the axis of the Bradys Bend syncline and the Fairmount syncline. They form the surface over a considerable strip along the southern margin, and cover most of Cowanshannock Township and the southeast corner of Wayne Township.

Mahoning sandstone.—Much confusion exists as to what beds should be included in this sandstone. So far as the writer can discover, it was first described by Lesley [a] as composed of two beds of sandstone 35 feet thick, separated by 25 feet of shale. I. C. White [b] describes it in almost identical terms, but makes the sandstone members 40 to 50 feet in thickness, with a bed of shale between, the whole varying in thickness from 100 to 150 feet. In an earlier work [c] the same writer restricts the name to the lowest member of the triple group. For reasons that have been fully stated in the Kittanning folio, the writer has decided to apply the name only to sandstones lying between the Upper Freeport and Brush Creek coals, an interval of 70 to 100 feet, as described on page 40.

The Mahoning sandstone usually lies at the base of the Conemaugh formation and closely overlies the Upper Freeport coal. It may, however, occupy a higher position and be separated from the coal by a shale bed of variable thickness. It is generally well developed in the southern part of the Kittanning quadrangle, and occurs at various points in the Rural Valley quadrangle. It varies from a medium-grained, flaggy, or even shaly to a coarse and thick-bedded sandstone, and runs from 10 to 40 feet thick. On the hills immediately southeast of Kittanning it is flaggy to shaly and 30 feet thick, and at Ford City and eastward it is flaggy and rather coarse. At the quarry west of the river nearly opposite Ford City it is 40 feet thick, coarse, thick bedded, and sometimes conglomeratic. It exhibits this thick-bedded character at numerous exposures in the southeastern part of North Buffalo Township and along Glade Run nearly to Walkchalk, where it yields bowlders of coarse white sandstone that probably mingle on the slopes with those of similar character from the Butler sandstone, which is also heavy at this locality. North and east of Walkchalk it becomes more flaggy and to the west seems to disappear entirely. Along the little run entering Glade Run from the north at North Buffalo post-office it is coarse and heavy. It shows again near the mouth of Marrowbone Run and along Buffalo Creek a short distance to the north as a rather coarse, flaggy rock. It exhibits the same character on Sipes Run about a mile above its mouth and becomes coarser and heavier on Cornplanter Run west of Boggsville, where it immediately overlies the Upper Freeport coal and often cuts out that seam. On the east fork of Buffalo Creek about 2 miles north of Rattigan it is coarse and conglomeratic. Along the western margin of the Kittanning quadrangle, from west of Fenelton northward to Yorkans, the Upper Freeport coal seems to be immediately overlain by about 20 feet of shale, above which there is a greater or less thickness, though scarcely exceeding 20 feet, of sandstone, generally thin bedded and flaggy, but sometimes coarse; this probably represents the Mahoning. In the northeast quarter of the Kittan-

[a] Manual of Coal and its Topography, 1856, p. 97.
[b] Bull. U. S. Geol. Survey No. 65, 1891, p. 95.
[c] Second Geol. Survey Pennsylvania, Rept. Q, p. 36.

ning quadrangle it seems to be only locally present. In the bluff south of the river midway between Mosgrove and Templeton, the sandstone is 50 feet thick and rests upon the Upper Freeport coal. In the western part of Mahoning Township its presence is indicated by the large bowlders of coarse sandstone that strew the surface in many places. It is here 40 to 50 feet above the Upper Freeport coal. The considerable areas of nearly flat land in this region are probably due to the presence of this sandstone. On the road from Oakland to Putneyville, near the top of the hill 1 mile northwest of Putneyville, the Mahoning is well exposed in the road cut as a coarse, very thick-bedded sandstone 40 to 50 feet thick, and is separated from the Upper Freeport coal by about 20 feet of shale. On the ridge north of McNees, between Cowanshannock Creek and Mill Run, the Mahoning takes the form of conglomerate, large blocks of which occur near the crest of the ridge and run down the north side nearly to the creek. About 1 mile northwest of Blanket Hill, north of Mill Run and about 100 feet above it, the sandstone crops out in a bold ledge 20 feet thick. Near the head of the first run northwest of Blanket Hill it is heavy and immediately overlies the Upper Freeport coal at a bank on the east side and yields large blocks from a position apparently considerably higher on the west side. At the head of Garrett Run it is flaggy and closely overlies the Upper Freeport coal

Mahoning coal (?).—At the intersection of the roads one-half mile east of Beatty's mill, which is on Buffalo Creek about one-half mile north of the mouth of Marrowbone Run, there is a good coal bloom about 40 feet above the Upper Freeport coal and just above the Mahoning sandstone. This coal was noted in several places northward for 1½ miles along the road toward Worthington. It is accompanied in a number of places by a thin limestone. South of the road crossing above mentioned the coal was not seen, but its limestone was traced for a mile along the road to Slate Lick. This coal was not observed elsewhere in the Kittanning quadrangle, but in the Rural Valley quadrangle, on the Indiana pike near the head of Rupp Run, a coal is exposed 1 foot thick, 25 to 30 feet above tho Upper Freeport, and the blossom of a coal apparently at the same horizon occurs in the road a short distance west of Bryan. These coals may probably be correlated with the coal at Beatty's mill. They occur at the horizon of the Mahoning coal of Maryland.[a]

Brush Creek coal.—Throughout the southern half of the quadrangles there is a persistent bed of black shale or coal, or both coal and shale, running from 70 to about 100 feet above the Upper Freeport coal. This coal occurs at the same horizon and is undoubtedly the same as the Brush Creek coal, described by I. C. White,[b] in southern Butler County. In the Kittanning quadrangle the black shale is often very conspicuous and generally contains the coal, but in the Rural Valley quadrangle the shale does not occur, though the coal appears to be rather thicker and more persistent. The shale is generally about 5 feet thick, but in a few places thickens to 20 feet. The latter thickness is well shown at the cross-roads near the church about 1¼ miles southeast of Worthington. The coal varies from a few inches to 2½ feet in thickness. On account of its importance as a horizon marker, the distribution of this bed warrants a pretty thorough description. It may be seen along the road between Weskit and Walkchalk, in the road on the hilltop west of Weskit, on the ridge road north of North Buffalo post-office, one-half mile east of Beatty's mill, on the road between the mill and Weskit, along the road from Beatty's mill to Worthington, beyond Worthington on the road toward the head of Long Run, along the road westward over the hill between the head of Sipes Run and Buffalo Creek, in the road westward over the hill from Sipes Run, and in a ravine near the road one-fourth mile northeast of Boggsville. It was observed on the Indiana pike on the hillside above the head of Rupp Run, where it is 90 feet above the Upper Freeport coal, and along the ridge road in Rayburn and Valley townships from one-half mile west of the boundary line in Rayburn Township to about 1 mile east of West Valley. At one point on this road it has been opened and is reported 2½ feet thick. It appears to be here 100 feet above the Upper Freeport coal. The blossom of this coal shows at several points along the road from Yatesboro to Smeltzer

[a] Maryland Geol. Survey, vol. 5, p. 303.
[b] Second Geol. Survey Pennsylvania, Report Q.

and about one-fourth mile east of Rural Valley the coal was seen in the road and is about 15 inches thick. It has been opened near the forking of Cowanshannock Creek at the road corners where the road starts south to Atwood along the western margin of the quadrangle, and is reported 20 inches thick. The Upper Freeport coal is reported to have been reached in a diamond-drill hole near this opening at a depth of 100 feet, showing that the interval between the two coals here is about 100 feet, and that accords well with drill records at Rural Valley.

Cambridge limestone (?).—At a few points a thin, dark limestone, carrying an abundance of marine fossils, occurs. Its horizon is not definitely known, but it appears to be above the Brush Creek coal. It is exposed and is 6 inches thick in the midst of shale on the Indiana pike just west of where it crosses the head of the first run in the Rural Valley quadrangle, one-half mile east of its western boundary. It also occurs by the roadside on the easternmost road running north and south in the southeast corner of Wayne Township, at a point about 1½ miles north of the southern boundary of the township and one-half mile west of the margin of the quadrangle. A thin, impure limestone with fossils was also observed on the road from the ridge down to Glade Run due west of Ford City, in the Kittanning quadrangle. This limestone is of interest as showing that marine conditions prevailed at least locally for a brief period in the region. It is possibly to be correlated with the Lower Cambridge limestone of Ohio and Maryland.[a]

Bakerstown coal.—About 75 feet above the Brush Creek coal and 150 feet above the Upper Freeport coal another small and probably worthless coal occurs in the southwestern part of the Kittanning quadrangle. Its blossom was observed at a few points in west North Buffalo South Buffalo, and Winfield townships, and at a point in the road about 1½ miles southwest of Coyleville, in Clearfield Township. This is probably the same as the Bakerstown coal described by I. C. White in southern Butler County.[b] It is not of sufficient importance to warrant further description.

Saltsburg sandstone.—Associated with the Bakerstown coal both above and below is a massive, coarse-grained sandstone whose limits are somewhat indefinite, but which is so prominent a feature in the southwestern part of the Kittanning quadrangle that it has been mapped as the Saltsburg member of the Conemaugh formation. There are 40 to 50 feet of sandstone below the coal and from 60 to 80 feet above it. The flat-lying land in the south western part of Winfield Township is formed by the upper sandstone. These two beds o sandstone are separated in places by a thin bed of shale containing the Bakerstown coal and fire clay. It is possible that this separation could be made throughout the part of the quadrangle in which the sandstones occur if exposures were good, but under present condi tions it is impossible to trace such a separating bed. The sandstone below the coal is clearly the same as the Buffalo sandstone of White,[c] and the upper occupies the position of the Saltsburg sandstone of Lesley.[d] It is believed, however, that the sandstone mass as a whole corresponds best with the Saltsburg sandstone in its type locality, and that name has been adopted.

The upper sandstone is the thicker and more conspicuous of the two. It occurs over all the area south of Rough Run and caps the high hill between Buffalo Creek and Sipes Run. The quarries on the hilltop at West Winfield are in this sandstone, which is here rather coarse and thick bedded. Besides its occurrence south of Rough Run the lower or Buffalo sandstone of White occurs over the area mapped along the West Winfield-Fenelton road. Along this road, 1½ miles north of the latter area, the Bakerstown coal occurs in the midst of shale, but the sandstone both above and below the coal has practically disappeared from the section. With a few possible exceptions these sandstones are not recognizable as such outside of the areas mapped. Where they are absent their place is occupied by sandy shale and occasionally by thin flags. Along the ridge road west of the river about 3 miles south of Weskit blocks of heavy sandstone occur which probably belong to this horizon. Near the

[a] Maryland Geol. Survey, vol. 5, p. 304.
[b] Second Geol. Survey Pennsylvania, Rept. Q., p. 96.
[c] Op. cit., p. 33.
[d] Second Geol. Survey Pennsylvania, Rept. K3, p. 22.

tops of the higher hills in the northwest quarter of the Kittanning quadrangle, along the ridge road nearly east of Templeton toward Goheenville, and on the ridge south of Hays Run and eastward in Rayburn and Valley townships, a sandstone that is generally coarse and friable, yielding small débris, but which is sometimes hard, may represent the Saltsburg, since it lies about 160 to 200 feet above the Upper Freeport coal.

Red shale.—In the vicinity of Sistersville, close beneath the Ames limestone and about 300 feet above the Upper Freeport coal, lies a bed of red shale. This was not noted elsewhere in the Kittanning quadrangle, but in the Rural Valley quadrangle it occurs from Blanket Hill to the central part of Cowanshannock Township, and northward into Wayne Township on a number of hilltops about 250 feet above the Upper Freeport coal.

Ames limestone.—On a few high knobs in North Buffalo Township, north of Slate Lick and Sistersville, a thin limestone occurs. It has a grayish or greenish color and is often full of fossils, among which crinoidal stems are plentiful. It has been noted during the present survey at two points. One of these is the top of the knob east of the road one-half mile south of the head of Marrowbone Run and 1⅓ miles slightly northeast of Slate Lick. The other is the knob one-half mile northeast of Sistersville. It is known only by fragments on the surface, and these would indicate a thickness of about 1 foot. In the former locality the distribution of the fragments would indicate that the limestone occurs in two beds separated by almost 20 feet of shale, the lower being about 315 and the upper about 335 feet above the Upper Freeport coal; the horizon of this limestone passes through several other knobs in the southwest corner of the quadrangle and it may occur on them. Platt [a] reports it on a high knob about 1 mile northwest of Slate Lick. This limestone has been traced pretty continuously across southern Butler County by I. C. White [b] and found to be the same as the crinoidal limestone of Beaver County, with which it agrees in its fossiliferous character and its stratigraphic position, which ranges from about 290 feet above the Upper Freeport coal in the Beaver quadrangle to about 330 feet above the coal in the Kittanning quadrangle. This limestone is generally known as the Crinoidal limestone throughout western Pennsylvania, but for reasons already stated (p. 34) in connection with the description of the Vanport limestone, the geographic name Ames [c] has been substituted for the descriptive name Crinoidal.

Higher sandstones.—Along the southern margin of the Rural Valley quadrangle in Plum Creek and Cowanshannock townships a number of hills have a coarse, heavy sandstone cropping out near their summits or capping them. The sandstones at the various points are similar in lithologic character, but if the interpretation of the structure of the region, as made out from well records, is correct, they can not be regarded as belonging to the same stratum, since they vary in position from 220 to 450 feet above the Upper Freeport coal. It is possible that the higher of these sandstones is the Morgantown, since it occupies nearly the stratigraphic position of that stratum as it occurs in Fayette and Westmoreland counties.

QUATERNARY DEPOSITS.

CARMICHAELS FORMATION.

Character and distribution.—Along several of the tributaries of the Allegheny, and especially along Mahoning Creek, there are thin deposits of alluvium and stream-worn material consisting of pebbles and rounded bowlders of considerable size, at heights above the present streams from 20 feet on the headwaters of the Cowanshannock to 100 feet on the Mahoning. These deposits differ from those described in the next section chiefly in that they are of local derivation solely and contain no admixture of foreign material. The name was applied by Campbell (Masontown-Uniontown folio) to terrace deposits of local origin and of probable Kansan age along Monongahela River, which are particularly well developed at Carmichaels, above Brownsville. The name has been extended appropriately to embrace all deposits of like age and origin in the western part of the State, but it must not be inferred that the

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 287.
[b] Second Geol. Survey Pennsylvania, Rept. Q., p. 77, et seq.
[c] Andrews, Ohio Geol. Survey, vol. 1, pt. 1, pp. 235, 296.

deposits bearing this name are alike either in character, thickness, or mode of accumulation in the different localities.

A small area of these deposits occurs in Glade Run in the Kittanning quadrangle and on the northern bank of Redbank Creek near the boundary between the quadrangles. They occur at various points on Mahoning Creek to above Eddyville and are composed of distinctly stream-worn and water-laid material. On the north side of South Fork of Pine Creek they may reach a thickness of 10 feet, but they contain here much less distinctively water-worn material and more alluvium than on the Mahoning. On Cowanshannock and Plum creeks they are scarcely distinguishable from the soil of the hillsides or from the alluvium of the flood plains, but have been mapped largely on topographic grounds, since the low terraces along those streams apparently correspond to those on which the deposits occur on the other streams.

GRAVEL AND SILT OF GLACIAL DERIVATION.

Earlier deposits—character and distribution.—This material exists in the form of terraces along Allegheny Valley the tops of which lie from 200 to 250 feet above the river. It is composed of more or less well-stratified clay, sand, and gravel, reaching a maximum thickness of 70 to 75 feet at the mouth of Limestone Run and east of Manorville. The character of the deposit is well shown in a cut of the Buffalo, Rochester and Pittsburg Railroad near the mouth of Limestone Run, where it is exposed to a depth of at least 50 feet. The greater part of the deposit is medium to fine gravel with which there is more or less sand. A small proportion of the gravel consists of pebbles of crystalline rocks.

The largest area of this material occurs on the terrace east of Ford City. On the opposite side of the river is another area. Weskit is built on such a gravel terrace; another occurs on the hill just northeast of Kittanning; there are several terraces covered with this material along the west side of the river below the mouth of Limestone Run, and farther north on the same side of the river these deposits stretch from the mouth of Limestone Run to opposite Templeton. Nearly opposite the mouth of Redbank Creek is a narrow area, east of East Brady is another small patch, and on the north side of the river near the margin of the quadrangle is another.

Origin of deposits.—The origin of this material is explained as follows: The river at one time flowed about 200 feet higher in the rocks than it does at present and in that position had eroded a valley with a floor varying about one-fourth mile to 1¼ miles in width. This condition existed in the early stages of Glacial time. At this time great quantities of gravel and silt were transported by the ice from as far north as the areas of crystalline rocks of Canada, whence came the crystalline pebbles of the deposits. This transported material was scattered over the surface covered by the ice down to its southern margin, which extended down the river to the vicinity of Kennerdell. Great quantities of this material were washed into the river, carried downward, and deposited on the old river bed, filling the valley to a depth of 100 feet or more. Subsequently most of this material was washed out by the river and the present trench cut below the former river bed, leaving the terrace gravels lying on the valley walls where they now exist. In some cases gravels occur much lower on the slopes than described above. These lower gravels have either been washed down the slopes from their original position or have been redeposited by the river on its curves while deepening its valley.

Age of deposits.—The high-level gravel deposits described above are believed by Leverett to be at least as old as the Kansan deposits of the interior and perhaps older.[a]

Gravel of Wisconsin age.—Subsequent to the trenching of the river valley after the Kansan filling described above, the bottom of the valley was filled to a depth of about 50 feet with gravel and silt, which forms the present narrow strips of level land at various points along the river. The level ground forming the sites of Kittanning and Ford City is a good example of this material. It was brought into the valley during the latest or Wisconsin stage of glaciation in the same manner as the deposits of Kansan age, and has been subsequently trenched by the river, leaving the higher portions above the flood level.

[a] Mon. U. S. Geol. Survey, vol. 41, 1902, pp. 239 et seq.

ALLUVIUM.

This consists of fine material laid down by the present streams at times of overflow and is present to a greater or less width along most of the principal streams well up toward their headwaters.

MINERAL RESOURCES.

COAL.

GENERAL DISCUSSION.

As will be seen by the accompanying illustration (fig. 6) the area described lies in the northern end of the great bituminous coal field of eastern United States and coal is its most important source of mineral wealth.

There are in all eight seams that reach minable thickness over areas of greater or less extent in the quadrangles. These are, in ascending order, the Brookville, Craigsville,

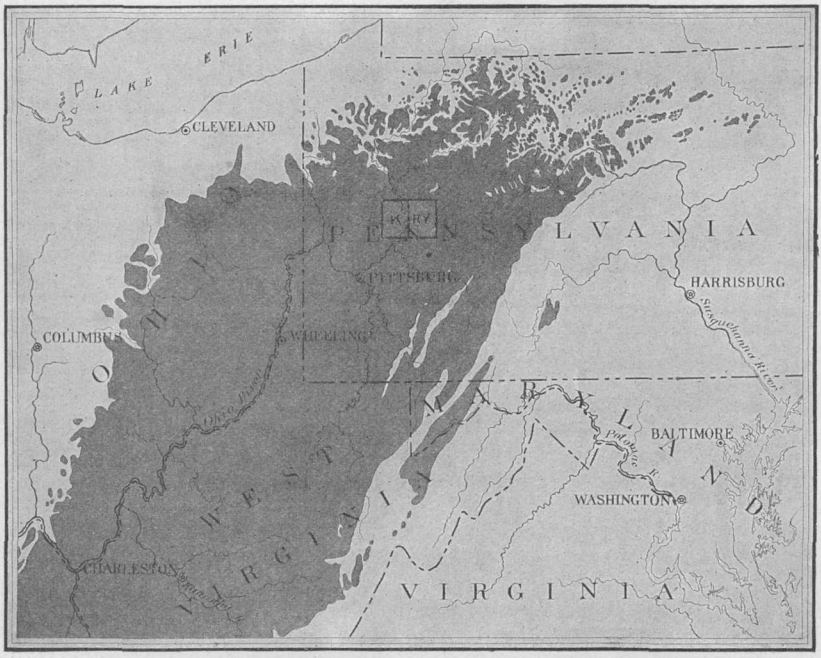
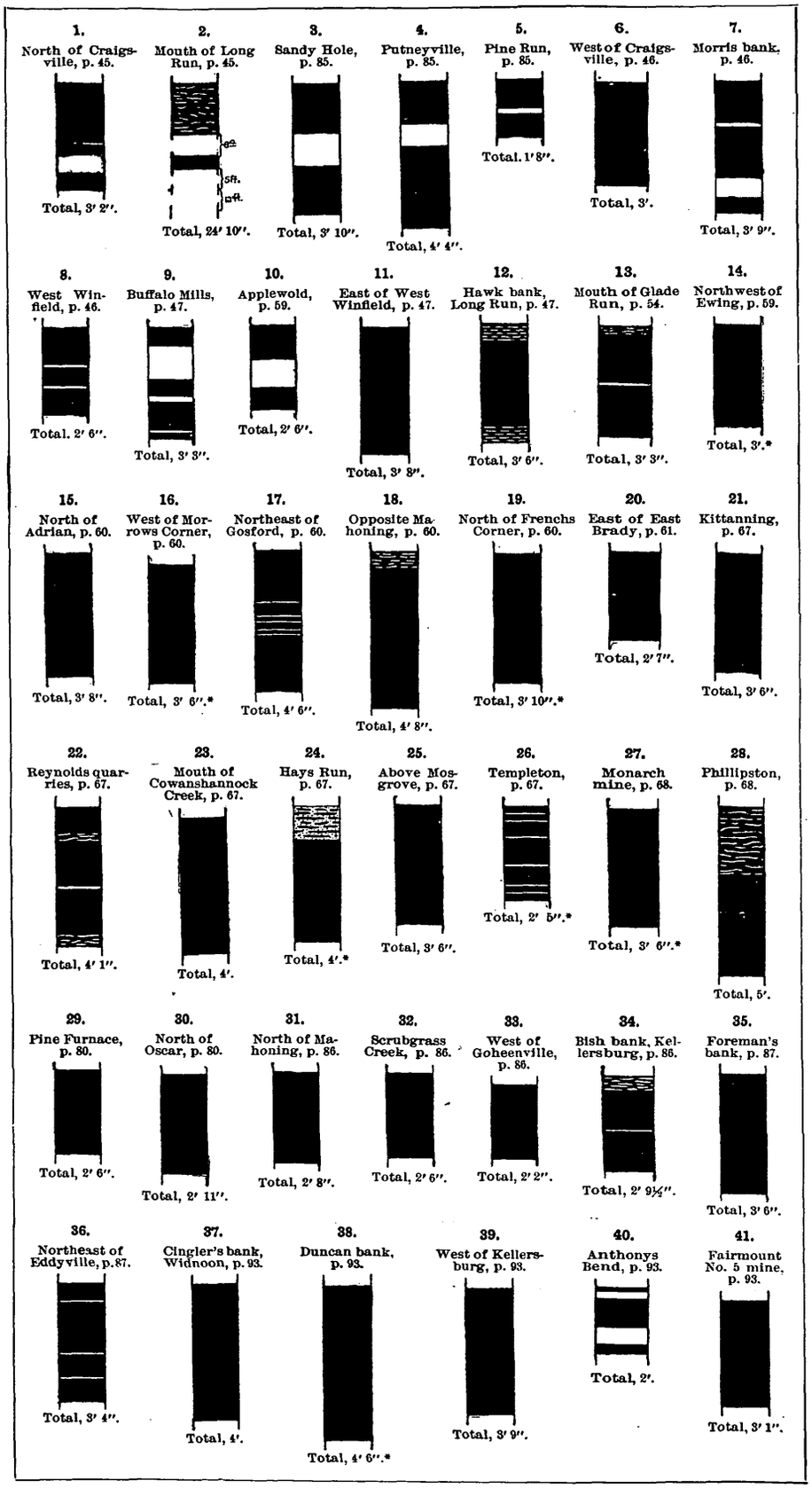


FIG. 6.—Map showing extent of the northern part of the Appalachian coal field.

Clarion, Lower Kittanning, Middle Kittanning, Upper Kittanning, Lower Freeport, Upper Freeport, and Brush Creek seams. The first seven of these seams occur in the Allegheny formation, and the last in the Conemaugh formation. Their general stratigraphic relationships are shown in the generalized section (Pl. V), and are set forth in the preceding description of those formations.

Of the eight seams, only two, the Lower Kittanning and the Upper Freeport, are generally workable. The Lower Freeport comes next in importance, followed by the Upper Kittanning. The remaining four, so far as known, are minable only in small areas and with the possible exception of the Brookville coal along Upper Mahoning Creek, hardly rank as coals of commercial importance.

On the accompanying map (Pl. XI) where a seam is known to be of minable thickness or is regarded as probably such, its outcrop is shown by a full line; where it is not known to be minable but is possibly so, its outcrop is shown by broken lines. Where nothing is



COAL SECTIONS.

Sections 1 to 5, Brookville coal; section 6, Craigsville coal; sections 7 to 10, Clarion coal; sections 11 to 41, Lower Kittanning coal.

*Maximum thickness.

known of a seam, or it is known to be too thin to mine, its outcrop is not shown on the map. In most cases the mapping of the outcrop of coals between the Lower Kittanning and the Upper Freeport seams is based upon the blossom of these coals at a few points along the roads, and their value can be determined only by prospecting along these lines.

The description of the coals will be given separately for each of seven drainage basins as follows: Buffalo Creek, Glade Run, Allegheny River with its smaller tributaries, Redbank Creek, Mahoning Creek, Pine Creek, and Cowanshannock Creek. The position of a bank, prospect, or outcrop is indicated on the map (Pl. XI) by a cross (X), and the position of a mine by crossed hammers. Each point is numbered on the map and the corresponding number is inserted in the text in connection with the description of the coal at the given point. By this means it is possible to indicate the exact locality at which an observation was made. In many cases coals are noted in the records of deep wells and in describing these coals the name of the well will be followed by a number in parentheses, which is the map number of the well. In a few cases where sections are taken from Platt's Report H5, it is impossible to identify the exact point at which the section was obtained. All points are numbered consecutively for each seam from the mouths or lower parts of the streams toward their heads, and a general index to the numbers is given on the margin of the map.

In these quadrangles the roof of the coal seams is prevailingly a stiff shale which holds up well, and the floor is usually fire clay, a rock that can be removed in mining without great expense. In the sections given in the detailed description of the coals, it is to be understood that the roof is probably shale and the floor clay unless otherwise stated. Under these conditions any seam having a fairly regular thickness of 2 feet or over is considered minable.

COALS IN BUFFALO CREEK BASIN.

BROOKVILLE COAL.

In the Dumbaugh heirs' well (183) near State Lick a coal is reported 464 feet deep and 4 feet thick that may be Brookville. This coal was once opened on the Nickels farm opposite the mouth of Long Run, as reported by Platt.[a] There is an abandoned bank in this locality, No. 1 on Pl. XI, which may be the one noted. The coal is broken by shale partings in such a manner as to be of little value, as shown by the following section:

Brookville coal at Nickels bank, opposite the mouth of Long Run, No. 1 (Pl. VI, 1).

	Ft.	in.
Coal	1	9
Shale		1
Coal		3
Shale		7
Coal		6
	3	2

A cut on the Buffalo, Rochester and Pittsburg Railroad, a short distance east of where it crosses the highway at the mouth of Long Run, No. 2, reveals the following section:

Brookville coal in railroad cut at mouth of Long Run, No. 2 (Pl. VI, 2).

	Ft.	in.
Bony coal	1	6
Sandy shale	8	
Coal		4
Shale	5	..
Sandstone (Homewood?)	10	..
	24	10

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 279.

The coal in this section is probably the Brookville, and its worthlessness is evident. On the road running north from Patterson Creek to Fosters Mills, No. 3, coal blossoms were noted, one of which is probably made by the Brookville seam, but nothing is known of its thickness.

CRAIGSVILLE COAL.

In the description of the Allegheny formation (p. 32) the name Craigsville is used for a coal in the vicinity of Craigsville between the Brookville and Clarion coals. The reasons for regarding this as a distinct seam are fully set forth in that discussion. At a bank near the road northward from Buffalo Creek, about 2 miles west of Craigsville, No. 4, this coal is 3 feet thick (Pl. VI, 6). On the hill about 1 mile northwest of Craigsville, No. 5, is an old opening in what appears to be this coal, which is reported 3 feet 6 inches thick, and apparently the same coal makes a good showing south of Patterson Creek along the road between Craigsville and Fosters Mills, No. 6. Judging from these indications, it is possible that there is a considerable body of workable coal in this seam northwest of Craigsville. This can be determined, however, only by thorough prospecting.

CLARION COAL.

The Clarion coal is mined to some extent by A. G. Morris at West Winfield, No. 7, where the seam reaches a good thickness, though it is divided into three benches by two shale partings. The following section was measured by the writer at this bank:

Clarion coal at the A. G. Morris bank, West Winfield, No. 7 (Pl. VI, 7).

	Ft.	in.
Coal	1	2
Shale		½-1½
Coal	1	6
Shale		7
Coal		5
	3 to 3	8½ to 9½

Analysis No. 1 of the table on page 98 is of a sample from this bed. Platt [a] published the following section from this place, though possibly not from the same bank:

Clarion coal at West Winfield (Pl. VI, 8).

	Ft.	in.
Coal	1	1
Shale		1
Coal		6
Shale		1
Coal		9
	2	6

This coal was also exposed in prospecting for the Clarion clay at the Duquesne Fireproofing Company's works, No. 8 on Pl. XI, and reported 2 feet 6 inches thick. The Clarion coal is believed to occur in the following wells on Buffalo Creek southeast of West Winfield:

Clarion coal in wells on Buffalo Creek.

Name of well.	Depth.	Thickness.
	Feet.	*Feet.*
Pump station (171)	20	4
T. J. Ewing No. 2 (172)	305	5
Ralston heirs No. 1 (170)	410	3

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 291.

At the roadside just below Buffalo Mills, No. 9 on Pl. XI, the following section is exposed and exhibits the worthless character of the coal:

Clarion coal below Buffalo Mills, No. 9 (Pl. VI, 9).

	Ft	in.
Coal		6
Shale	1	0
Coal		6
Shale		2
Coal		10
Shale		1
Coal		2
	3	3

About 2 miles above Craigsville, No. 10, this coal is reported to be 2 feet thick. It is not known elsewhere on Buffalo Creek.

LOWER KITTANNING COAL.

The Lower Kittanning coal has been worked to some extent on Buffalo Creek east of West Winfield, and it is known or reported at a number of points. There is an opening at No. 11, where the coal is 3 feet 8 inches thick (Pl. VI, 11). In the T. J. Ewing well No. 2 (172), the Lower Kittanning is reported 5 feet thick and 145 feet deep. At the Blane bank near creek level 1½ miles east of West Winfield, No. 12, the coal is 3½ to 4 feet thick. In the Blane well near by this coal is reported 4 feet thick and 75 feet deep, and in the Fink well, No. 2 (180), situated near the mouth of a ravine just above the Blane bank, the coal is reported 3 feet thick and 39 feet deep. At an opening in the southwest corner of West Franklin Township, No. 13, the coal is 2 feet 5 inches thick. In the northwest corner of Winfield Township, No. 14, the Lower Kittanning coal has been stripped, but at the time this survey was made it was not exposed to observation. In the general region of Buffalo Mills and farther south the coal is usually good. Near Buffalo Creek, about 2 miles below Buffalo Mills, No. 15, is a working bank, and in an opening 1½ miles southwest of Buffalo Mills, No. 16, the coal was 2 feet 8 inches thick. On the Peter Graff property, at Buffalo Mills, Nos. 17 and 18, Platt[a] reports the coal 3 feet 6 inches thick on the average. The seam contains here, 1 foot 6 inches from the floor, a persistent binder 6 inches to 1 foot thick and thinner and less persistent bands below. The coal from the upper part of the seam is the best and, it is claimed, produces a high heat. It was once used for fuel in the woolen mill and for burning lime. At old openings just north of the Butler pike midway between Buffalo Mills and Coyleville, Nos. 19 and 20, the coal is reported 3 feet 8 inches thick. (See analysis No. 3, p. 98). The coal has been opened at other points in this vicinity, Nos. 21 and 22. At Bowser's bank, No. 23, 1 mile north of Buffalo Mills, the coal is 3 feet 8 inches thick. A sample of coal from this bank was analyzed with the result shown in analysis No. 6 (p. 98). At a bank on the D. S. Hawk farm, No. 24, the coal has the following section:

Lower Kittanning coal at the D. S. Hawk bank, No. 24, Long Run (Pl. VI, 12).

	Ft.	in.
Coal, shaly		6
Coal	2	6
Coal, shaly		6
	3	6

At an opening on the north side of Long Run, No. 25, the coal was 2 feet 6 inches thick, and at a bank one-half mile above, No. 26, the coal is 3 feet 6 inches thick. Just above are two other openings, No. 27. In the vicinity of Fosters Mills are a number of old openings, Nos. 28 and 29, where the coal is reported by Platt[b] to average 3 feet in thickness. In this vicinity it is closely overlain by a coarse sandstone. Near Craigsville and Nichola

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 281.

[b] Op. cit., p. 278.

are several old openings. In old pits near the top of the hills west of Craigsville, Nos. 30 and 31, the coal was reported 2 feet 6 inches thick. At an opening on the hill 1 mile northwest of Craigsville, No. 32, the coal runs from 2 feet to 2 feet 6 inches thick, and in a working bank three-fourths mile west of Nichola, No. 33, the coal varies from 2 feet 6 inches to 2 feet 10 inches in thickness. In the immediate vicinity of Nichola the coal has been opened at three points, Nos. 34, 35, and 36. At No. 35 its thickness varies from 3 to 4 feet. The Lower Kittanning coal is below water level on both streams a short distance above Nichola and is not elsewhere exposed in this basin. It is reported of good thickness in a number of wells in the northern part of the Buffalo Creek basin, as shown below.

Lower Kittanning coal in wells in Buffalo Creek basin.

Name of well.	Depth.	Thickness.	Name of well.	Depth.	Thickness.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Michael Maley No. 1 (75)	103	4	Pontius No. 1 (110)	325	3
Goldlinger No. 2 (76)	284	4	John Patton (233)	58	4
Goldlinger No. 1 (77)	320	4	Scott Hepler (234)	140	4
John King No. 4 (86)	192	.....	John Adams (236)	215	4
King No. 3 (87)	226	4	James Henry (232)	140	4
King No. 2 (88)	292	4	Keener (226)	100	4
A. Black No. 1 (102)	295	.....	J. B. Neal (274)	269	3
Pontius No. 3 (105)	255	.....			

MIDDLE KITTANNING COAL.

There is considerable evidence of the presence of the Middle Kittanning coal in the vicinity of West Winfield. It is exposed in a cut of the West Winfield Railroad three-fourths mile below the mouth of Rough Run, No. 37, and there is an old opening in it by the highway on the opposite side of the creek, No. 38. At No. 37 the coal as seen from the highway opposite appears to be from 2 to 3 feet thick. The blossom of what is regarded as this coal shows at points Nos. 39 to 41, north of West Winfield. Southwest of Buffalo Mills its blossom was observed at two points, Nos. 42 and 43, and 1 mile northwest of Buffalo Mills it shows in the road at No. 44. Along the Buffalo, Rochester and Pittsburg Railroad on Long Run, No. 45, the coal shows as a thin seam. In the road west of the head of Long Run, and about 1½ miles west of Cowansville post-office, No. 46, the coal had been stripped and is 2 feet thick. The blossom of this seam was seen in the road about 1½ miles south of Fosters Mills, No. 47, and there is an old opening in it 1 mile northeast of Fosters Mills, No. 48. Along Buffalo Creek between Craigsville and Fenelton this coal appears to be thicker than usual, and may be of economic importance. At an opening on the hill 1¼ miles northwest of Craigsville, No. 49, the coal is 2 feet 1 inch thick.

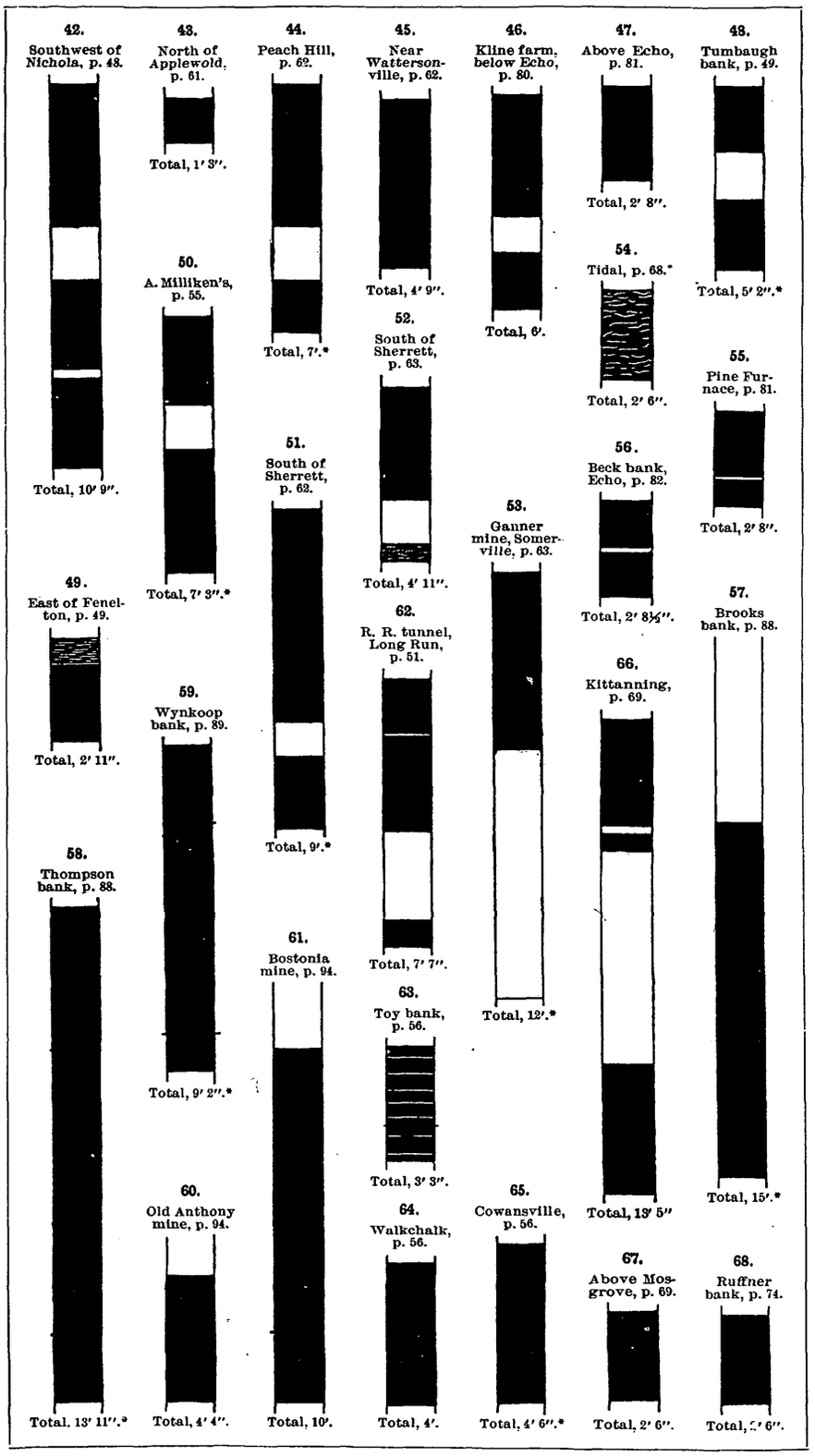
I. C. White[a] published the following section of a coal which he regarded as the Lower Kittanning, but which is more probably Middle Kittanning:

Middle Kittanning coal south of Buffalo Creek, 1½ miles southwest of Nichola, No. 50 (Pl. VII, 42).

	Ft.	in.
Coal	4	
Slate	1	6
Coal	2	6
Shale		3
Coal	2	6
	10	9

In mining, the upper 4 feet is left for roof. The lower benches are excellent coal. The exact locality of the opening at which this section was obtained is not clear from White's

[a] Second Geol. Survey Pennsylvania, Rept. Q., p. 138.



COAL SECTIONS.

Sections 42 to 47, Middle Kittanning coal; sections 48 to 61, Upper Kittanning coal; sections 62 to 68, Lower Freeport coal.

* Maximum thickness.

description, but it seems to be in a little run entering Buffalo Creek from the south about 1 mile west of the county line, in the vicinity of point No. 50. From the known position of the Lower Kittanning coal at No. 33, from the reported position of the Vanport limestone at water level at the bridge below No. 33, and from the westward dip that prevails in the region, it seems impossible to accept White's identification of this coal as the Lower Kittanning; moreover, its section is entirely different from that of the Lower Kittanning in the vicinity. On the opposite side of Buffalo Creek, No. 51, is an old opening, now closed, in the same coal, which is reported 6 feet thick. On the south side about one-half mile higher up the creek, No. 52, is another old pit in which the same thickness is reported. If the above identifications are correct, there is in this region a considerable area of Middle Kittanning coal of workable thickness.

UPPER KITTANNING COAL.

What appears to be the Upper Kittanning coal is recorded in the R. Z. McClatchey well (169) 400 feet deep and 5 feet thick, and in the T. J. Ewing well No. 2 (172) 305 feet deep and 5 feet thick. At an old opening in this coal, No. 53, 1½ miles east of West Winfield, the indications are that it is of no value. Coal blossoms believed to be Upper Kittanning show at a number of points in the southwest part of the Buffalo basin as follows: In the road one-half mile south of West Winfield, No. 54; in the road along Rough Run 1 mile south of the Winfield-Clearfield boundary, No. 55; in the road 1½ miles north of West Winfield, No. 56, and in the road nearly 1 mile east of the latter point, No. 57. All of these exposures are of small extent. In the road in the southeast corner of Clearfield Township, No. 58, the coal is exposed 2 feet thick, and at No. 59 in the same locality it makes a good showing. In the M. Weiland well (55) what may be this coal is reported 12 feet thick at a depth of 310 feet. In the region surrounding Buffalo Mills the presence of this seam is indicated by its blossom at several points, Nos. 60 to 64. At No. 62 southwest of Buffalo Mills and at Nos. 63 and 64, northeast of Buffalo Mills, the showing is good. Near the head of a little ravine almost on the boundary between East and West Franklin townships, No. 65, is an old opening, which is possibly that of the Tumbaugh bank, where Platt[a] obtained the following section:

Upper Kittanning coal at the Tumbaugh bank, Long Run, No. 65 (Pl. VII, 48).

	Ft.	in.
Coal	1	10
Shale and fire clay	1 to 1	1 to 4
Coal	1 to 2	10 to 10
	4 to 5	8 to 2

In the J. B. Neal well (274), in the northwest corner of West Franklin Township, this coal was reported 2 feet thick and 140 feet deep. What is regarded as the blossom of this coal occurs in the road where it crosses the head of Long Run between Cowansville and Browns Crossroads, No. 66. Along the streams from Nichola to Rattigan, and to Fenelton, the Upper Kittanning coal appears to be fairly well developed. Its blossom was seen in the road south of Buffalo Creek in the eastern part of Clearfield Township, Nos. 67 and 68, and north of the creek, No. 69, is an opening in which the following measurement was obtained:

Upper Kittanning coal 1 mile east of Fenelton, No. 69 (Pl. VII, 49).

	Ft.	in.
Sandstone roof		
Coaly shale		9
Coal	2	2
	2	11

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 283.

The seam here is very irregular in thickness; in one place the sandstone roof cuts out its upper portion and reduces it to 8 inches. In the northeast corner of Clearfield Township, No. 70, this coal was reported 4 feet thick in an old pit; in the southeast corner of Donegal Township, No. 71, its blossom shows in the road, and about one-half mile north of the latter point, No. 72, is another old opening, probably in this coal. In well No. 118 (90) on the Bradys Bend tract, 1 mile west of Rattigan, the Upper Kittanning is recorded 2 feet thick at a depth of 60 feet, and in the Pontius well, No. 1 (110), in northern Donegal Township, it is reported 4 feet thick at a depth of 259 feet.

LOWER FREEPORT COAL.

In the Charles Myers well (167) southeast of Slate Lick what appears to be the Lower Freeport coal is reported 5 feet thick, at a depth of 250 feet, and in the Rayburn heirs No. 1 well (182), north of Slate Lick, it is reported 4 feet thick and 145 feet deep. North of Rough Run and about 1 mile west of West Winfield, No. 73, this coal was reported 2 feet 8 inches thick by parties sinking a prospect hole for iron ore. Its blossom at points in southern Clearfield Township, Nos. 74 to 76, indicates a thickness of 2 feet. In the southwest corner of West Franklin Township a thin blossom was seen at No. 77 and at No. 78 the coal makes a good showing and may be 2 or more feet thick. This coal was noted in the following wells in southern West Franklin Township:

Lower Freeport coal in wells in West Franklin Township.

Name of well.	Depth.	Thickness.
	Feet.	*Feet.*
M. E. Smith (213)	30	4
Lesley Long (221)	100	.....
S. B. Claypool (222)	170	4

Along the western margin of West Franklin Township the Lower Freeport coal makes a good showing at several points, Nos. 79 to 84, and may be of minable thickness. In the vicinity of Fenelton what is presumably this coal has been opened just east of the station, No. 85, and its blossom shows in the road a short distance west of Fenelton, No. 86. In southeastern Donegal Township the coal is of such thickness that it has been worked at several points. At No. 87 its blossom was seen, at No. 88 is an old opening, and in the vicinity of Rattigan, Nos. 89 to 91, the blossom shows. West of Buffalo Run is a working bank, No. 92, and in the road just west of Buffalo Bridge, No. 93, the coal is apparently 3 to 4 feet thick. It also makes a good showing in the road about one-half mile farther west, No. 94, at which point it is closely overlain by the Butler sandstone, which yields the large blocks so conspicuous in that vicinity. Still farther up the little run to the northwest the coal has been opened at several points, Nos. 95 to 97, and its blossom was noted at Nos. 98 and 99. At No. 95 considerable coal has been taken out, judging from the waste still remaining about the pit mouth. About 1 mile northwest of Rattigan, No. 100, is an old opening in what is probably this coal. In the Pontius well No. 1 (110) the Lower Freeport coal is penetrated at a depth of 142 feet, and reported 8 feet thick, which is of course an exaggerated estimate. Over a considerable territory between Worthington and Cowansville this coal is of good thickness. About 1 mile north of Worthington, No. 101, what appears to be the Lower Freeport coal has been opened under a coarse sandstone. Two miles northeast of the latter point, No. 102, the blossom of the coal appears in the road, and still farther northeast, No. 103, the coal is cut through in the tunnel of the Buffalo, Rochester and Pittsburg Railroad, and shows the following sections:

Lower Freeport coal in the Buffalo, Rochester and Pittsburg tunnel, No. 103 (Pl. VII, 62).

	Ft.	in.
Coal	1	6½
Shale		1
Coal	2	8½
Clay	2	6
Coal		9
	7	7

While this is a great thickness for a coal seam in this region, only 4 feet 4 inches of it is available for mining. Northward along the road through Cowansville, Nos. 104 to 106, are openings which show that this coal is of minable thickness over a considerable area. The bank at No. 105 is now worked, the others are closed. One-half mile south of Fosters Mills, No. 107, a few fragments of coal were noted which indicate the presence of this seam. On the road between Browns Crossroads and Cowansville indications of this coal were seen at points Nos. 108 and 109, and about 2 miles northwest of Fosters Mills, No. 110, the coal shows in the road.

UPPER FREEPORT COAL.

The Upper Freeport coal is generally of good thickness in the Buffalo basin, though there are exceptions to the rule. It was noted in well records in the southern part of the quadrangle as follows: Casper Freehling No. 3 (2), 250 feet deep; Painter heirs (4), 200 feet deep. In both it is reported 3 feet thick. It crops out near the base of the hills along Cornplanter Run and is closely overlain by the Mahoning sandstone, which is said to cut out the coal to such an extent as to render mining unprofitable. The coal has been opened at several points on the last-mentioned stream, Nos. 111 to 113. At No. 111 it was 3 feet thick, at No. 112 over 2 feet thick, and at No. 113 it is reported 1 foot 6 inches thick. There are a number of old banks in the vicinity of Boggsville, Nos. 114 to 116, but nothing was learned of the thickness or quality of the coal. Above the road three-fourths mile north of Boggsville, No. 117, the coal has been opened and is 2 feet thick (Pl. VIII, 75), and on the west side of Buffalo Creek, No. 118, it makes a good showing in the road. The Upper Freeport coal is noted in a number of wells in the southern part of this basin, as shown below:

Upper Freeport coal in wells in Buffalo Creek basin.

Name of well.	Depth.	Thickness.
	Feet.	*Feet.*
Charles Myers (167)	193	3
J. Weaver No. 1 (168)	255	4
Lewis Baker (174)	135	4

This coal is generally of a good thickness where exposed in western North Buffalo Township. On Marrowbone Run, No. 119, the following section was measured:

Upper Freeport coal on Marrowbone Run, No. 119 (Pl. VIII, 76).

	Ft.	in.
Coal		8
Coal	2	6
	3	2

The coal is here underlain by fire clay and that in turn by the Upper Freeport limestone, which appears to be pure and of good thickness. It is also closely overlain by the Mahoning sandstone which is coarse and 20 feet thick. At Beatty's mill, No. 120, the coal is 3 feet thick and shaly (Pl. VIII, 77). The shaly coal bench of the section on Marrowbone Run seems to have thickened so as to include the whole seam in the Beatty's mill section At

this point the limestone below the coal is 3 to 4 feet thick. On the Meals farm in this locality Platt[a] obtained the following section of this coal:

Upper Freeport coal on Meals farm, Buffalo Creek (Pl. VIII, 78).

	Ft.	in.
Shale		6
Coal	3 to 4	6 to 0
	4 to 4	0 to 6

The seam at this point is overlain by 20 feet of sandstone. Platt regarded this coal as Lower Freeport, but its thickness and stratigraphic relations indicate rather that it is the Upper Freeport. The coal makes a good showing in the shale cut by the highway on the point overlooking Buffalo Creek 1 mile southwest of Beatty's mill, No. 121. Its blossom was observed on the road to the north, No. 122, and fragments of coal probably from this seam were found in the sand of the road bank south of the bridge over Buffalo Creek, No. 123. The Upper Freeport coal is generally of good thickness in the uplands along Rough Run. A good blossom was observed in the road eastward over the hill from the junction of Rough Run and Buffalo Creek, No. 124, and also in the road running southwest over the hill from West Winfield, No. 125. There is an old opening near the next road south from Rough Run, No. 126, and one-half mile farther west is a working bank on the Heim farm, No. 127, at which the following section was obtained:

Upper Freeport coal at Heim bank, No. 127, south of Rough Run (Pl. VIII, 79).

	Ft.	in.
Shaly coal		6
Coal	2	7
	3	1

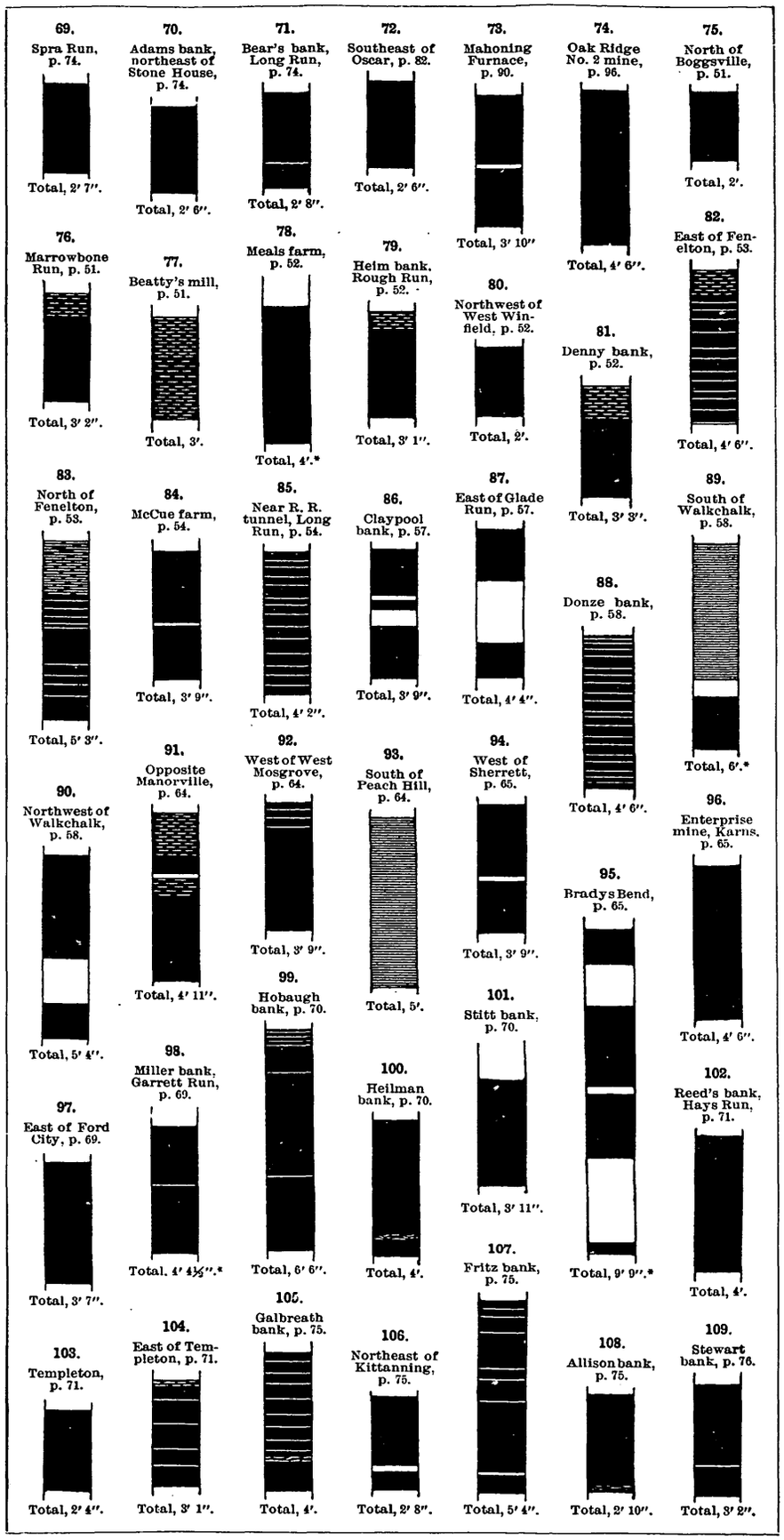
On the little run south of Rough Run, 1 mile east of the quadrangle boundry, is the John Green bank, No. 128, at which the coal was reported 2 feet 10 inches thick. Just south of the Green bank is another, No. 129, from which considerable coal is taken. There are a number of other openings in this vicinity where the coal is of fairly good thickness. On the hilltop north of West Winfield, No. 130, the coal was opened and a thickness of 1 foot 6 inches was exposed. The opening was not driven under rock cover, however, so the coal may be thicker. Still farther to the west, near the second road north from Rough Run there is an old opening, No. 131, and a short distance farther west along the hill, No. 132, the coal is 2 feet thick (Pl. VIII, 80). About 2 miles northwest of West Winfield the coal is opened on the Laurence Denny farm, No. 133, and shows the following section:

Upper Freeport coal at the Denny bank 2 miles northwest of West Winfield, No. 133 (Pl. VIII, 81).

	Ft.	in.
Shaly coal	1	
Coal	2	3
	3	3

At the head of a western branch of Rough Run near the edge of the Kittanning quadrangle, No. 134, the coal makes a good showing, as also in the road crossing the head of the run in southern Clearfield Township, Nos. 135, 136. Nearer the southeast corner of Clearfield Township, No. 137, the coal makes another small showing. In southwestern West Franklin Township, No. 138, the coal was opened at one time, but nothing could be learned of its thickness or character. At other points in this region, Nos. 139 to 141, the blossom of the coal was noted. While it is evidently present on the hilltops of this region, it is in small patches, and its thickness and character are not known. In the Lesley Long well

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 285.



COAL SECTIONS.

Sections 69 to 74, Lower Freeport coal; sections 75 to 109, Upper Freeport coal.

*Maximum thickness.

(221), 1½ miles south of Worthington, the Upper Freeport coal was noted at a depth of 40 feet, and in the S. B. Claypool well (222), 1 mile southeast of the Long well, it was penetrated at a depth of 130 feet and was reported 3 feet thick. In the vicinity of Worthington, Nos. 142 to 145, the blossom of what is regarded as this coal was noted, and an old opening in the same was reported in the village, No. 143. At all these points the indications are that the coal is thin. In the eastern part of Clearfield Township the coal was once opened and worked on the McGucken farm, No. 146, and it is reported 3 feet thick. One mile north of this farm a good blossom was noted just south of the Butler pike, No. 147, and north of the pike, No. 148, an old bank was reported from which considerable coal was once taken. In the M. Weiland well (55), southwest of Coyleville, the Upper Freeport coal was penetrated at a depth of 170 feet and reported 4 feet thick, and in the McShane No. 4 well (56), on the margin of the quadrangle about 1 mile northwest of the Weiland well, the coal was reported 188 feet deep and 5 feet thick. West of Fenelton there are a number of old banks in this coal, Nos. 149 to 151. At No. 151 the coal is reported 1½ feet thick. One-half mile southeast of Fenelton, No. 152, the coal is reported 4 feet thick at an old opening, and on the opposite side of Buffalo Creek, No. 153, the following measurement was obtained:

Upper Freeport coal one-half mile east of Fenelton, No. 153 (Pl. VIII, 82).

	Ft.	in.
Shaly coal		9
Coal with thin partings of shale	3	9
	4	6

About three-fourths mile north of Fenelton is a working bank, No. 154, and another that has been abandoned, No. 155. At the former the following section was measured:

Upper Freeport coal three-fourths mile north of Fenelton, No. 154 (Pl. VIII, 83).

	Ft.	in.
Coaly shale	1	7
Coal with thin partings	1	
Coal	1	
Coal with thin partings	1	
Coal		8
	5	3

In southern Donegal Township, just west of Buffalo Run, are old openings at Nos. 156 and 157. About 1 mile south of Rattigan there are a number of old openings, Nos. 158 to 164. The coal is reported 3 to 4 feet thick. One-half mile west of Rattigan the coal shows in the road, No. 165, and is 1 foot thick or over. Still farther west, No. 166, a good showing was noted, and about 2 miles north of the latter point, No. 167, the coal also makes a small showing. Along the road south of Chicora are two working banks, Nos. 168 and 169. At the latter the coal was reported 4 feet thick. In the vicinity of Chicora and northward toward Karns are a number of old workings, Nos. 170 to 180. Unfortunately no information was obtained about the coal at these points, but the number of workings indicates that it is probably of good thickness. About 1 mile northeast of Chicora, No. 173, the coal makes a good showing, and is probably 4 feet thick. North of Rattigan the blossom of this coal was noted at Nos. 181 and 182, and still farther north, in eastern Donegal Township, are two old openings, Nos. 183 and 184. East of the latter point, near the western margin of Sugar Creek Township, its blossom was observed, No. 185. In the Michael McCray well (242), in western Sugar Creek Township, this coal was recorded 30 feet deep and 5 feet thick, and in the Pontius No. 1 well (110), just across the boundary of Donegal Township, it was penetrated at the depth of 130 feet, being reported 2 feet thick. According to all reports and indications the coal is thin over a considerable area along the county line north of Rattigan. It was reported to the writer that efforts had been made in this region to obtain coal for fuel in the early days of drilling for oil, but

without success. On the McCue farm, in southwestern Sugar Creek Township, which the writer is unable to locate, Platt[a] secured the following section of the Upper Freeport coal:

Upper Freeport coal on McCue farm, in southwestern Sugar Creek Township (Pl. VIII, 84).

	Ft.	in.
Coal	2	1
Slate		1
Coal	1	7
	3	9

McCue's ravine was said to lie west of the Catholic Church, and it is possible that the bank referred to by Platt was the one by the roadside north of the church, No. 186. Northeast of the church are two old openings, Nos. 187 and 188. On the hilltop one-half mile north of Fosters Mills, No. 189, is an old opening that may be Wilson's bank referred to by Platt,[a] who reports the coal here 3 feet 6 inches thick, but shaly and impure. Southwest of Adams are two old openings, Nos. 190 and 191, one of which may be the opening in McElroy's ravine referred to by Platt.[b] He reported the coal at this bank as irregular in thickness, varying from 1 foot 6 inches to 4 feet. One mile south of Adams, No. 192, a small blossom of the coal was seen, as also at two points about 1 mile southwest of Adams, Nos. 193 and 194. At Adams the coal makes a good showing in the road, No. 195, and is 3 to 4 feet thick.

Along the road between Worthington and Cowansville, about three-fourths mile west of the tunnel, No. 196, the coal makes a good showing in the road, and is said to have been opened in an adjacent field, where it is 4 feet 6 inches thick. Near the road, almost directly over the railroad tunnel, No. 197, the coal was measured in a bank and found 4 feet 2 inches thick, with a few thin partings up to one-fourth inch in thickness (Pl. VIII, 85). Just south of the tunnel is an old opening, No. 198, at which the coal is reported 4 feet 6 inches thick. In the J. B. Neal well (274) already referred to (p. 49) the Upper Freeport is 55 feet deep and 4 feet thick.

BRUSH CREEK COAL.

The Brush Creek coal shows at many points between Boggsville and Worthington, but as it is of no commercial importance in the region it will not be described in detail. In order to enable the reader to identify the seam, however, a few points at which it is exposed are indicated by Nos. 199 to 206. At No. 200 it has been worked by the owner, Mr. Stonecipher, who said that he had taken out several hundred bushels of good coal. At No. 204 it has also been worked. At 206 only the black shale that usually accompanies the seam is present and is here 20 feet thick.

COALS IN GLADE RUN BASIN.

LOWER KITTANNING COAL.

The Lower Kittanning coal is exposed only at the mouth of Glade Run, where there is an old opening, No. 207, which may be the Bruner bank, at which Platt[c] obtained the following section:

Lower Kittanning coal at Bruner bank, No. 207, near the mouth of Glade Run (Pl. VI, 13).

	Ft.	in.
Coal, bony		3
Coal	1	5
Slate		1
Coal	1	6
	3	3

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 278. [b] Op. cit., p. 277. [c] Op. cit., p. 259.

This seam was said by Platt to yield but little good coal at the Bruner bank. The Lower Kittanning coal was noted in a number of wells in North Buffalo and East Franklin townships as follows:

Lower Kittanning coal in wells in Glade Run basin.

Name of well.	Depth.	Thickness.
	Feet.	*Ft. in.*
John Miller (186)	362	9
W. J. Bowser (193)	280	4
David R. Bowser No. 2 (207)	60	5
J. B. Drake (258)	235	3 3
J. H. Guthrie (260)	205	4
J. A. Patton (261)	235	6

MIDDLE KITTANNING COAL.

The horizon of the Middle Kittanning coal is exposed only near the mouth of Glade Run, and little is known of it in the area. The blossom of what may be the seam was observed at North Buffalo post-office, No. 208. It is reported in the logs of the following wells along Glade Run:

Middle Kittanning coal in wells in Glade Run basin.

Name of well.	Depth.	Thickness.
	Feet.	*Ft. in.*
Samuel Gray (191)	282	5
Ellermeyer (255)	200	4
J. B. Drake (258)	126	2 1
J. H. Guthrie (260)	155	3

UPPER KITTANNING COAL.

The horizon of the Upper Kittanning coal is exposed from the southern boundary of the quadrangle to one-half mile south of Walkchalk, where it goes under the surface and continues below to about 1 mile south of Cowansville station. What is probably its blossom shows in the road west of North Buffalo, No. 209. Still farther north, No. 210, the seam makes a good showing and has an apparent thickness of 2 feet. Its blossom was noted on the east bank of the run 1½ miles northeast of McHaddon, No. 211. In the J. B. Drake well (258) it was penetrated at a depth of 112 feet, and is 2 feet 4 inches thick. At the road crossing about 1 mile south of Walkchalk, No. 212, the seam is exposed in the road near creek level, and is 1 foot 6 inches thick. The coal seam is at creek level one-half mile south of Walkchalk, No. 213, where, according to report, it was once stripped from the creek bed. It is next noted south and southeast of Cowansville station, at No. 214, where it makes a good showing and is probably over 2 feet thick, and at Nos. 215 and 216, where only fragments were noted. It was apparently in the vicinity of the latter point, No. 216, that Platt[a] obtained the following section of what he regarded as Upper Kittanning coal:

Upper Kittanning coal at A. Milliken's, south of Cowansville (Pl. VII, 50).

	Ft.	in.
Coal	2	3
	to 2	6
Slate	1	
	to 1	3
Coal	3	4
	6	7
	to 7	3

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 267.

It seems possible that in this case Platt mistook the Lower Freeport for the Upper Kittanning coal, since the above section is much like that of the Lower Freeport of that locality. North of Cowansville post-office, at the head of Glade Run, in southwestern Washington Township, No. 217, there is an old opening in what is probably this seam.

LOWER FREEPORT COAL.

The Lower Freeport is an important coal in the Glade Run basin, especially in the vicinity of Cowansville. Near the mouth of the run little is known of the coal. About one-half mile north of North Buffalo, No. 218, it outcrops in the road and appears to be 1 foot 6 inches thick. Farther north it makes a good showing in the road on the right bank of the stream, No. 219, and a little farther upstream, on the opposite bank, No. 220, its presence is indicated by fragments. In the W. C. Barnett well (200) the Lower Freeport coal is 72 feet deep and 1 foot 9 inches thick, and in the T. H. Allison well (211), about 1 mile north of the Barnett well, it is 22 feet deep and 1 foot 6 inches thick. In the road from Weskit to McHaddon, No. 221, a small blossom was noted, and a short distance south of this point, No. 222, the coal is exposed in a bluff and is 2 feet thick. It is here overlain by 25 feet of shale, and the sandstone so prominent at Walkchalk has disappeared from the section. In southwestern East Franklin Township the Lower Freeport coal is of good thickness, and has been worked to a considerable extent. It is worked on the Toy farm, No. 223, and near by is another opening, No. 224. At the latter opening the coal is 2 feet 6 inches thick, and in the Toy bank it shows the section below:

Lower Freeport coal at Toy bank, East Franklin Township, No. 223 (Pl. VII, 63).

	Ft.	in.
Coal with thin partings	2	3
Coal with shale partings up to one-half inch	1	
	3	3

In the Samuel Gray well (191), about 1 mile northwest of McHaddon, the coal is reported 160 feet deep and 5 feet thick, and in the Thomas Hays No. 1 well (253), about 2 miles south of Walkchalk, the coal is 95 feet deep and 3 feet thick. Northward along Glade Run to Walkchalk the Lower Freeport coal has been opened and worked to a considerable extent. A little more than 1 mile south of Walkchalk are abandoned openings, Nos. 225 to 226, and a working bank, No. 227, in which the coal was reported to be troubled with rolls, which rendered mining difficult and expensive. In the J. B. Drake well (258) the coal is 77 feet deep and 4 feet thick, and in the W. P. Bowser well (259), south of Walkchalk, it is 257 feet deep and 3 feet 7 inches thick. At Walkchalk are two openings, Nos. 228 and 229. At No. 229 the coal is 4 feet thick (Pl. VII, 64), and immediately overlain by the Butler sandstone, which is coarse and heavy throughout this vicinity. In the J. A. Patton well (261), about 2 miles northwest of Walkchalk, the Lower Freeport is reported at a depth of 60 feet. About 1 mile to the southeast and east of Cowansville station the coal shows well. At No. 230 it is exposed in the road, and is apparently 3 to 4 feet thick. At No. 231 the blossom of the coal was seen, and in the railroad cut 1¼ miles northeast of the station, No. 232, it is about 4 feet thick. At the Cowansville Mining Company's mine, No. 233, the seam is 4 feet to 4 feet 6 inches thick (Pl. VII, 65). Analysis No. 17 of the table on page 98 is of a sample from this mine. The seam is also of good thickness at the east portal of the tunnel southwest of Cowansville, No. 234.

UPPER FREEPORT COAL.

The Upper Freeport seam is present and generally of good thickness in the Glade Run basin except in the vicinity of Cowansville, where it is thin. Near the southern margin of the quadrangle are two openings, Nos. 235 and 236. No. 235 is the J. S. Bruner bank, in which the coal has the following section:

Upper Freeport coal at the J. S. Bruner bank, No. 235, southwest of North Buffalo.

	Ft.	in.
Coal	1	4
Shale		6
Coal	1	6
	3	4

The coal at this bank has an unusually high percentage of ash, as shown by analysis No. 21 of the table on page 98. One-half mile west of North Buffalo post-office, No. 237, is an old opening, and in the next ravine, one-half mile farther west, in the Claypool bank, No. 238, the following section was measured:

Upper Freeport coal at Claypool bank, west of North Buffalo, No. 238 (Pl. VIII, 86).

	Ft.	in.
Coal	1	4
Shale		2
Coal		3
Shale		6
Coal	1	6
	3	9

On Nicholson Run the coal has been opened at many points, and is probably of good thickness. Nos. 239 and 240 are working banks.

In the vicinity of Sistersville and McHaddon the Upper Freeport coal is reported in several wells as follows:

Upper Freeport coal in wells in Glade Run basin.

Name of well.	Depth.	Thickness.	Name of well.	Depth.	Thickness.
	Feet.	*Feet.*		*Feet.*	*Feet.*
W. A. Jack (185)	80	4	W. J. Bowser (193)	55	3
John Miller No. 1 (186)	192	4	Margaret Zimmer (194)	125	3
S. A. McClelland No. 2 (187)	265	4	Samuel Gray (191)	110	4
S. A. McClelland No. 1 (189)	150	.....	David R. Bowser No. 3 (204)	80	3
J. V. Easley (188)	272	.....			

In a ravine about three-fourths of a mile north of North Buffalo, No. 241, the coal is 3 feet thick, underlain by a good bed of clay and by its limestone, and immediately overlain by 20 feet of sandstone. In the road one-half mile to the east, No. 242, is an old opening in the midst of sandstone. About 1 mile northeast of North Buffalo the coal has been opened at Reed's bank, No. 243. It was not seen here, but is closely overlain by the Mahoning sandstone, which is very coarse. Just across the run east of Reed's bank the coal was found 3 feet thick in a diamond-drill hole (195) on the McKee farm at a depth of 52 feet. In the ravine near the road 2 miles north of North Buffalo, No. 244, the coal is 1 foot 8 inches thick, and is overlain by 40 feet of coarse Mahoning sandstone. A mile east of this point, the coal makes a good showing in the road on the west side of Glade Run, No. 245, and has been opened near by. On the east side of the run, No. 246, is an old opening, and near the bottom of the ravine a little above the latter point, No. 247, the following section was measured :

Upper Freeport coal in ravine east of Glade Run, No. 247 (Pl. VIII, 87).

	Ft.	in.
Dirty coal	1	6
Black shale		10
Shale	1	
Coal	1	
	4	4

On the west side of the run, near the Freeport pike, is an old opening, No. 248, and one-half mile northwest, No. 249, is a working bank on the Sarah Donze farm, at which the coal is 4 feet 6 inches thick and full of very thin partings (Pl. VIII, 88). Along the little run in the southwest corner of East Franklin Township are a number of old openings, Nos. 250 to 252, and 1 mile above this, No. 253, the coal has been opened and worked to a considerable extent near creek level. It goes below the level of the stream at this point. All around the head of this run the coal is closely overlain by 20 feet or more of Mahoning sandstone. East of Glade Run, on the road to Weskit, No. 254, the blossom of the coal shows, and in the ravine eastward on the Coll farm, No. 255, a little coal is reported to have been dug. Sandstone also overlies the coal at this point. On the road crossing Glade Run directly west of Weskit the coal shows on both sides, Nos. 256 and 257. At No. 270 the seam underlies about 30 feet of coarse sandstone, and at No. 271 about 2 feet of black shale were seen, carrying streaks of coal 2 inches in thickness. This accords with the character of a seam as reported in an opening in the next ravine to the west, about one-half mile north of No. 257 and 1½ miles south of Walkchalk. At this opening, No. 258, the following section was obtained:

Upper Freeport coal on Glade Run, 1½ miles south of Walkchalk, No. 258 (Pl. VIII, 89).

	Ft.	in.
Coal and shale alternating in one-half to one-fourth inch layers		3 to 4
Shale		6
Coal	1	6
		5 to 6

The coal also makes a large blossom in the road, No. 259, near the bank at which the the above section was obtained. On the J. B. Drake property, on the east side of Glade Run, is a working bank, No. 260, and two old openings, Nos. 261, 262. In a diamond-drill hole on this farm (258) the Upper Freeport coal is 22 feet deep and 3 feet 4 inches thick. In the W. P. Bowser well (259), on the opposite side of the run and south of Walkchalk, the Upper Freeport coal was found at a depth of 210 feet, and the seam consists of 1 foot 4 inches of coal and slate. The foregoing facts would indicate that the seam is irregular in thickness in this vicinity, and is liable to contain so much shale as to be practically worthless.

On the road running northward from the Drake property, No. 263, the coal makes a good showing underneath heavy sandstone. Along the road for a mile east of Walkchalk the coal shows at several points, Nos. 264 to 265, and is overlain by flaggy sandstone. At No. 264 the showing is large, indicating a thickness of about 4 feet, though the character of the seam could not be determined. About one-half mile north of Walkchalk the coal makes a good showing near the road intersection, No. 266, and is closely overlain by a considerable thickness of Mahoning sandstone. About 2 miles northwest of Walkchalk the coal shows in the road, No. 267, and one-half mile beyond is a bank, No. 268, at which the following section was obtained:

Upper Freeport coal 2 miles northwest of Walkchalk, No. 268 (Pl. VIII, 90).

	Ft.	in.
Coal	3	
Shale	1	4
Coal	1	
	5	4

Near the level of Glade Run, about 1½ miles north of Walkchalk, No. 269, the coal has been opened and is reported 3 feet thick. It probably lies just above creek level for about 1 mile above this point and then begins to rise rapidly toward Cowansville. It shows as an apparently thin bed in the road, No. 270, and again on the top of the hill just south of

the bridge over the railroad track at Cowansville, No. 271. On the hill south of Cowansville post-office, Nos. 272, 273, it also shows as a bed apparently 1 foot thick. About 1 mile east of Cowansville station its blossom was seen in the road, No. 274. About 2 miles northeast of Cowansville the coal makes a good showing near the crest of a ridge, No. 275.

BRUSH CREEK COAL.

The Brush Creek coal shows at a number of points in the Glade Run basin, a few of which are here indicated. It shows in the road as a black shale with streaks of coal about 1½ miles slightly northeast of North Buffalo post-office, No. 276, and about 2 miles farther north along the same road, No. 277. West of Weskit it was noted at two points, Nos. 278, 279. About 1 mile east of Walkchalk, No. 280, it is associated with black shale outcrops and is several feet thick. It shows at other points also, but enough has been said to enable prospectors to identify it, so that they may not be misled into the expenditure of time and money in an effort to develop it, for it is everywhere worthless.

COALS IN ALLEGHENY BASIN WEST OF THE RIVER.

MERCER COAL.

What may be the Mercer seam is exposed in the bed of Limestone Run about one-half mile above its mouth, No. 281, where from 1 to 2 feet of coal was seen. The same coal outcrops in the bank opposite East Brady, No. 282, as a double bed in the midst of shale. It is of no value.

BROOKVILLE COAL.

The Brookville coal makes a good showing in the road on the bluff of the Allegheny opposite Rimer, No. 283, but is not known to the writer elsewhere in this basin.

CLARION COAL.

The Clarion coal is of no value in the Allegheny basin so far as known. It shows at the foot of the bluff just north of Applewold, No. 284, where the following section was obtained:

Clarion coal at Applewold, No. 284 (Pl. VI, 10).

	Ft.	in.
Coal	1	
Shale		10
Coal		8
	2	6

Only a few feet away the lower bench has disappeared and the upper bench only, underlain by 3 feet of clay, was seen. The blossom of the coal was seen at the mouth of Limestone Run, No. 285, and again in the road opposite Rimer, No. 286. Platt[a] reports it 1 foot thick in the ravine of Whiskey Run in Bradys Bend Township.

LOWER KITTANNING COAL.

The Lower Kittanning is the most important seam in the Allegheny basin. It rises from water level a short distance below Kittanning, and crops out at road level at Applewold, where there are several old openings, Nos. 287 to 291. North of Applewold it has been worked in the bluff at Nos. 292, 293, and nearly opposite Ewing are three openings, Nos. 294 to 297, at which the coal is 3 feet thick. In the next ravine, No. 295, one-half mile to the north, the coal is opened at a number of points and is from 2 feet 6 inches to 3 feet thick (Pl. VI, 14). In the second ravine below the mouth of Limestone Run the coal is reported to be 3 feet thick, but the exact point is not known to the writer. This coal is exposed along the Buffalo, Rochester and Pittsburg Railroad on Limestone Run at two points, Nos. 296, 297, within 1 mile above the mouth. At No. 297 the coal is over 2 feet thick. The coal here is at or below railroad level, but the railroad is apparently mapped

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 224.

50 feet too low, for the coal is 1,000 feet above the sea. In the A. B. Wyant well No. 1 (270) the coal is 4 feet thick and 190 feet deep, and in the H. E. Zellifrow well (271) it is recorded at a depth of 175 feet. The coal is of good thickness in the vicinity of Adrian, and has been opened at several points both north and south of that place. To the south are two old openings, Nos. 298, 299. On the north is an old opening, No. 300, a working bank, No. 301, and an old pit, No. 302. At No. 299 the coal is 4 feet thick, at No. 301 it is 3 feet 8 inches thick (Pl. VI, 15), and at No. 302 is 3 to 4 feet thick.

In the George McCracken well (272) about 1 mile northeast of Adrian the Lower Kittanning is reported 4 feet thick at a depth of 170 feet. In the vicinity of Morrows Corner are a number of old openings, Nos. 303 to 305. At the Helm bank, about 1 mile west of Morrows Corner, No. 306, the seam runs from 3 feet to 3 feet 6 inches solid coal (Pl. VI, 16), and three-fourths of a mile northwest of this bank is another old opening, No. 307. About 2 miles west of the last-named point, near one of the head streams of Huling Run in eastern Sugar Creek Township, the coal is reported 4 feet thick in the S. F. Booher well No. 2 (228) at a depth of 110 feet, and in the James Crawford well (227) it is reported at a depth of 100 feet. At No. 308 a good blossom was seen, underlain by clay, that probably indicates the presence of the Lower Kittanning seam.

In a ravine near the boundary between the quadrangles, three-fourths of a mile north of the river, No. 309, the coal is worked and shows the following section:

Lower Kittanning coal three-fourths of a mile north of the river near quadrangle boundary, No. 309 (Pl. VI, 17).

	Ft.	in.
Coal	1	10
Coal with thin partings	1	
Coal	1	8
	4	6

In the Rural Valley quadrangle, one-half mile east of the boundary, is an old opening, No. 310, just above the railroad track. About 1 mile above the railroad bridge at Mosgrove, No. 311, is a bank in which the coal is reported 4 feet 4 inches thick, but in another bank close to this the coal is thinner. The seam in this locality is overlain by heavy sandstone and is probably somewhat irregular in thickness. The coal is opened in a ravine 2 miles farther north, No. 312, and in the next ravine, 1½ miles still farther north, No. 313. West of Mahoning, one-half mile north of the last-named point, are three openings, Nos. 314 to 316. At the first of these the section below is measured:

Lower Kittanning coal west of the river opposite Mahoning, No. 235 (Pl. VI, 18).

	Ft.	in.
Bony coal		6
Coal	4	2
	4	8

In the Myers well (283) near Frenchs Corner the coal is 235 feet deep and 4 feet thick, and in the Abraham Chrisman well (287), northeast of Frenchs Corner, it is 230 feet deep and 4 feet thick.

In the Kittanning quadrangle, about 1 mile north of Frenchs Corner, is the Hooks bank, No. 317, at which the coal is 4 feet 4 inches thick. Near by, No. 318, is another old opening, and one-fourth mile west, No. 319, is another bank at which the coal is 3 feet 8 inches to 3 feet 10 inches thick (Pl. VI, 19). On the river bluff about 1¼ miles below Rimer are several openings, Nos. 320 to 322. At No. 322 the coal is reported to run from 2 feet to 3 feet 8 inches in thickness. In the ravine, about three-fourths mile south of Peach Hill, No. 323, the coal has been worked and is reported 4 feet thick, and on the road from Peach Hill down the river bluff opposite Rimer is an old pit, No. 324, at which the coal is also

reported 4 feet thick. Platt[a] states that the coal is 4 feet thick in the vicinity of Sherrett. There is a working bank in the ravine northeast of Sherrett, No. 325, an old working just to the north, No. 326, and on the edge of Sugar Creek Township, 2 miles northwest of Sherrett, No. 327, is another old pit. On the river bluff 2 miles south of Wattersonville is a mine, No. 328. In the ravine of Huling Run, about 1 mile southwest of Wattersonville, No. 329, and in the ravine of Snyders Run, about 1½ miles above its mouth, No. 330, are old openings. South of the river, about 1 mile above Phillipston, is the Keystone mine, at which the Lower Kittanning seam is from 3 feet 6 inches to 4 feet thick. In the ravine of Harts Run the coal shows at Lacys Store, No. 331, and at a number of points below, Nos. 332 to 334, it has been worked to some extent. On Holder Run the coal has been opened one-half mile above its mouth, No. 335. On Sugar Creek, in the vicinity of Kaylor, the Great Lakes Coal Company is opening four mines in this seam—the Snow Hill, Pine Run, Braneman, and Kaylor mines, the latter being a slope. The coal in this locality runs about 4 feet thick, as shown in the natural exposure at creek level just east of Kaylor, No. 336. The coal is reported in the Amos Steele well (245) and the Kepple well (246) south of Kaylor. In the former it is 4 feet thick at a depth of 320 feet, and in the latter 3½ feet thick at a depth of 310 feet. On Pine Run, about 2 miles above the mouth, is an old pit, No. 337, and on Cove Run is another near the northern edge of the quadrangle, No. 338. North of the river, east of East Brady, No. 339, is another old working, while still farther east, No. 340, is a working bank in which the seam is 2 feet 7 inches thick (Pl. VI, 20).

The preceding description shows that the Lower Kittanning coal is under nearly the whole surface of this basin, and is of minable thickness throughout. It is regretted that nothing can be said here of the quality of the coal, but there is no reason to doubt that it is as good as the average Allegheny coal for steaming and fuel purposes.

MIDDLE KITTANNING COAL.

The Middle Kittanning coal seems to be of possible value only in portions of Washington township. In the bluff north of Applewold, Nos. 341 and 342, it is exposed and is 1 foot 3 inches thick (Pl. VII, 43). This probably is fairly representative of the character of the seam throughout most of the area of the quadrangles. North of the mouth of Limestone Run, near the boundary, Nos. 343, 344, its blossom was noted, and along the Buffalo, Rochester and Pittsburg Railroad in the valley of Limestone Run the coal is exposed as a thin seam at two points, Nos. 345, 346. One-half mile south of Adrian, No. 347, is an old opening in this coal, and the same distance southwest of Adrian is another old opening, No. 348, and an exposure in the road, No. 349, where the coal shows about 2 feet thick. About 1 mile southeast of Morrows Corner, Nos. 450, 451, are two old pits apparently in this coal, but there is a possibility of mistake in the identification of the coal seams in this locality and that the coal at the points given above is Lower instead of Middle Kittanning.

In the William Johns well (285), north of Frenchs Corner, what appears to be the Middle Kittanning seam is reported 4 feet thick at a depth of 166 feet. Near the head of Limestone Run, No. 452, coal fragments were noted, and one-half mile west is an old opening across the ravine north of the road, No. 453. This seam is probably to be regarded as Middle Kittanning. North of Morrows Corner the blossom of this coal was noted at several points, Nos. 354 to 356. In the vicinity of Sherrett the coal has been opened at a number of places. From one-half mile to 1 mile south of that place are three old openings, Nos. 357 to 359. At No. 359 the coal is reported 3 to 4 feet thick. Nearer Sherrett it makes a good showing in the road, No. 360. One-half mile southeast of that place, No. 361, is an old opening, and three-fourths of a mile southwest, No. 362, are two old openings. About 1 mile still farther west in eastern Sugar Creek Township, No. 363, fragments of coal prob-

[a] Second Geol. Survey Pennsylvania Rept. H5, p. 228.

ably indicate the presence of this seam. Along the road on the river bluff below Peach Hill, No. 364, the following section of what appears to be this coal was obtained:

Middle Kittanning coal near Peach Hill, No. 364 (Pl. VII, 44).

	Ft.	in.
Coal	3 to 4	6
Slate	1	6
Coal	1	6
	6 to 7	6

Still farther north along this ridge, 1½ miles south of Wattersonville, No. 365, what is regarded as this seam is mined and shows the following section:

Middle Kittanning coal near Wattersonville, No. 365 (Pl. VII, 45).

	Ft.	in.
Coal	3	3
Hard block coal	1	6
	4	9

On Harts Run, just east of Lacys Store, No. 366, a seam 5 feet 2 inches thick is exposed and is apparently Middle Kittanning. In the Amos Steele well (245), south of Kaylor, what appears to be this coal is recorded 5 feet thick at a depth of 280 feet.

UPPER KITTANNING COAL.

The Upper Kittanning coal is a mere thread at the base of the Freeport sandstone on the road up the bluff at Weskit, No. 367, but in the ravine just to the west of Weskit, No. 368, it makes a good showing. In the road up the ravine west of the river opposite Ewing, No. 369, the coal is reported 1 foot 6 inches thick, and near the head of the ravine west of the river three-fourths mile above Ewing, No. 370, what is probably this coal makes a large showing. One mile southeast of Adrian are two old pits in this coal, Nos. 371 and 372. One-half mile north of Adrian the coal shows in the road, No. 373, and one mile northeast of the last-named point, No. 374, it is exposed to a thickness of 2 feet. One-half mile north of Frenchs Corner the Upper Kittanning coal shows in the run, No. 375, and near by, No. 376, is an old pit, where it is reported 3 to 4 feet thick. About 2 miles northeast of Frenchs Corner, in the Rural Valley quadrangle, what is probably this coal makes a small showing in the road, No. 377. In the Miller Bowser well (284) and in the Myers well (283) this coal is reported. In the former it is 5 feet thick at a depth of 240 feet, and in the latter 3 feet at a depth of 140 feet.

Near the hilltop, about 1½ miles northeast of Morrows Corner, No. 370, the Upper Kittanning coal is now worked and is reported 4 to 5 feet thick. Near the road on the river bluff below Peach Hill, No. 379, the coal has been opened and is reported 4 feet thick, but irregular and soon thinning to nothing. About one-half mile southwest of Peach Hill No. 380, are two old openings, and three-fourths of a mile farther west are others, Nos. 381, 382. At No. 381 the following section is reported:

Upper Kittanning coal south of Sherrett, No. 381 (Pl. VII, 51).

	Feet.
Coal	4 to 6
Shale	1
Coal	2
	7 to 9

At No. 382 the coal is reported 7 feet thick with 1 foot of shale in the middle. In this locality Platt[a] reports the following section:

Upper Kittanning coal south of Sherrett (Pl. VII, 52).

	Ft.	in.
Coal	3	2
Shale	1	3
Coal		6
	4	11

Along the road east of Sherrett are two old openings, Nos. 383, 384. About three-fourths of a mile west of Sherrett, No. 385, and on Snyders Run, about 3 miles above its mouth, No. 386, are other old openings in this same coal. The Ganner mine at Somerville, No. 387, is noted in the region for the great thickness attained by the Upper Kittanning seam. Platt[b] (H5, p. 222) published the following section measured at this mine:

Upper Kittanning coal, Ganner mine, Somerville, No. 387 (Pl. VII, 53).

	Feet.
Bituminous coal	2 to 5
Cannel slate	0 to 7
	2 to 12

Platt[b] says of the seam here and in the region generally:

The Kittanning Upper coal seam occurs almost directly underneath the Freeport sandstone. Ten inches thick along the river front, it receives a rider of cannel slate in the ravine of Holder Run, becoming upward of 12 feet thick. The bed generally is obscure. The cannel slate exists only in irregular depressions or concavities, similar to those already described in connection with the same Kittanning Upper seam at Bostonia on the Redbank and at Mrs. Thompson's on the Little Mudlick. Out of the depressions the bed is sometimes scarcely more than a streak in the rocks. A good exhibition of its cannel-slate feature may be had at the Ganner mine in the ravine of Holder Run, at which place the bed is 2 feet thick at the outcrop, increasing within a short distance to 5 feet, all bituminous coal of a fairly good quality. The floor of the seam then rapidly descends at an angle of 10° to a depth of 7 feet, the roof meanwhile remaining horizontal. The interval between is gradually occupied by mass of impure cannel slate of a dull luster and having a conchoidal fracture. The bed being below the water level of the run, difficulty is encountered in draining the mine, which fact has put a stop to the developments in that direction, leaving the limits of the cannel-slate deposit a matter of conjecture. The "cannel," however, is of no value, being much too impure even for domestic purposes. The over- and underlying strata are so well exposed on the Ganner property that the geological horizon of the cannel-slate deposit can there be satisfactorily determined.

It is evident that the thickness reached in the Ganner mine is not persistent over any great area, since it does not show in outcrop in the bluff one-fourth mile below the mine, where the rocks are well exposed. In the Kepple well (246), south of Kaylor, this coal is reported 2 feet thick at a depth of 235 feet. Just north of Kaylor is a working bank, No. 388, and about 1 mile northeast, No. 389, is an abandoned working.

LOWER FREEPORT COAL.

The Lower Freeport coal is not much known south of Weskit in this basin. Along the road one-half mile south of Weskit, No. 390, its blossom was observed, as also in the road one-half mile to the west of that place, No. 391. At Weskit, No. 392, and a little farther north, No. 393, its blossom was noted, and at the latter place it makes a good showing. About 1½ miles northwest of Weskit, No. 394, is an old opening, and in the road one-fourth mile east of the latter point, No. 395, the coal makes a good showing and is probably 3 feet or more thick. No further traces of this coal were seen along the river north of this point. On the hill south of Adrian its blossom was noted in the road, No. 396. About 1 mile east of Adrian, No. 397, and about 1 mile west of Frenchs Corner, No. 398, it also makes a good showing. In the William Johns well (285) north of Frenchs Corner what appears to be this coal 3 feet thick is noted at the depth of 75 feet, and in the Abraham Chrisman well (287) to the northeast it is also reported 3 feet thick at the depth of 60

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 229. [b] Op. cit., p. 222.

feet. At Peach Hill, No. 399, the coal makes a good showing and a thickness of about 3 feet is indicated. About 2 miles west of Sherrett it shows near the crest of a ridge crossed by the highway, No. 400, and also about one-half mile to the north, No. 401. At No. 400 it is apparently 1 to 2 feet thick. The blossom of what seems to be this coal was seen about 1 mile southeast of Lacys Store, No. 402. On the whole, the Lower Freeport coal does not promise much in this area.

UPPER FREEPORT COAL.

The Upper Freeport seam is of good thickness over most of the areas underlain by it in this basin. In the river bluff opposite Ford City the coal appears to be pinched out, at least locally, as shown by the fact that at one point on its outcrop, No. 403, it is only about 6 inches thick. Near the road 2 miles to the north, across the river from Manorville, No. 404, it is thicker and overlain by the Mahoning sandstone. Below is a section measured at this point:

Upper Freeport coal opposite Manorville, No. 404 (Pl. VIII, 91).

	Ft.	in.
Shaly coal	1	3
Coal		6
Clay		2
Slaty coal		6
Coal	2	6
	4	11

One-half mile west of Weskit the blossom of the coal was seen in the road, No. 405, and one-half mile northwest of this point it was recorded in the Blair well (257) 90 feet below the surface. Just north of Weskit it makes a blossom in the road, No. 406, and about 1 mile farther north it shows at points, Nos. 407, 408. About 2 miles northwest of Ewing are two old pits, Nos. 409, 410. Along the road south of Adrian the coal is known at several points. Near the head of the first ravine west of Limestone Run, No. 411, is an old bank, and in the next ravine to the north, No. 412, is another. The blossom of the coal was noted on the north side of this ravine, No. 413, and over the ridge beyond, three-fourths of a mile south of Adrian, is another old opening, No. 414. About 1 mile southwest of Adrian, No. 415, is an old bank, and to the north the blossom was observed at three points, Nos. 416, 417, 418. One mile north of the mouth of Limestone Run, No. 419, the coal makes a good showing in the road, and in the ravine one-half mile northeast, No. 420, is an old pit. Just across the boundary in the Rural Valley quadrangle, about three-fourths of a mile west of West Mosgrove, No. 421, is a bank at which the following section was measured:

Upper Freeport coal west of West Mosgrove, No. 421 (Pl. VIII, 92).

	Ft.	in.
Coal, three thin partings		9
Coal	3	
	3	9

On the hill about one-third of a mile northwest of the railroad bridge at Mosgrove is an old opening, No. 422. One-half mile south of Frenchs Corner, No. 423, is another, and on the ridge nearly opposite Templeton, No. 424, is another, at which the coal is reported about 2 feet thick and poor. It is reported generally poor to the northeast of Frenchs Corner. In the James Toy well (273), southwest of Frenchs Corner, the coal was penetrated at the depth of 110 feet and is 4 feet thick. On a knob one-half mile south of Peach Hill, No. 425, is an opening at which the seam is 5 feet thick, with many thin partings of shale (Pl. VIII, 93).

At Peach Hill the coal makes a good showing on both sides of the ridge, No. 426. About one-half mile northeast of Sherrett the coal is exposed near the top of a knob, No. 427. Still farther north along the ridge west of the river is an old opening, No. 428, and a good

blossom, No. 429. On a knob crossed by the Washington-Sugar Creek boundary, 2½ miles north of Cowansville, is a small area of the seam which has been opened at No. 430. On the Crawford farm, 1 mile west of Sherrett, Platt[a] obtained the following section:

Upper Freeport coal on Crawford farm 1 mile west of Sherrett (Pl. VIII, 94).

	Ft.	in.
Coal	2	1
Shale		2
Coal	1	6
	3	9

The exact location of this bank can not be determined.

About 1¼ miles west of Sherrett, No. 431, the blossom of the coal was seen, and on the knob about 2 miles west of Sherrett the coal was noted at four points, Nos. 432 to 435. At No. 435 is an old pit at which the coal is reported 4 feet 2 inches thick. About 1 mile south of the mouth of Snyders Run, No. 436, a good blossom of the Upper Freeport coal was seen in the road. Within 1 mile northeast of Browns Crossroads is an old pit, No. 437, at which the coal is reported 4 feet thick. Just south of the ridge from the last-named point, No. 438, a blossom was seen in the road, and there is another old opening, No. 439, one-half mile to the west. A little over a mile to the northeast of Adams the coal was observed at three points, Nos. 440 to 442. At the first and last of these points the blossom was noted and at the other is an old pit. About 1 mile southeast of Lacys Store, No. 443, the coal makes a large blossom, and about one-half mile west of this point, No. 444, about 1 foot 6 inches of coal was observed. Near the road one-half mile southeast of Lacys Store, No. 445, is an old pit, and 1 mile to the east near the Keystone mine the blossom of the Upper Freeport coal was observed in the road, No. 446. On the knob at the apex of the river bend at East Brady, No. 447, the coal has been worked in connection with its underlying iron ore. About a mile to the west, on the hill west of Holder Run, No. 448, is an old opening. The following section published by Platt[b] was obtained somewhere in this general region, but the exact location is unknown:

Upper Freeport coal at Bradys Bend (Pl. VIII, 95).

	Ft.	in.
Coal	1	
Fire clay and roof slate	1 to 1	6
Coal	2	4
Slate		3
Coal	1	10
Shale	2	6
Coal		4
	9 to 9	3 to 9

Just west of Somerville are two old pits, Nos. 449, 450. To the south and southeast of Kaylor are the Barnhart and Reese mines in the Upper Freeport coal. In the Amos Steele well (245) and the Kepple well (246) in this vicinity, the coal is recorded at a depth of 100 feet, being in the former 5 feet and in the latter 3 feet thick. To the west the blossom of the coal was seen about 1 mile southwest of Kaylor, No. 451, and one-half mile east of Kepples Corners, No. 452, is an old opening. Near the northern margin of this quadrangle, northwest of Kaylor, is an old opening, No. 453. About 1 mile east of Karns are three old openings, Nos. 454 to 456. About 1 mile south of Karns is the Enterprise mine, in which the coal is 4 feet to 4 feet 6 inches thick (Pl. VIII, 96). Just southwest of this mine, No. 457, is an old opening at which the coal is said to be 3 feet thick. About 1½ miles southwest of Karns are two old pits, Nos. 458, 459, and near by, No. 460, the coal makes a good showing in the road. About one-half mile southwest of Karns are two old mines, No. 461. To the northwest of Karns are several old openings, Nos. 462 to 463, and one working bank, No. 464.

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 228. [b] Op. cit., p. 219.

BRUSH CREEK COAL.

The Brush Creek coal is exposed at the road intersection one-half mile south of Frenchs Corner, No. 465, and appears to be over 1 foot thick. It also makes a small blossom in the road one-half mile north of Frenchs Corner, No. 466, and about 1 mile northeast of that place, No. 467.

COALS IN ALLEGHENY BASIN EAST OF THE RIVER.

None of the coals below the Lower Kittanning coal are of any value in this territory, but a few points are indicated where they were observed.

POCONO COALS.

Two or three thin seams of impure coal outcrop in the Pocono formation in the river bluff above Mahoning, No. 468. None of them exceeds 1 foot in thickness. These coals also show along the incline of the Riverview mine north of Cosmos at 80 to 100 feet above the Allegheny Valley Railroad.

MERCER COALS.

What may be Mercer coal is reported in the Thomas Smith well near Ford City (300) and in the George Aye well (302). In the former it is recorded 3 feet thick at the depth of 380 feet, and in the latter 7 feet thick at 470 feet. The thin streaks and pockets of coal occurring at the base of a heavy sandstone along the road on the bluff between Templeton and Mahoning, No. 469, are referred to this group, and so also are two seams 8 and 12 inches thick at 227 and 235 feet above the railroad in the section along the incline at the Riverview mine, and a thin coal or coaly shale on the bench southeast of Redbank station, No. 470.

BROOKVILLE COAL.

What is probably the Brookville coal crops out in the river bluff between Templeton and Mahoning, about 200 feet above the railroad track, No. 471. It is apparently 2 to 3 feet thick.

CLARION COAL.

The Clarion coal is revealed as a thin seam 6 inches to 1 foot thick in connection with the clay workings at Wickboro, Ewing, and Cowanshannock station, and at Templeton. It is of no value.

LOWER KITTANNING COAL.

The Lower Kittanning coal is apparently over 200 feet below the surface and 3 to 5 feet thick in the southeast corner of the Kittanning quadrangle, as shown in the following records of deep wells in the vicinity of Ford City:

Lower Kittanning coal in wells near Ford City.

Name of well.	Depth.	Thickness.
	Feet.	*Feet.*
Logan well (291)	360	3
John Heilman well (293)	225	5
Montgomery No. 2 well (299)	294	4
Jacob Hobaugh No. 1 (305)	115	5

The coal rises from water level just below Kittanning and is revealed in the quarries of the Kittanning Clay Manufacturing Company about 75 feet above the river, at which point

it is 3 feet 6 inches thick (Pl. VI, 21). At the old Reynolds quarries, the location of which is unknown to the writer, Platt [a] obtained the section given below:

Lower Kittanning coal, Reynolds quarries, Kittanning (Pl. VI, 22).

	Ft.	in.
Coal		10
Bony coal		2
Coal	1	4
Parting (chiefly pyrite)		1
Coal	1	4
Bony coal		4
	4	1

Platt describes the coal as of indifferent quality, as indeed the presence of pyrite (the source of sulphur) and bone would indicate.

At Kittanning is the McNees & Painter mine of the Kittanning Clay Manufacturing Company, at which the coal is largely mined for use at the present time. Analysis No. 4 (p. 98) is of a sample from this mine. On the hill east of Wickboro, No. 472, the coal is 3 feet 6 inches thick at a working bank; 1 mile farther north are old mines, No. 473, at which the coal is 4 feet 4 inches thick. Just south of the mouth of the Cowanshannock, No. 474, the seam is now mined and is 4 feet thick (Pl. VI, 23), and across the creek to the north is an old opening, No. 475, and a mine, No. 476. See analysis No. 5 (p. 98) for the composition of the coal at this bank.

On Hays Run, about 1 mile above the mouth, No. 477, the coal is exposed at water level and is overlain by a heavy sandstone. It shows the following section:

Lower Kittanning coal on Hays Run, No. 477 (Pl. VI, 24).

	Feet.
Sandstone with thin layers and pockets of coal	1
Coal	2 to 3
	3 to 4

Near the river, about 2 miles above Mosgrove, No. 478, is an old opening beneath a heavy sandstone, at which the coal is 3 feet 6 inches thick (Pl. VI, 25). Two miles below Templeton, No. 479, there is an abandoned mine at which the coal is 4 feet thick, but reported to be largely a cannel shale. In the ravine to the east of Templeton, No. 480, the following section was measured by the writer at a working bank:

Lower Kittanning coal near Templeton, No. 480 (Pl. VI, 26).

	Ft.	in.
Coal		2
Parting, very thin.		
Coal		2
Parting, very thin.		
Coal		5
Parting.		
Coal		9
Parting (shale)		½ to 1
Coal		6
Parting.		
Coal		2
Parting.		
Coal		2
	2 to 2	4½ to 5

Platt [b] reports this coal 1 foot 6 inches thick in Templeton ravine, which is probably the ravine in which the above measurement was obtained. In the region overlooking the river

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 250. [b] Op. cit., p. 234.

along the bend above Mahoning the coal was observed at the points described below: North of Mahoning is the opening of an old mine, No. 481; three-fourths of a mile farther north is a bank, No. 482; at Nos. 483 and 484 the coal outcrops in the road; and at No. 485 are two old banks. North and east of Rimer the coal has been extensively worked at country banks. The positions of the old openings are indicated by Nos. 486 to 494. At No. 486 is a well-timbered old opening that would indicate a mine of some proportions. About 1½ miles north of Cosmos there is a bank, No. 495, and near by, No. 496, the coal makes a good showing in the road. At the Riverview mine, 1½ miles north of Cosmos, the coal is 3 feet thick. In the ravine to the east, No. 497, is another opening, and 1 mile farther east, No. 498, there is a working bank. North of the Riverview mine are a number of openings, Nos. 499 to 501, and a little north of the last is a working bank, No. 502. The coal runs from 3 to 4 feet in thickness in this region. On the point of the spur at Redbank, No. 503, is an old mine, and in the ravine to the north, No. 504, is an old pit. In the Monarch mine on the river bluff 1½ miles above Redbank the seam is 3 feet to 3 feet 6 inches thick (Pl. VI, 27).

One and one-half miles west of the Monarch mine is an old opening, No. 505. One mile west of Phillipston, No. 506, the following section was measured in a working bank:

Lower Kittanning coal 1 mile west of Phillipston, No. 506 (Pl. VI, 28).

	Feet.
Bony coal	2
Coal	3
	5

From East Brady northward along the river bluff are a number of old workings, Nos. 507 to 512. It is shown by the foregoing description that the Lower Kittanning coal is of workable and generally of good thickness throughout all this region.

MIDDLE KITTANNING COAL.

The Middle Kittanning coal was scarcely recognized in this area, and is probably of little or no value. Its blossom shows in the road one-half mile west of Phillipston, No. 513.

UPPER KITTANNING COAL.

The UpperKittanning coal is practically unknown, and probably is of little value, in this territory. In the Thomas Smith well (300), before mentioned, what seems to be this coal is reported 4 feet thick at a depth of 246 feet. It shows in the bluff of the river just north of Garrett Run, No. 514, as a mere thread in sandstone, and along the trolley road a little farther north, No. 515, as a seam 4 to 6 inches thick. In the ravine at the southern end of Kittanning, No. 516, it also makes a small showing, as it does in the road above the cemetery at the north end of town, No. 517. On a knob north of Mahoning station the coal makes a large showing, No. 518, and is apparently 2 to 3 feet thick. Near Tidal, in the northwest corner of the Rural Valley quadrangle, No. 519, it is a bony coal 2 feet 6 inches thick (Pl. VII, 54).

LOWER FREEPORT COAL.

Very little is known of the Lower Freeport coal in the region, and it is probably of little value. What is regarded as this seam is noted in wells near Ford City, as follows:

Lower Freeport coal in wells near Ford City.

Name of well.	Depth.	Thickness.
	Feet.	*Feet.*
Logan (291)	244	4
Charles Heilman (294)	125	5
George Aye (302)	120	6

It is exposed 1 foot thick along the trolley road between Garrett Run and Kittanning, No. 520. In the ravine already mentioned at the southern end of Kittanning, No. 521, it is represented by a bed of black, fossiliferous shale several feet thick. In the road east of Kittanning, No. 522, it makes a good showing, and in the ravine a short distance to the east, No. 523, are old openings that appear to be in this coal. In the road above the cemetery, No. 524, it shows well, and in this vicinity Platt[a] obtained the following section:

Lower Freeport coal near pike northeast of Kittanning, No. 524 (Pl. VII, 66).

	Ft.	in.
Coal	3	
Shale		3
Coal		6
Shale	6	
Coal	3	8
	13	5

The upper bench of coal is somewhat slaty, but the lower is good coal. According to Platt[a] the seam was opened at another place near by, but had thinned down to a few inches. These facts indicate that the seam is exceedingly variable in this locality and probably of little value.

Near the head of Hays Run, No. 525, this coal is exposed in the road to the thickness of 1 foot 6 inches, and it may be thicker. High up on the bluff of the Allegheny, about 3 miles above Mosgrove, No. 526, the coal is exposed about 20 feet below the Upper Freeport coal, and is 2 feet 6 inches thick (Pl. VII, 67). This coal may probably be disregarded as an economic factor in the region.

UPPER FREEPORT COAL.

The Upper Freeport is a valuable coal throughout the eastern part of the Allegheny basin. It is under nearly all the area in the southern portion, but its extent in the northern part is small, being confined to a few high hilltops. At the southern end of Ford City it outcrops in the bluff, No. 527, and is mined in a ravine 2 miles east of that place, No. 528, where it is 3 feet 7 inches thick (Pl. VIII, 97). It is exposed and of good thickness along the road on the face of the bluff north of Ford City, No. 529, and in the ravine one-half mile to the east, No. 530, is an old pit. In the Crytzer well, just across the boundary in the Rural Valley quadrangle, it is reported 6 feet thick at a depth of 175 feet. In the vicinity of Manorville Platt[b] reports this coal 3 feet 6 inches thick on the average. Along Garrett Run and its branch, called Rupp Run, this coal has been opened at a number of points and is of good thickness throughout. About one-half mile east of Manorville is an old opening, No. 531, and the showing in the road near by indicates a thickness of 3 feet. Three-quarters of a mile northeast is another opening, No. 532, at which the coal is said to be about 4 feet thick. At Nos. 533 to 535 are old openings. The coal at No. 534 is near water level and immediately overlain by the Mahoning sandstone. In the next ravine one-half mile to the east, No. 536, is the Miller bank, at which the section below was measured:

Upper Freeport coal at the Miller bank, Garrett Run, No. 536 (Pl. VIII, 98).

	Ft.	in.
Bone and clay		2 to 6
Coal	1 to 1	6 to 10
Clay		½
Coal	2	
	3 to 4	8½ to 4½

[a] Second Geol. Survey Pennsylvania, Rept. H5. p. 253. [b] Op. cit., p. 257.

A short distance south of the Miller bank, at the junction of Rupp and Garrett runs, No. 537, is an opening at which the coal is 3 feet 6 inches thick. One-half mile up Rupp Run is the Hobaugh bank, No. 538, at which the following section was measured:

Upper Freeport coal at Hobaugh bank, Rupp Run, No. 538 (Pl. VIII, 99).

	Ft.	in.
Coal, with thin clay partings		6
Coal		9
Parting		½
Coal	3	
Parting		½
Coal	2	2
	6	6

The coal here shows considerable pyrite in irregular streaks. One-half mile above the Hobaugh bank the coal is exposed in a ravine, No. 539, and is over 3 feet thick. Still higher up the run, No. 540, the coal has been stripped from the stream bed and near by is an old bank, No. 541. Near the head of Rupp Run the coal was noted in the G. S. Rohrer well (319) at a depth of 80 feet and reported 4 feet thick. Near the head of Garrett Run on the south, at No. 542, the coal was reported. Just below, No. 543, its limestone is quarried, and in the Margaret Wallace well (318) the coal is reported 80 feet deep and 4 feet thick. The coal is worked somewhat extensively at a number of banks along the north side of Garrett Run, Nos. 544 to 548. At the Chambers Heilman bank near the junction of the runs, No. 549, the section of the coal was given by Mr. Heilman as follows:

Upper Freeport coal at Chambers Heilman bank, Garrett Run, No. 549 (Pl. VIII, 100).

	Ft.	in.
Coal	3	4
Bone		2
Coal		6
	4	

Along the south branch of Garrett Run are old openings, Nos. 550 to 554. At the Jacob Stitt bank, No. 555, considerable coal is taken out. The section at this point is given below:

Upper Freeport coal at Jacob Stitt bank, Garrett Run, No. 555 (Pl. VIII, 101).

	Ft.	in.
Bone		9
Coal	3	2
	3	11

Just east of the Stitt bank are old pits, No. 556. Beyond this point the coal begins to rise more rapidly toward the axis of the Greendale anticline to the east, and can be traced along the road for some distance, but is lost sight of near point No. 557. The Upper Freeport seam in this region can probably be depended upon to yield about 3 feet 6 inches of good coal, and the topographic and structural conditions are very favorable for mining it.

In a ravine one-half mile northeast of Garrett Run, No. 558, and above the road between Garrett Run and Kittanning the coal has been opened, No. 559. In the ravine followed by the Indiana pike over the hill southeast of Kittanning, No. 560, the coal was extensively mined at one time, but the mine is now abandoned, probably owing to the fact that the mine was driven down the dip, and the difficulty of draining by drifts at lower levels was found too great. Going northward the coal shows below several feet of flaggy sandstone in the ravine at the south end of Kittanning, No. 561; its blossom shows in the road east of town, No. 562, and there is an old opening in it on the road to the northeast, No. 563.

According to Platt[a] this coal runs from 3 feet 6 inches to 4 feet in thickness in this locality, in some places with thin shale partings.

North of the mouth of Cowanshannock Creek are old openings, No. 564, and a working bank, No. 565. To the east, along Hays Run, is an old opening, No. 566, and a working bank on the farm of Caspar Reed, No. 567, at which the coal is 4 feet thick (Pl. VIII, 102). The coal is here quite closely overlain by Mahoning sandstone. Just across the run from Reed's bank is an old opening, and near by the coal is exposed in the road, No. 568. One-half mile farther up the run is a bank on the Banks property, No. 569. Near the mouth of Hays Run on the north is the Mosgrove mine, of which an opening is shown, No. 570. The coal at this mine varies in thickness from 3 feet to 3 feet 10 inches, with an average of about 3 feet 6 inches. It is more or less affected by rolls or horsebacks of sandstone, which cut out the coal locally and add considerably to the expense of mining. Analysis No. 26 (p. 98) is of a sample from this mine. About one-half mile to the north of the Mosgrove mine is an old opening, No. 571. One mile above the mouth of Pine Creek the blossom of the coal shows in the road, No. 572, and still farther north in the river bluff, No. 573, it is exposed beneath the Mahoning sandstone, which is 40 to 50 feet feet thick, while the coal is 3 to 4 feet thick. Still farther north, No. 574, the coal is mined at a bank on the river bluff 1½ miles south of Templeton, the coal being 2 feet 2 inches to 2 feet 4 inches thick (Pl. VIII, 103). It is overlain by 10 feet of rusty shale, and this in turn by 10 feet of flaggy sandstone. In the ravine about 1 mile southeast of Templeton, No. 575, the following section was measured at a bank:

Upper Freeport coal east of Templeton, No. 575 (Pl. VIII, 104).

	Ft.	in.
Bone and coal		2
Coal with three or four partings	2	11
	3	1

The coal is here overlain by rusty shale and this in turn by flaggy sandstone. On the hill between Templeton and Dee, No. 576, is another bank, at which the coal is 2 feet 8½ inches thick, with an inch of bone at top. North of this locality the coal occurs only on a few knobs in Madison Township in both Armstrong and Clarion counties. South of Redbank Creek it has been opened at two points, Nos. 577 and 578, but nothing was learned of its character or thickness. Just to the north of these openings its blossom shows in the road at two points, Nos. 579 and 580, and at the latter point a thickness of at least 2 feet is indicated. Along the ridge east of East Brady the coal shows in the road at several points, Nos. 581 to 583. Just to the south of the latter point are old banks, No. 584, with indications of extensive mining, and one-half mile to the north is another old mine, No. 585.

BRUSH CREEK COAL.

The Brush Creek coal is present in the southern part of this basin, and a few points are indicated at which it was observed: Southeast of Ford City, No. 586; about 1½ miles to the east, No. 587, and on the Indiana pike on the hillside, where it descends into the valley of Rupp Run, No. 580. The coal is of no value here. South of the head of Hays Run this coal is exposed in the road, No. 589, appearing to be about 2 feet thick, and about three-fourths of a mile to the east the same seam has been opened and worked on the A. C. Ellenberger farm, No. 590. Mr. Ellenberger reports the coal 2 feet 6 inches thick and of excellent quality. This is the only place in the quadrangles where the coal is known to be of minable thickness.

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 256.

COALS IN THE COWANSHANNOCK BASIN.

So far as known the lower coals have little or no value in this basin. The few facts known, however, may be of sufficient interest to warrant giving them.

BROOKVILLE COAL.

The Brookville seam outcrops near creek level just below the point where the creek is crossed by the axis of the Greendale anticline, No. 591, where it is 6 inches thick and associated with black shale. What is probably this seam is noted in the D. A. McAfoose well (465), 2 miles north of Yatesboro, at the depth of 455 feet. The coal is reported 5 feet thick, but it is probable that this thickness is mostly black shale.

CLARION COAL.

In a ravine one-half mile east of Stone House, No. 592, the Clarion coal outcrops and is 6 inches thick. Its clay shows by the roadside near the axis of the anticline, No. 593, and the coal is again exposed above Greendale at creek level, No. 594, where it is a few inches thick

LOWER KITTANNING COAL.

The outcrop of the Lower Kittanning coal in this basin is of small extent. Over most of the area it is deep beneath the surface, and knowledge of it has been gained entirely from deep-well records, in a few of which it has been identified with a greater or less degree of certainty. The coal outcrops from the mouth of the creek to the boundary between the quadrangles, at which point it dips below water level toward the axis of the Fairmount syncline, where it is 100 feet below the surface. It rises eastward from this axis and emerges from cover one-half mile east of the boundary between Rayburn and Valley townships; thence it outcrops along the valley to a point 1 mile east of Greendale, where it descends finally below the surface. Along its outcrop west of the Fairmount syncline the coal is good, but east of the syncline the indications are mostly unfavorable.

Near the mouth of the creek the coal has been opened at several points on the south side, Nos. 595 to 597. At No. 597 it is 2 feet 6 inches thick. On the north side of the creek the coal makes a good showing at the road intersection one-half mile above the mouth, No. 598. A little farther up is an opening, No. 599, and at the junction of a ravine from the east, No 600, is an old mine at which the coal was once extensively worked. What is regarded as this coal is exposed 1 foot thick in a cut of the projected trolley road between Kittanning and Rural Valley, about one-half mile east of the Rayburn-Valley boundary, No. 601, and it shows in the bank along the road east of the cut, No. 602. In a ravine one-half mile east of Stone House No. 603, its blossom associated with clay was observed and a considerable thickness was indicated, and in the next ravine to the east is an old opening, No. 604. Its presence is indicated by fragments in the road near the anticlinal axis, No. 605, and about 1½ miles farther east, No. 606, is an old bank at which considerable coal has evidently been taken out. This may be the Rhea bank, at which Platt[a] reports the seam to vary from 2 feet 6 inches to 4 feet in thickness. Analysis No. 7 of the table (p. 98) is of a sample from this bank.

This coal is noted in the following wells in the basin:

Lower Kittanning coal in wells in Cowanshannock basin.

Name of well.	Depth.	Thickness.	Name of well.	Depth.	Thickness.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Peter Heilman No. 2 (313)	225	4	Burns (418)	388	5
George L. Blose (315)	220	.....	Reisinger (450)	105	6
McElroy (316)	375	3	Gourley heirs (453)	320	3
Collum No. 1 (321)	295	5	Brown (473)	330	3

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 96.

MIDDLE KITTANNING COAL.

The blossom of the Middle Kittanning coal appears in the road 1½ miles northeast of Kittanning, No. 607, and was seen in the bank at the road intersection one-half mile east of Rayburn-Valley boundary, No. 608. In the ravine before mentioned one-half mile east of Stone House, No. 609, it is exposed and is 1 foot 6 inches thick. A coal that appears to be in the position of the Middle Kittanning is noted in the John Boyer well (416) in Plum Creek Township at the depth of 515 feet.

UPPER KITTANNING COAL.

The blossom of this coal was seen in roads leading down to Cowanshannock Creek, 1½ miles northeast of Kittanning, Nos. 610 and 611. It was noted at a few points above McNees on Mill Run, Nos. 612 to 614. At No. 612 is an old pit that seems to be at the level of this coal. At No. 613 is an opening at which the coal is 1 foot 6 inches thick, and at No. 614 the coal is exposed in the road and is about 2 feet thick. Along Cowanshannock Creek it is reported about 1 foot thick at J. M. Schreckengost's house, No. 615, and shows by the roadside a few rods beyond. It is exposed in the ravine one-half mile east of Stone House, No. 616, where it is 1 foot 6 inches thick. South of Cowanshannock Creek, east of Greendale, No. 618, it shows in the road and is over 1 foot thick. One mile west of Yatesboro, at road level, No. 614, the coal is worked by Mr. Benjamin Schreckengost, and is reported 4 feet thick. (See analysis No. 16, p. 98, for the composition of the coal at this point.) Mr. Schreckengost regarded his coal as the Lower Freeport, so did Platt[a], but its relations to the Vanport limestone, which is recorded in the Kennerdell and Reisinger wells (449 and 450) near by at 120 and 111 feet, respectively, show that the seam in question more nearly accords in position with the Upper Kittanning.

The Upper Kittanning coal is recorded in a number of wells in this basin as follows:

Upper Kittanning coal in wells in Cowanshannock basin.

Name of well.	Depth.	Thickness.	Name of well.	Depth.	Thickness.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Peter Heilman No. 2 (313)	110	3	Wampler (441)	268	5
Thomas N. Bowser No. 1 (352)	218	4	J. A. Bowser (443)	228	4
Madison Wagoner (420)	400	.....	Gourley heirs (453)	221	7
Jacob Espey (427)	215	.....	William Schreckengost (461)	308	4
Smith (433)	90	4	Brown (473)	210	8

The consistency of these well records, in connection with the observed thickness of the seam at the Schreckengost bank, indicates a possible workable area of Upper Kittanning coal of large extent. Of course the drill records can not be depended on for precise measurements, and reveal nothing as to the character of the seam—whether it is all coal or partly shale—nor as to the quality of the coal. They yield sufficient information, however, to warrant further investigation.

LOWER FREEPORT COAL.

The Lower Freeport seam has a wide extent of outcrop in this basin, and all observations point to the fact that it is probably workable along the whole outcrop, but very little can be said of it in the southeast corner of the Rural Valley quadrangle, where it is under deep cover. In the western part of the basin it runs 50 to 60 feet below the Upper Freeport seam, but in the vicinity of Yatesboro the interval decreases to 30 feet.

West of Cowanshannock Creek, northeast of Kittanning, the coal yields a good blossom in the roads, Nos. 620 and 621. Farther up the creek, in the Rural Valley quadrangle, Nos. 622 to 625, indications of the coal were noted. At Nos. 622 and 624 it shows as a worthless

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 93.

shaly bed a foot or two in thickness. Going southeast along Mill Run the coal increases in thickness and improves in quality. On the road east of McNees, No. 626, it makes a good showing and has been mined. One-half mile above McNees is an old pit, No. 627, and in a ravine about three-fourths mile southeast of the last-named point the coal is exposed in the stream bed, No. 628, apparently 2 to 3 feet thick. North of Mill Run, 1½ miles east of McNees, the coal has been opened in a ravine, No. 629. One mile farther up the run the coal is opened at the Ruffner bank, No. 630, and is 2 feet 6 inches thick (Pl. VII, 68). At a bank, No. 631, up the ravine north of Ruffner bank, the seam shows an identical section. The coal is free from partings, and is of a firm, bright appearance. South of the Ruffner bank is another old bank, No. 632. Farther east, toward the head of Spra Run, the coal has been worked at two points, Nos. 633 and 634, and at No. 634 is 2 feet 7 inches thick (Pl. VIII, 69).

Still farther east, in the valley of Huskins Run, the coal is worked at the Moses Beer bank, No. 635, and is 2 feet 4 inches thick. In the Boyer well (416) and in the P. Rearick well (417), in Plum Creek Township, the coal was noted at depths of 420 and 200 feet, respectively. In the road on Huskins Run, 1 mile north of the mouth, No. 636, the Lower Freeport is exposed over 1 foot thick, and within 1 mile south of Greendale are two old banks, Nos. 637 and 638 North of Cowanshannock Creek the coal was reported to have been opened on the farm of J. M. Schreckengost, No. 639, above the junction of Mill Run. About 1 mile north of this point this seam was penetrated in the William Brunt well (351), 143 feet deep, and reported as the 3-foot vein, possibly denoting that it is 3 feet thick. In a ravine one-half mile east of the Rayburn-Valley boundary is an old opening by the roadside, No. 640, and near the road in a ravine one-half mile farther east the coal is worked on the Robinson farm, No. 641, where it is reported 2 feet 6 inches to 3 feet thick and of excellent quality. Near the head of the ravine three-fourths mile southwest of West Valley the coal is exposed by the stream, No. 642, and has about the thickness given above. Near by Nos. 643 and 644 are old openings. About 1 mile southeast of West Valley the coal is opened by the roadside on the Adams farm, No. 645, and is 2 feet 6 inches thick (Pl. VIII, 70). Near the head of Long Run the Lower Freeport coal makes a good showing in the road, No. 646, and three-fourths mile to the southeast it is worked at Henry Bear's bank, No. 647, and shows the following section:

Lower Freeport coal at Bear's bank, Long Run, No. 647 (Pl. VIII, 71).

	Ft.	in.
Coal	2	
Parting (thin).		
Coal		8
	2	8

In a ravine about 1 mile northwest of Yatesboro, No. 648, the coal is opened, and a thickness of 2 feet is reported. At the Yatesboro No. 2 mine the coal was opened beneath sandstone. It is 30 feet below the Upper Freeport coal and is reported 2 feet 9 inches thick. This seam was penetrated in the following wells north of Yatesboro:

Lower Freeport coal in wells north of Yatesboro.

Name of well.	Depth.	Thickness.
	Feet.	*Feet.*
P. & J. Brown (475)	165	5
Lynes (476)	180	3
William Schreckengost No. 1 (461)	240	4

UPPER FREEPORT COAL.

The Upper Freeport is a good coal throughout the basin and has a great extent of outcrop in the western half. In the eastern half it is under deep cover and lies nearly flat. At the Galbreath bank, northeast of Kittanning, No. 649, the seam has the following section:

Upper Freeport coal at Galbreath bank, No. 640, northeast of Kittanning (Pl. VIII, 105).

	Ft.	in.
Coal, with knife-edge partings	3	
Bone		2
Coal		10
	4	

Analysis No. 22 (p. 98) gives the composition of the coal at this bank. About one-half mile to the east, No. 650, is another opening, at which the seam has the following section showing a great change from its excellent condition in the Galbreath bank:

Upper Freeport coal northeast of Kittanning, No. 650 (Pl. VIII, 106).

	Ft.	in.
Coal	2	
Shale		2
Coal		6
	2	8

The coal has been worked in the ravine east of the old mill 1 mile above the mouth of Cowanshannock Creek, No. 651, and also at the Fritz bank about 1 mile to the south, No. 652, where the seam presents the section given below:

Upper Freeport coal at Fritz bank, northeast of Kittanning, No. 652 (Pl. VIII, 107.)

	Ft.	in.
Coal		2
Thin parting.		
Coal		2
Thin parting.		
Coal		5
Parting		½
Coal	1	
Parting		½
Coal		3
Parting		½
Coal		7
Parting		½
Coal	2	
Parting		1
Coal		6
	5	4

Three-fourths mile southeast of the Fritz bank is an old opening, No. 653, and near by the coal makes a good showing in the road. At the Allison bank, on the Clearfield pike 2 miles east of Kittanning, No. 654, the following section is reported:

Upper Freeport coal at Allison bank, east of Kittanning, No. 654 (Pl. VIII, 108).

	Ft.	in.
Coal	2	8
Coaly shale		2
	2	10

The coal here is reported to swell locally to a thickness of 3 feet 10 inches. Near the Allison bank No. 655, the coal has been opened recently, and on the north side of the creek one-half mile above is an old opening, No. 656. In a ravine on the south side of Cowanshannock Creek three-fourths mile below Mill Run is a bank, No. 657, at which the coal is 3 feet 4 inches thick, with occasional thin clay partings, and near this bank to the southward are old openings, Nos. 658, 659. In a ravine north of the creek opposite the one just

described the coal is of good thickness. Near the mouth is an old opening, No. 660, and a short distance north is the Stewart bank, No. 661, at which the following section was measured:

Upper Freeport coal at the Stewart bank, southeastern Rayburn Township, No. 661 (Pl. VIII, 109).

	Ft.	in.
Coal	2	4
Parting.		
Coal		10
	3	2

Near the head of this ravine is the Miller bank, No. 662, at which the coal is above the average thickness, as shown by the following section:

Upper Freeport coal at the Miller bank, eastern Rayburn Township, No. 662 (Pl. IX, 110).

	Ft.	in.
Bone		3
Coal	2	2
Parting		½
Coal	1	10
	4	3½

On the hillside south of Mill Run one-half mile above its mouth is an old opening, No.663, and on the opposite side of the run to the east are several others, No. 664, indicating that considerable coal has been dug. On the hill one-half mile east of McNees is the Daniel Rosenberger bank, No. 665, at which the following section was measured:

Upper Freeport coal at the Rosenberger bank, Mill Run, No. 665 (Pl. IX, 111).

	Ft.	in.
Coal with two or three thin partings		8
Coal	2	
Clay		½
Coal		11½
	3	8

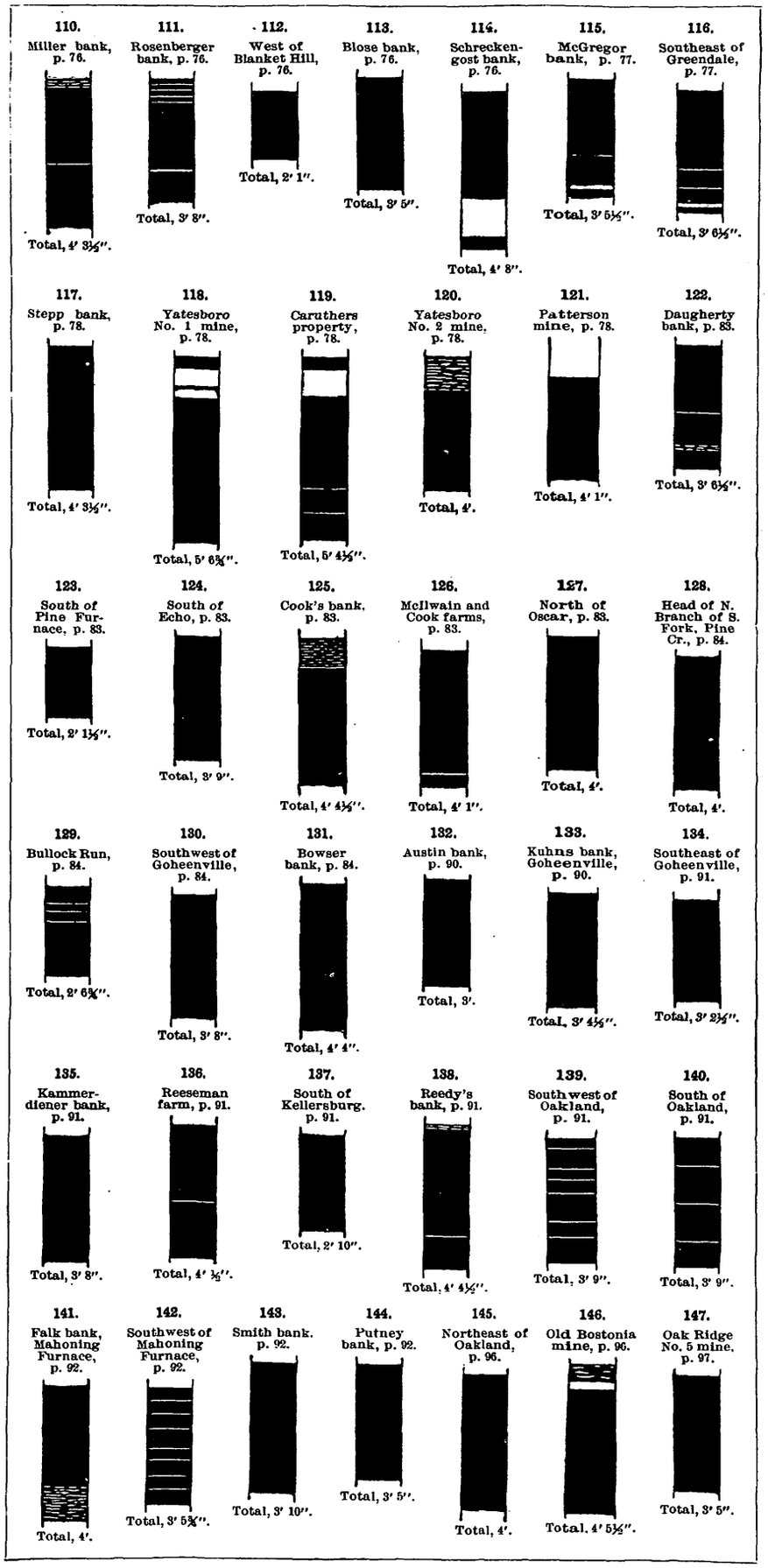
One-half mile south of McNees the blossom of the coal shows in the road, No. 666, and in a ravine one-half mile southeast of this point is an opening, No. 667, at which the coal is reported 4 feet thick. This opening is about 60 feet above the stream bed, where the Lower Freeport coal is exposed at No. 628, and this affords a good measure of the interval between the two seams. In the next ravine west of Blanket Hill near the crossing of the Indiana pike, No. 668, the coal is exposed in the road and 3 to 4 feet thick, and on the east side of the run, No. 669, the coal is opened and is 2 feet 1 inch thick (Pl. IX, 112). The coal here is immediately overlain by the Mahoning sandstone, which is coarse and thick all over the region between this point and Cowanshannock Creek. To the north along the ravine is an old opening, No. 670, and about 1½ miles to the east near the head of Mill Run is another, No. 671.

In the McElroy well (316) southeast of Blanket Hill what is probably this coal is reported 3 feet thick at the depth of 70 feet. Southeast of this well is the Blose bank, No. 672, at which the coal is 3 feet 5 inches thick (Pl. IX, 113).

North of Cowanshannock Creek, above the mouth of Mill Run, the coal is worked on the J. M. Schreckengost farm, No. 673, where the following section was measured:

Upper Freeport coal at the Schreckengost bank, eastern Rayburn Township, No. 673 (Pl. IX, 114).

	Ft.	in.
Coal	3	2
Shale	1	2
Coal		4
	4	8



COAL SECTIONS.

Sections 110 to 147, Upper Freeport coal.

The coal here is overlain by about 10 feet of shale and this in turn by Mahoning sandstone. One-half mile north of the Schreckengost bank is an old bank, No. 674, and still farther north is the McGregor bank, No. 675, where the following section was obtained:

Upper Freeport coal at the McGregor bank, Valley Township, No. 675 (Pl. IX, 115).

	Ft.	in.
Coal	2	3
Parting		½
Coal		10
Shale and bone		2
Coal		2
	3	5½

In a ravine three-fourths mile east of the Rayburn-Valley boundary, on the Robinson farm, No. 676, springs were pointed out as indicating the outcrop of this seam, and near the head of the next ravine on the east, No. 677, another spring was believed to indicate its presence. Near the head of the ravine south of Cowanshannock Creek, 1 mile southwest of Stone House, No. 678, the coal has been stripped and a thickness of 1 foot 6 inches was exposed immediately beneath the Mahoning sandstone. On the opposite side of the spur to the north overlooking Cowanshannock Creek, No. 679, is an old opening. On the crest of the spur between Spra Run and Cowanshannock Creek, No. 680, the coal has been opened and is reported 4 feet thick, but under too thin cover to be workable. In the northeast corner of Kittanning Township is an old opening, No. 681, and a bank, No. 682, the exact location of which is uncertain. Near the head of Spra Run is an old opening, No. 683, at which the coal is reported 2 feet thick. In the Collum well (321) near this point the coal is reported 4 feet thick at the depth of 100 feet. Near the head of the ravine running north from Stone House is an old opening, No. 684, and a working bank, No. 685, on the Barker farm. Near the head of Long Run, No. 686, the blossom of the coal was observed where a ditch had been dug for a pipe line; on the spur 1 mile northwest of Greendale, No. 687, abundant débris of the coal was noted, and there is an opening at No. 688. About 1 mile north of Greendale is an old opening, No. 689, and a bank, No. 690, at which the coal is 3 feet 9 inches thick. Near the road in the ravine south of Cowanshannock Creek one-half mile above Greendale is an old bank, 691, at which the following section was measured:

Upper Freeport coal southeast of Greendale, No. 691 (Pl. IX, 116).

	Ft.	in.
Coal	2	4
Parting		½
Coal		6
Parting		½
Coal		4½
Parting		1½
Coal		1½
	3	6½

Near the point of the spur north of this bank, No. 692, is a working bank, and on the east side of the spur, No. 693, is a bank on the Rosenberger farm, at which the seam is 3 feet 8 inches thick.

Proceeding up Huskins Run an old opening is reached, No. 694. Opposite on the east is a working bank, No. 695, and still farther up are three openings, No. 696, at which the coal is reported 4 feet thick. At Blanco are openings of the Yatesboro No. 1 mine, No. 697. In the ravine to the west of Blanco are old openings, No. 698, and just above at water level, No. 699, the blossom of the coal was seen. Farther west are the McCurdy bank, No. 700, at which the coal is 4 feet thick, and the Stepp bank, No. 701, at which it is 4 feet

3½ inches thick (Pl. IX, 117). A coal seam identified as the Upper Freeport has been penetrated in deep wells of this section of the basin as follows:

Upper Freeport coal in wells in Cowanshannock basin.

Name of well.	Depth.	Thickness.	Name of well.	Depth.	Thickness.
	Feet.	*Feet.*		*Feet.*	*Feet.*
S. & A. McCurdy No. 1 (432)	155	4	A. A. Marshall (424)	70	3
S. & A. McCurdy No. 2 (431)	159	.....	W. C. Devinney (425)	265	5
John Boyer (416)	360	.....	James Peters (445)	270	.....
John Bell (419)	285	.....	J. A. Bowser (443)	155	4
N. H. Duff (421)	294	5	H. Wampler (441)	200	5
Caroline Fisher (423)	75	5			

The Upper Freeport coal is mined on a large scale at Yatesboro by the Rochester and Pittsburg Coal and Iron Company. It crops out on Plum Creek about 2 miles south of Atwood, in the Elders Ridge quadrangle, and at a bank thicknesses of 2 feet 10 inches and 3 feet 6 inches were measured. The coal is also shown to be of good thickness in a number of diamond-drill holes in that locality. Platt collected samples from the Beers bank, in the vicinity of Blanco, which were analyzed with the result shown in No. 28 of the table on page 98. At the Yatesboro No. 1 mine the following section was obtained:

Upper Freeport coal at Yatesboro No. 1 mine (Pl. IX, 118).

	Ft.	in.
Coal		4
Parting		6½
Coal		¾
Parting		3
Coal	4	4½
	5	6¾

The similarity of this section to the one given below, taken from Platt,[a] suggests that his section was measured at the same point:

Upper Freeport coal on the Caruthers property, west of Rural Valley (Pl. IX, 119).

	Ft.	in.
Coal		4
Slate		10
Coal	2	9
Slate (thin).		
Coal		8
Slate		½
Coal		9
	5	4½

The coal undergoes a marked change in crossing the creek about 1 mile to the northeast, where it has the following section at the Yatesboro No. 2 mine:

Upper Freeport coal at Yatesboro No. 2 mine (Pl. IX, 120).

	Feet.
Bony coal	1
Coal	3
	4

This section is also almost identical with that published by Platt[a] of his so-called Gallitzin coal:

Upper Freeport (Gallitzin) coal at Patterson mine (Pl. IX, 121).

	Ft.	in.
Slate, gray and black	1	
Coal	3	1
	4	1

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 91.

Platt published an analysis of the coal at this bank, which is given in No. 27 of the table (p. 98). The seam mined at Yatesboro No. 2 is called Gallitzin by some, who maintain that it is 50 feet above the Upper Freeport coal, but, as shown on page 38 of this bulletin, that contention can hardly be sustained.

The Upper Freeport coal dips beneath water level at Yatesboro, and is at a considerable depth below the surface throughout all the southwest corner of the quadrangle. North of Cowanshannock Creek it is recorded in deep wells, as follows:

Upper Freeport coal in wells north of Cowanshannock Creek.

Name of well.	Depth.	Thickness.	Name of well.	Depth.	Thickness.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Crow No. 1 (452)	282	2	William Schreckengost No. 2 (463)	90	3
Gourley heirs (453)	150	4	William Schreckengost No. 3 (464)	100	4
Daniel Schreckengost (455)	80	4	Brown (473)	150	4
Jerry Elgin No. 2 (460)	105	5	Kelly heirs (480)	230	7
William Schreckengost No. 1 (461)	165	4	Samuel Moore (485)	80	4

BRUSH CREEK COAL.

The Brush Creek coal is almost exactly 100 feet above the Upper Freeport coal in this locality, and occupies the position of the Gallitzin coal in Cambria County, as before noted (p. 38). This interval is shown in the record of the Brown well (473), north of Rural Valley, in which the depth of the Brush Creek coal is 50 feet and that of the Upper Freeport coal 150 feet. This Brush Creek coal shows in the road, just east of Rural Valley, No. 702, and is about 1 foot thick. It was opened farther east, near the margin of the quadrangle, No. 703, and reported 1 foot 8 inches thick. It makes a good blossom along the road north of Smeltzer, No. 704.

COALS IN PINE CREEK BASIN.

BROOKVILLE COAL.

The Brookville coal makes a good showing in the road about 2 miles west of Oscar, No. 705, and what is probably the same coal is noted in the records of a number of wells in the basin, as follows:

Brookville coal in wells in Pine Creek basin.

Name of well.	Depth.	Thickness.	Name of well.	Depth.	Thickness.
	Feet.	*Feet.*		*Feet.*	*Feet.*
J. & F. Powers (361)	60	2	A. Heffelfinger (377)	80	4
J. Carson (482)	310	5	J. A. White No. 2 (516)	274	6
Stoops (503)	185	3	Rebecca Martin No. 2 (514)	150	3

It is to be remarked concerning the last two wells that there is great uncertainty as to the identification of the coal noted, but it is thought to be of interest as well as of possible value to state the facts of depth and thickness, whatever the seam may be in each case.

CLARION COAL.

Nothing is known of the Clarion coal in this basin save possibly in the records of two wells, namely, the J. E. B. Mateer well No. 3 (370), on North Fork 1½ miles above the mouth of Bullock Run, and the J. W. Halderman well (512), below Muff. In the former a coal at the depth of 190 feet and in the latter a coal at the depth of 108 feet and 3 feet thick may be the Clarion seam.

LOWER KITTANNING COAL.

The Lower Kittanning coal has a considerable extent of outcrop in this basin—more, however, along South Fork than along North Fork. It is of good thickness near the mouth of the creek, but is immediately overlain by the Kittanning sandstone, which is coarse and 20 feet thick. It has been opened at a few points near the junction of the two forks, Nos. 706 to 708. At the first point the coal is 3 feet thick and at the last two points are old openings now closed. On South Fork it probably outcrops at about water level from the junction of the forks to a point one-half mile west of Pine Furnace; then its outcrop rises to the axis of the Greendale anticline, whence it descends to water level one-half mile west of Echo. It is exposed along two of the ravines northeast of Echo, running northward toward the axis of the Greendale anticline. The seam appears to be of good thickness along this stream, but little is known of its character. In the vicinity of Pine Furnace, No. 709, Platt reports the coal to be 2 feet 6 inches thick (Pl. VI, 29). In the ravine on the north just above Pine Furnace, No. 710, the coal has been worked to some extent, and at J. W. Gillis's bank above Pine Furnace, No. 711, it is reported to be 4 to 6 feet thick, separated into two benches by a layer of clay 1 foot thick. This bank was unfortunately flooded and inaccessible at the time of the writer's visit and this made it impossible to examine the coal. The seam is opened north of Oscar, No. 712, and is 2 feet 11 inches thick (Pl. VI, 30), and still farther north is another opening, No. 713, now closed. One mile northeast of Echo is an old opening at road level, No. 714, that may be in this coal. One and a half miles southwest of Belknap, No. 715, and the same distance to the southeast, No. 716, are old pits in this seam. On North Fork the coal outcrops for one-half mile above the mouth; it is then under cover for 2½ miles across the Fairmount syncline, and then outcrops again for 3 miles west of the axis of the Greendale anticline. But a single opening was noted, 1 mile east of Slabtown, No. 717. It is recorded in the following wells:

Lower Kittanning coal in wells in Pine Creek basin.

Name of well.	Depth.	Thickness.	Name of well.	Depth.	Thickness.
	Feet.	*Feet.*		*Feet.*	*Feet.*
A. Bowser (472)	260	.....	Rebecca Martin No. 1 (515)	150	3
H. Slease No. 3 (358)	160	4	Stockdill No. 2 (521)	104	4
Robert Martin No. 1 (365)	80	4	John Snyder (522)	100	3
Mateer No. 1 (374)	210	4	Stockdill No. 3 (523)	100	2
J. A. White No. 2 (516)	140	4			

MIDDLE KITTANNING COAL.

The Middle Kittanning seam promises to be of value in the eastern part of Pine Creek basin. Its blossom shows in the road north of the junction of North and South forks, No. 718. On North Fork it has been stripped at the mouth of a ravine on the north 1½ miles west of Slabtown, No. 719, and it is here about 2 feet thick. South of Slabtown, No. 720, the seam is exposed by the roadside and is apparently 3 feet thick. About one-half mile west of Muff, No. 721, is a good blossom apparently made by this seam. On the north branch of South Fork above Echo this coal becomes of considerable importance. Platt[a] published the following section obtained at a bank on the Kline farm, between Echo and Belknap:

Middle Kittanning coal on Kline farm, between Echo and Belknap (Pl. VII, 46).

	Ft.	in.
Coal	3	5
Slate	1	
Coal	1	7
	6	

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 115.

The location of this opening can not be determined with certainty from Platt's description, but it is possibly just north of the road 1½ miles above Echo, No. 722, where there is an old bank at which the coal is reported thick and where it appears to have been rather extensively dug. Near the point just described is a working bank, No. 723, in which the coal is good and 2 feet 8 inches thick (Pl. VII, 47). On the opposite side of the branch to the south is an old opening, No. 724, and about three-fourths mile farther up the branch, No. 725, is another old bank at which the coal is reported 2 feet 4 inches thick. Still farther up the branch, 1¼ miles west of the quadrangle boundary, near the point where the coal goes under the stream, No. 726, is an old opening at which the coal is reported 5 feet thick, and on the south side of the branch opposite, near railroad level, are a number of old openings, No. 727. These workings indicate that the Middle Kittanning seam is of minable thickness over a considerable area along the north branch of South Fork of Pine Creek. What appears to be this coal is noted in the following wells in the Pine Creek basin:

Middle Kittanning coal in wells in Pine Creek basin.

Name of well.	Depth.	Thickness.	Name of well.	Depth.	Thickness.
	Feet.	*Feet.*		*Feet.*	*Feet.*
J. Carson (482)	125	5	Concord Church (524), near Muff	190	.....
Laura Pontius (499)	170	.....	Joseph Clever No. 2 (525)	100	2
William Wadding (500)	220	.....			

UPPER KITTANNING COAL.

The Upper Kittanning coal is of good thickness in this basin as far east as Pine Furnace and Slabtown. It has been opened at two points near the junction of the forks of Pine Creek, one of which is in the ravine to the north, No. 728, where it is close beneath the Freeport sandstone and apparently about 3 feet thick, and the other is near the road on the point of the spur between the two forks, No. 729. There is a large blossom at two points in the road along South Fork, Nos. 730 and 731, and a thickness of 2 to 3 feet of coal is indicated.

In the ravine just beyond, the coal has been opened at two points, Nos. 732 and 733, and also in the ravine to the south, No. 734. About one-half mile farther up the creek, No. 735, is an old mine at which the coal was extensively mined for coke for use at Pine Creek Furnace. One-half mile above this are two old workings, No. 736. It is probably at the eastern one of these that Platt[a] obtained the following section:

Upper Kittanning coal at Pine Furnace (Pl. VII, 55).

	Ft.	in.
Coal	1	10
Slate and bony coal		1
Coal		9
	2	8

Mr. John Painter, superintendent of the works at Pine Creek Furnace, reports the coal to be of good quality, but expensive to mine because it is cut out to considerable extent by the overlying Freeport sandstone, which appears to be heavy over much of this region. The coal mined at these points was coked in open pits at the furnace with good results. This seam was regarded as the Lower Freeport, but its stratigraphic relations indicate rather that it is Upper Kittanning. In the ravine on the north just above Pine Creek Furnace, No. 737, the coal is exposed and is about 2 feet thick. There is an old opening on the east side of Deaver Run, No. 738, that is probably in this coal, and at the head of the

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 123.

run, Nos. 739 and 740, the coal is partly exposed and appears to be over 1 foot thick. On the road southwest from Oscar the coal shows at No. 741, and near by is an old pit. At Echo this seam is of minable thickness and considerable coal is taken out at the Beck bank, No. 742, at which the following section was measured:

Upper Kittanning coal at the Beck bank, Echo, No. 742 (Pl. VII, 56).

	Ft.	in.
Coal	1	4
Shale		1½
Coal	1	3
	2	8½

Beyond this point nothing further is known of the coal in outcrop on South Fork. On North Fork it has been opened beneath the Freeport sandstone at the mouth of Bullock Run, No. 743, and is over 2 feet thick. In the road north of Slabtown, No. 744, its outcrop indicates a thickness of 2 feet, and just across the ravine to the east is an old opening, No. 745, at which it is reported 2 feet 6 inches thick. Just south of Slabtown, No. 746, and still farther south opposite the head of Deaver Run, No. 747, are old openings. A seam identified as Upper Kittanning is reported in the following wells:

Upper Kittanning coal in wells in Pine Creek basin.

Name of well.	Depth.	Thickness.	Name of well.	Depth.	Thickness.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Ben Hill No. 1 (468)	142	3	N. H. Rupp (501)	165	5
Alec Brice No. 1 (498)	110	5	Mateer No. 1 (374)	100	4

It is highly probable that there is a workable body of Upper Kittanning coal of considerable extent between the forks of Pine Creek west of a line connecting Slabtown and Oscar, and this may be connected with the workable area in the vicinity of Rural Valley.

LOWER FREEPORT COAL.

The Lower Freeport coal does not appear to be present in any thickness in the lower part of this basin. Its blossom was observed, however, in the road north just above the junction of the two forks, No. 748, and in the road on the point of the spur between the two forks, No. 749. In the ravine south of Pine Furnace it makes a good showing in the road, No. 750, and it has been dug in a western branch of the ravine on the north just above Pine Furnace, No. 751, where considerable coal débris shows in the stream and the Lower Freeport limestone underlies the coal. In the second ravine on the south above Pine Furnace is an old opening, No. 752, and on the point of a spur 1 mile east is another, No. 753. Along Deaver Run it has been opened on the east, No. 754, and near the head of the run, No. 755, it is exposed in the road and is 2 feet or more in thickness. Its blossom was seen in the road one-half mile south of Oscar, No. 756, and 1 mile east it has been opened on the hillside, No. 757, and is 2 feet 6 inches thick (Pl. VIII, 72) two miles east, in the ravine south of Echo, are openings, Nos. 758, and 759. Just north of Echo it shows in the road, No. 760, and still farther north, No. 761, is a bank at which the coal is 2 feet 5 inches thick. On the ridge between this ravine and the next on the east the coal makes a large showing in the road, No. 762.

On North Fork it was observed near the mouth of Bullock Run, No. 763, 6 inches thick, but nothing was seen of it between this point and the vicinity of Muff, where it reappears on the hills to the north. It makes a large showing at several points on the hills northwest of Muff, Nos. 764 to 766, and has been opened on the ridge to the northeast, No. 767. Nothing definite, however, was learned concerning the thickness and character of the seam in this locality.

UPPER FREEPORT COAL.

The Upper Freeport coal appears to be generally good throughout the basin. South of South Fork it has been worked to some extent in a ravine west of Pine Furnace. There is an old bank, No. 768, and a working bank on the Daugherty property, No. 769, at which the following section was measured:

Upper Freeport coal at the Daugherty bank, southwest of Pine Furnace, No. 769 (Pl. IX, 122).

	Ft.	in.
Coal	2	
Bone		½
Coal		11½
Bone		2
Coal		6½
	3	6½

At an opening in the ravine south of Pine Furnace, No. 770, the coal is 2 feet to 2 feet 3 inches thick (Pl. IX, 123) and one-half mile south, No. 771, the coal is exposed in the road and is 2 feet or more thick. The coal in this ravine is overlain by sandstone and shows a great thinning between this locality and the Daugherty bank. Near the head of the ravine just northeast of Pine Furnace, No. 772, abundant coal débris, clay, and springs indicate the position of the seam. Near the head of Deaver Run, No. 773, its blossom was seen in the road. Near the point of a spur just west of West Valley, No. 774, an opening had been started, but had not been driven in beneath rock cover. About 1 foot of coal was exposed and fragments of limestone had been thrown out, indicating that the coal is Upper Freeport. At the head of the ravine to the east, No. 775, the coal was reported in the cellar of a house. On the point of a spur 1 mile northeast is an old opening, No. 776, 50 feet above an opening into the Lower Freeport coal. One mile southwest of Oscar are two old openings, Nos. 777 and 778, and just over the divide beyond the coal makes a good showing in the road, No. 779. Near the head of a ravine about 1½ miles east of Oscar, No. 780, is an old opening, and at the head of the next ravine to the east, south of Echo, No. 781, is a bank at which the coal is 3 feet 9 inches thick (Pl. IX, 124). Still farther east in the ravine followed by the railroad to Yatesboro is Cook's bank, No. 782, at which the coal has the section given below:

Upper Freeport coal at Cook's bank, southeast of Echo, No. 782 (Pl. IX, 125).

	Ft.	in.
Coal, slaty		10
Parting		½
Coal	3	6
	4	4½

At the Carson bank three-fourths mile west of Bryan, No. 783, 2 feet 10 inches of coal were seen and the coal is reported 4 feet to 4 feet 2 inches thick; just across the branch to the north is an old opening, No. 784, and in a ravine to the northwest, No. 785, is another. Somewhere in this neighborhood, apparently, Platt[a] obtained the following section:

Upper Freeport coal at McIlwain farm and at Cook farm, Echo (Pl. IX, 126).

	Ft.	in.
Coal	3	8
Slate		1
Coal		4
	4	1

On the spur 1 mile north of Oscar, No. 786, the seam is worked and is 4 feet thick (Pl. IX, 127).

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 111.

In the road north of Echo, No. 787, the blossom of the coal was seen, and on the ridge farther north, No. 788, the coal is opened at two points, at one of which, on the Brown & Mosgrove property, the coal is 4 feet thick with irregular thin partings. On the knob three-fourths mile southeast of Muff, No. 789, is a bank and a little to the east of this point the coal makes a large showing in the road, No. 790. On knobs 1 to 2 miles east of Muff the coal is present and of good thickness. At No. 791 it makes a good showing in the road, and on the knob about 1 mile east is a bank, No. 792. The Freeport limestone outcrops in the road at No. 793, and the blossom of the coal shows in the road to the north, No. 794. On a knob north of North Branch, 2 miles northeast of Echo, No. 795, the coal makes a large showing in the road. One mile farther east, No. 796, the Freeport limestone is reported in a well and near by is a prospect pit for the coal. Little could be learned of the coal south of North Branch. In the side valley above Echo clay and springs were observed, Nos. 797 and 798, that probably indicate the position of the seam; 1 mile to the northeast, No. 799, its blossom was seen; just to the north of this point, No. 800, is an old pit; and one-half mile farther north on the north side of the spur, No. 801, coal débris was seen that may come from this coal, though the position is rather low. Near the head of North Branch the coal shows near the stream level, No. 802, to the north the coal makes a good showing in the road, No. 803, and near by, No. 804, are two banks at one of which the coal is 4 feet thick (Pl. IX, 128).

Just over the hill from this point, in the Mahoning basin, No. 805, is another old opening associated with a limestone quarry. There is doubt as to whether the coal is present, as mapped, beneath the flat land just to the southwest of the last-described points, but the structure and topography seem to indicate that it is, though it is probably under too thin cover and too much weathered to be of any value. On the knob to the west, No. 806, the coal is exposed in connection with a limestone quarry, and on the knob southwest of this point, No. 807, there is another limestone quarry and probably the coal is present, but under thin cover.

On North Fork of Pine Creek the coal has been opened in the ravines north of the junction of the forks, Nos. 808, 809. In the road on the point of the spur between the two forks, No. 810, the coal is exposed and about 1 foot 6 inches was seen. On Bullock Run the coal has been opened at several points, Nos. 811 to 814. At No. 811 is a working bank beneath the Mahoning sandstone; at the other points are old workings. At the bank the following section was obtained:

Upper Freeport coal on Bullock Run, No. 811 (Pl. IX, 129).

	Ft.	in.
Coal		6
Parting		¼
Coal		2
Parting		¼
Coal		3
Parting		¼
Coal	1	7
	2	6¾

On North Fork about 1 mile above the mouth of Bullock Run the blossom of the coal was seen in the road on the south, No. 815, and in the ravine just above on the north its limestone is quarried, No. 816, and its blossom was seen, Nos. 817 and 818. In the ravine next eastward the coal has been opened in several places, Nos. 819 to 823. At No. 823 it is 3 feet and at No. 821 it is 3 feet 8 inches thick (Pl. IX, 130). It also shows in the road at No. 824. About 1 mile northeast of Slabtown it shows in the road, No. 825, and has been opened at No. 826. In the G. W. Sowers well (384) at this point the coal was penetrated at the depth of 80 feet and reported 4 feet thick. On the knob three-fourths mile south of Slabtown, No. 827, is a bank and on the knob 1½ miles northeast, No. 828, is an old opening. East of Muff the coal occurs only in small patches on the tops of the highest knobs, the last outlier being on the high knob at Concord Church, in which are two banks, Nos. 829 and 830. At the latter, known as the Bowser bank, the coal is 4 feet 4 inches thick (Pl. IX, 131).

BRUSH CREEK COAL.

The Brush Creek coal shows at a few points along the ridge road in the vicinity of West Valley, Nos. 831 to 835. At these points a thickness of 2 feet or more is indicated. At the first is an old pit that may have been dug in search of this coal, but probably is too low for it.

COALS IN THE MAHONING BASIN.

BROOKVILLE COAL.

The blossom of the Brookville coal was seen in the road north of Dee, No. 836, and a thickness of 2 feet is indicated. In the valley near the road crossing east of Kellersburg, No. 837, the coal is apparently over 1 foot thick. It reaches a good development along the upper part of Mahoning Creek within the quadrangle. At the mouth of the ravine known as Sandy Hole, which enters Mahoning Valley about 2 miles below Putneyville, No. 838, the coal is exposed and exhibits the section given below:

Brookville coal below Putneyville, No. 838 (Pl. VI, 3).

	Ft.	in.
Coal	1	5
Shale	1	
Coal	1	5
	3	10

About 1 mile below the mouth of Sandy Hole, No. 839, a coal 4 feet thick, with an 8-inch parting in the middle, which is evidently Brookville, is reported near creek level. In the bluffs at the point of the big bend below Putneyville, No. 840, this coal has been faced up by Mr. Miles Putney, and shows the following section:

Brookville coal at the big bend below Putneyville, No. 840 (Pl. VI, 4).

	Ft.	in.
Coal	1	3
Hard binder		8
Coal	2	5
	4	4

This coal is very hard, brittle, and lusterless. Nothing is known as to its chemical composition or fuel qualities. Near the dam at Putneyville, No. 841, this coal has been dug to some extent. South of Eddyville it has been opened in a ravine, No. 842, and on the Bittinger property on Camp Run farther south, No. 843. At the last point two benches are reported, the upper of which was worked. In the Daniel West well (535), 3 miles south of Eddyville, this coal was reported 6 feet thick at 129 feet, and in the Conrad Berline well (529), east of Belknap, it is reported 3 feet thick at 139 feet. Northeast of Eddyville on Pine Run, No. 844, the coal is exposed in the bank of the ravine below the road. At this point it shows the same section as given above, but has dwindled to less than half the thickness.

Brookville coal on Pine Run, No. 844 (Pl. VI, 5).

	Ft.	in.
Coal		10
Hard binder		2
Coal		8
	1	8

Still farther up Pine Run, just below McWilliams, No. 845, a hard, brittle coal is exposed at the base of a heavy sandstone. About 2 feet was seen. It is probably the Brookville. These observations indicate the probability of a good body of this coal along upper Mahoning Creek, and the further fact that what appears to be this same bed is noted of good thickness in several wells on North Fork of Pine Creek below Muff, as already described, suggests the possibility that the bed underlies the intervening territory. The indications would appear to justify prospecting at least.

CLARION COAL.

The Clarion coal was noted at only a few points and everywhere as a thin bed. It shows in the road north of Dee, No. 846, and in the ravine east of Deanville it is exposed and is 1 foot thick. In the W. H. Kuhns well (395), at Goheenville it is reported 2 feet thick at the depth of 90 feet. It is apparently of no value in this basin.

LOWER KITTANNING COAL.

The Lower Kittanning seam varies much in thickness in different parts of the Mahoning basin. It is mined at the Mahoning colliery north of Mahoning, and at a bank about one-half mile north of this point, No. 847, the seam is 2 feet 8 inches thick (Pl. VI, 31). Analysis No. 2 (p. 98) is of a sample of the coal from this locality. About the head of the ravine southeast of Widnoon are a number of old banks, Nos. 848 to 851. On the east side of this ravine, No. 852, is a new opening in which the coal is 2 feet thick. The opening has not been driven deep enough, however, to obtain the full thickness of the seam. Near by, No. 853, is an old opening. In a ravine three-fourths mile southeast of Dee, No. 854, the coal is exposed beneath dark shale, and is 2 to 3 feet thick. Along Scrubgrass Creek the coal is near water level as far east as Goheenville. There is evidence that it has been stripped at the mouth of a ravine on the south 2 miles above the mouth, No. 855, and just above No. 856, the coal is exposed at creek level at the mouth of a ravine on the north and is 2 feet 6 inches thick (Pl. VI, 32).

The coal at this point is immediately overlain by about 30 feet of soft black shale and that in turn by a heavy sandstone, a section that is characteristic of the locality. About three-fourths mile below Goheenville, No. 857, the coal is 2 feet 2 inches thick (Pl. VI, 33), and is opened beneath black shale, which is overlain by 20 feet of heavy sandstone. It was noted in the following wells in the vicinity of Goheenville:

Lower Kittanning coal in wells near Goheenville.

Name of well.	Depth.	Thickness.
	Feet.	*Feet.*
J. Brosius No. 2 (397)	289	4
Houser heirs (393)	260	4
J. P. Kammerdiener (392)	35	4

At Goheenville is an old pit, No. 858, and 1 mile east of town the blossom of the coal was seen in the road, No. 859. Near Kellersburg is an old opening, No. 860, and a working bank on the Bish farm, No. 861, at which the section below was measured:

Lower Kittanning coal at the Bish bank, Kellersburg, No. 861 (Pl. VI, 34).

	Ft.	in.
Bone		5
Coal	1	2
Parting		½
Coal	1	2
	2	9½

The miner at this bank reported that the seam yielded on the average not over 2 feet of good coal. At the head of the valley east of Kellersburg are two old openings, Nos. 862, 863. Near the mouth of the ravine south from Deanville, No. 864, the coal was exposed in a side ravine to the thickness of 1 foot 6 inches. The coal was not seen between the mouth of this ravine and Mahoning Furnace, but in the ravine to the north of that point it shows as a thin bony bed, No. 865. Its blossom was noted 1½ miles to the southwest of Mahoning Furnace, No. 866. Near the mouth of Sandy Hole, below the big bend at Putneyville, the coal has been worked on the Schreckengost property, No. 867, but the opening was

flooded and the writer could not examine the coal. The seam was reported to yield only about 1 foot 8 inches of good coal, which is said to be excellent for steaming purposes. In a ravine northwest of Putneyville, No. 868, the seam is reduced to 6 inches in thickness, but at the forks of Cathcart Run north of Putneyville, No. 869, the coal is reported on good authority to be 2 feet 6 inches thick. At Foreman's bank southeast of Putneyville, No. 870, the coal is 3 feet 6 inches thick (Pl. VI, 35).

This shows a great improvement in the coal from its condition below Putneyville. The coal undergoes a great change one-half mile to the south of Foreman's bank, where the following section was exposed in the road, No. 871:

Section in road near head of run in the southeast corner of Mahoning Township, No. 871.

	Feet.
Coal	2
Clay	6
Limestone	2
Shale	5
Coal	1½ to 2
Clay	6
Shale	4
Sandstone	1
Shale	1
Sandstone	3
Coal	1
Shale	10
Concealed	10
Vanport limestone.	

It is somewhat difficult to interpret such a section as this. The lower and middle coals fall within the usual limits of the Lower Kittanning coal above the Vanport limestone, but the upper coal is higher above the limestone than the Lower Kittanning is known elsewhere in the quadrangle, yet the interval is less than that known between the Vanport limestone and the Middle Kittanning coal. The assumption, therefore, that these thin beds really represent the Lower Kittanning coal split into three benches seems the most probable. Such cases are known to occur elsewhere in this and other seams, and may be the result of local rapid deposition of sediment during the accumulation of the coal seam which interrupted the continuity of the accumulation.

On the bluff of the Mahoning 1 mile southeast of Eddyville, No. 872, is an old opening and about 1 mile to the south the coal shows in the road, No. 873. On the forks of Camp Run it has been opened at several points, Nos. 874 to 876, and its blossom shows at Nos. 877 and 878. On the hill overlooking the gorge of Glade Run, No. 879, is an old bank at which the coal is reported 3 to 4 feet thick, and 1½ miles northeast on the bluff of Mahoning Creek is another opening, No. 880. In the Jewell heirs well (532), on the brow of the south bluff of Mahoning Creek, the coal is reported 3 feet thick at 36 feet, and in the A. H. West well (533) near by it is reported at 28 feet. On the hill, 1 mile south of Eddyville, No. 880, the coal has been opened and is reported 3 feet thick, and a short distance northeast is another old opening, No. 882. About 1½ miles northeast of Eddyville, near the quadrangle margin, No. 883, is a working bank at which the coal has the following section:

Lower Kittanning coal northeast of Eddyville, No. 883 (Pl. VI, 36).

	Ft.	in.
Coal		6
Parting		
Coal	1	6
Parting		
Coal		8
Parting		
Coal		8
	3	4

Near by, No. 884, is an old opening. East of Charlestown, near the margin of the Rural Valley quadrangle, No. 885, the blossom of the coal shows in the road and indicates a thickness of 1 to 2 feet, and west of Charlestown is an old opening, No. 886. Toward the head of Little Mudlick Creek the blossom of the coal shows at a number of points, Nos. 887 to 889; still higher is an opening, No. 890, at which the coal is 2 feet thick, and just above is another old opening, No. 891. On the whole this coal seems to be variable and of uncertain value across the central part of this basin from Putneyville to Dee, but of greater thickness and value to the east from Charlestown to Belknap.

MIDDLE KITTANNING COAL.

Very few indications of the Middle Kittanning coal were noted in the Mahoning basin. It makes a good showing in the road on the point of the spur south of Mahoning Furnace, No. 892, and is reported to have been opened and found 3 feet thick in the vicinity. On the ridge southwest of Eddyville, No 893, is an old opening in this coal and just south, No. 894, its blossom was seen in the road.

UPPER KITTANNING COAL.

In the upper portion of this basin the Upper Kittanning seam is locally of great thickness. It is also present between Widnoon and Kellersburg, but nothing definite was learned about it in that locality. About 1 mile east of Widnoon is an old pit, No. 895, that appears to be in this seam. Southwest of Deanville, No. 896, it was seen in a ravine below 10 feet of flaggy sandstone and it outcrops in the road near by. At both points it appeared to have a thickness of 2 feet. Below the road southwest of Goheenville, No. 897, is an old opening probably in this coal. On the hill 1 mile south of Eddyville is an old opening, No. 898, at which this coal is reported 3 feet thick. It is best developed, however, in the ravine of Cathcart Run north of Putneyville and on the east side of Little Mudlick Creek. At the former place the seam reaches a thickness of 15 feet in the Brooks bank, No. 899, and is composed of two benches of cannel coal or shale and two of bituminous coal, as shown in the section below:

Upper Kittanning coal at Brooks bank, No. 899, near the head of Cathcart Run north of Putneyville [a] *(Pl. VII, 57).*

	Ft.	in.
Cannel shale	5	1
Bituminous coal	1	
Cannel	to 7	10
Bituminous coal	2	
	8	11
	to 15	1

An analysis of the cannel shale at this bank is given in No. 11 of the table on page 98. On the east side of Little Mudlick Creek the coal is of better quality than elsewhere and it has been worked for years at the Thompson and Wynkoop banks, in which the seam has the section given below:

Upper Kittanning coal at Thompson bank in Little Mudlick Creek [a] *(Pl. VII, 58).*

	Ft.	in.
Slate roof		
Bituminous coal	4	
Cannel	0	
	to 8	
Bituminous coal	1	11
	5	11
	to 13	11

See analyses Nos. 12, 13, and 14 (p. 98).

[a] Platt, W. G., Second Geol. Survey Pennsylvania, Rept. H5, p. 178.

Upper Kittanning coal at Wynkoop bank, Little Mudlick Creek[a] *(Pl. VII, 59.)*

	Ft.	in.
Slate roof.		
Bituminous coal	2	2
Cannel coal	1 to 6	
Bituminous coal	to 1	6
	4 to 9	8 2

The exact location of these banks is not known to the writer, but there is a bank, No. 900, on the east side of Little Mudlick Creek about 2 miles below where it crosses the quadrangle boundary, that may be one of them. At any rate the bank is in the general locality in which this seam reaches the good development shown in the sections.

East of Charlestown, and probably off the quadrangle, this seam is found to thicken up again over a small area. It has been worked at a bank on the Jacob Schieck farm where the section is similar to those given above.[b]

Platt, writing twenty-five years ago, stated that this seam had not been found on the west side of Pine Run in the vicinity of Charlestown and McWilliams, though diligent search had been made by the farmers of that locality, nor had it been found on the west side of Little Mudlick Creek. The present writer found nothing indicating any recent discovery of the coal in these areas.

It seems likely, therefore, that the seam as developed at the Brooks, Thompson, and Wynkoop banks is of small extent, not persisting through the hill from the Brooks bank to the west side of Little Mudlick Creek, nor from the Thompson and Wynkoop banks to the valley of Pine Run on the east. Whether the seam extends from the region of the Bostonia mine near New Bethlehem to that of the Brooks bank with anything like the thickness existing at those places is unknown, but the presumption is against such a conclusion. As will be shown later (p. 94) the greatest thickness at Bostonia in the Redbank basin south of New Bethlehem persists only along the main heading, while on the cross headings it thins out rapidly. Platt describes the thick coal on the east side of Little Mudlick Creek as lying in a series of troughs running in a northeast-southwest direction and thinning on each side in the transverse direction, a feature that is well shown in the Thompson bank, where the main entry is driven in a southeast direction across the troughs and the intervening rolls. At the mouth of the entry the cannel is only a few feet thick, while at a distance of 100 feet from the pit mouth it thickens to 8 feet and the floor of the seam descends a corresponding amount. From this point the floor rises along the main entry, the cannel thins gradually and finally disappears, leaving only the two bituminous benches which have united at the level of the top of the seam. In the center of this depression side headings have been driven off from 50 to 100 feet, but no thinning of the cannel occurred. In other workings in this vicinity the bituminous bench has been worked across the comparatively narrow ridge and into the next adjoining trough on the southeast.

It thus appears that in these limited areas of special thickening the increase in thickness is due to the development of a lenticular bed of cannel which lies above a bench of bituminous coal or is intercalated between two benches of the same. In all cases the roof of the seam is said to form a nearly regular surface, while the increased thickness of the seam where the lenses of cannel are present is accommodated by depressions in the floor of the seam.

As shown above, the lateral extent of these troughs is comparatively limited; their longitudinal extent, so far as the writer is aware, has in no case been determined. Nor is it known whether there may not be other deposits of a similar nature in this region that do not crop out and have never been discovered. These matters could only be determined by diamond drilling or by following out the seam under the surface.

[a] Platt, W. G., Second Geol. Survey Pennsylvania, Rept. H5, p. 178. [b] Platt, op. cit., p. 182.

LOWER FREEPORT COAL.

Generally the Lower Freeport is not an important coal in this basin. It was mined below the coke yards at Mahoning Furnace, No. 901, and Platt[a] measured the following section there:

Lower Freeport coal at Mahoning Furnace, No. 901 (Pl. VIII, 73).

	Ft.	in.
Coal	2	
Slate		2
Coal	1	8
	3	10

See analysis No. 18 (p. 98) for the composition of the coal at this point.

Platt states that the coal is so loaded with pyrites as to be worthless, and mining was abandoned. North of this point, near Oakland, No. 902, the coal shows in the road and is about 2 feet thick. In a ravine about 2 miles southeast of Mahoning Furnace, No. 903, about 3 feet of the seam is exposed, and it is reported 5 feet thick. About one-half mile northwest of this point the coal yields a large blossom in the road, No. 904. On the point of the sharp spur south of Mahoning Furnace, No. 905, it has been worked and is reported from 4 to 5 feet thick. In the John Brosius well No. 2 (397), northwest of Goheenville, the Lower Freeport coal is reported 5 feet thick at a depth of 94 feet, and in the Brosius well No. 1 (398) it is 4 feet thick at a depth of 90 feet.

About 1 mile east of Goheenville the coal has been opened near the road, No. 854. One-half mile northwest of Belknap the coal makes a good showing in the road, No. 907, as it also does at points farther northwest, Nos. 908 and 909. On the Smullen farm, which from description appears to be near the head of Cathcart Run, the coal was found 3 feet 1 inch thick in a diamond-drill hole. About 1 mile west of the mouth of Little Mudlick Creek, No. 910, this coal shows in the road, and near by it was reported 3 feet 5 inches thick in a diamond-drill hole. It shows again in the road west of Little Mudlick Creek, No. 911. On the high knob in the northeast corner of the quadrangle is an old opening, No. 912. East of Little Mudlick Creek it shows in the road over the ridge to Charlestown, No. 913, and is from 1 to 2 feet thick. Just across the ridge to the east, No. 914, it also shows and along the ridge to the northeast on the little knob by the roadside, Nos. 915 and 916, fragments of coal were seen that probably came from this seam.

While this coal may be locally of considerable thickness in certain parts of the basin, it would appear from the foregoing description that it is very irregular and generally too thin to be of value.

UPPER FREEPORT COAL.

The Upper Freeport coal is the most important coal of the basin. Although it has been eroded from large portions of the area crossed by the Kellersburg anticline on the west and by the Greendale anticline on the east, it underlies large tracts along the axis of the Fairmount syncline and outliers of considerable size flanking the syncline on both sides. This coal was formerly mined to a considerable extent in a ravine about 1 mile southeast of Dee, No. 917, and coked for use at Stewardson Furnace, which was located at Dee. (See analysis No. 23, p. 98.) In the next ravine to the south of Scrubgrass Creek is a working bank, No. 918, and on the spur to the north is an old pit, No. 919. On the Robert Thompson property, south of Scrubgrass Creek, 1½ miles above its mouth, No. 920, is an old stripping at which coal is reported 3 feet thick and of good quality, and one-half mile to the east is the Austin bank, No. 921, at which the coal is 3 feet thick (Pl. IX, 132).

Three-quarters of a mile east of the Austin bank is an old opening, No. 922; on the north side of the creek opposite the Austin bank, No. 923, is another, and 1½ miles to the east is the Kuhns bank, No. 924, at which the coal is 3 feet 4½ inches thick (Pl. IX, 133). In the J. M. Halderman well (396), just to the east of the Kuhns bank, the coal is reported 3 feet thick and 40 feet deep.

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 160.

South and southeast of Goheenville are four banks, Nos. 925 to 928; at No. 928 the thickness is 3 feet 2½ inches (Pl. IX, 134). East of Goheenville is an old opening, No. 929, a bank, No. 930, at which the coal is 3 feet 6 inches thick, and the Peter Kammerdiener bank, No. 931, at which the coal is 3 feet 8 inches thick (Pl. IX, 135). One-half mile northwest of the Kammerdiener bank is an old bank, No. 932, and a good showing in the road, No. 933; three-fourths mile east of the Kammerdiener bank is another working bank, No. 934. On the knobs in northern Wayne Township, between Belknap and Putneyville, are working banks Nos. 935, 937, and 940, and abandoned banks, Nos. 936, 938, and 939. In this vicinity Platt [a] obtained the section below:

Upper Freeport coal on John Reeseman farm, near McCrea Furnace (Pl. IX, 136).

	Ft.	in.
Coal	2	3
Slate		1½
Coal	1	8
	4	½

There are a few small outliers of this coal on the knobs south of Kellersburg and on one is a bank, No. 941, at which the coal is 2 feet 10 inches thick (Pl. IX, 137). On the knob three-fourths mile farther south is an old opening, No. 942. On the ridge west of Deanville the coal shows in the road, No. 943; across the ridge to the east, No. 944, is an old opening, and another on a little knob just west of Deanville, No. 945. Southward from Deanville the coal shows in the road at No. 946. There is an old opening at No. 947, a blossom at No. 948, another old bank at No. 949, and a working bank, No. 950. North of Deanville is an old bank, No. 951, and about three-fourths mile farther north is Reedy's bank, No. 952, at which the following section was measured:

Upper Freeport coal at Reedy's bank, No. 952, Deanville (Pl. IX, 138).

	Ft.	in.
Bone		1½
Coal	3	2½
Parting		¼
Coal	1	
	4	4¼

North of Reedy's bank is an old prospect pit, No. 953, and an old bank, No. 954. Along the ridge above Redbank Creek at the point of Anthonys Bend the coal shows in the road, No. 955; a short distance east is a bank, No. 956; a little way to the south is an old opening No. 957, and at the head of the ravine one-half mile farther south is a working bank, No. 958, at which the coal is 3 feet 9 inches thick, with a few thin, irregular partings (Pl. IX, 139). On the ridge about one-half mile west of Oakland is an old pit, No. 959, at which the coal is reported 4 feet thick. Just south of Oakland are two old banks, No. 960, and about three-fourths mile south is a working bank, No. 961, at which the following section was measured:

Upper Freeport coal south of Oakland, No. 961 (Pl. IX, 140).

	Ft.	in.
Coal		9
Parting (thin).		
Coal	1	1
Parting (thin).		
Coal	1	1
Parting (thin).		
Coal		10
	3	9

One mile south of Oakland is a bank on the Doverspike farm, No. 962, and across the ridge to the east is an old opening, No. 963. Near the southern point of the ridge over-

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 146.

looking Mahoning Furnace is a working bank on the Falk farm, No. 964, at which the following section is shown:

Upper Freeport coal at the Falk bank near Mahoning Furnace, No. 964 (Pl. IX, 141).

	Ft.
Coal	3
Bony coal	1
	4

On the point of the spur to the northwest of Mahoning Furnace is the old mine, on the Colwell property, No. 965, that supplied coal for the coke used at the furnace. Platt[a] reports the coal here 3 feet 11 inches thick. His analysis of a sample of the coal from this mine is No. 25 of the table on page 98. On the road up the bluff of the Mahoning, 2½ miles southwest of Mahoning Furnace, No. 966, is a working bank at which the coal is 3 feet 5¾ inches thick, with a few thin, irregular clay seams (Pl. IX, 142). Just around the point of the hill in the next ravine to the east, No. 967, are old openings, and on the sharp spur south of Mahoning Furnace, No. 968, the coal shows in the road. Still farther east, in the northwest corner of Wayne Township, it shows in the road at No. 969, and in a ravine at No. 970 it was reported stripped at one time. Just east is an old opening, No. 971. Northeast of this point, at the head of the ravine known as Sandy Hole, No. 972, is a bank on the Smith farm, at which the coal is 3 feet 10 inches thick (Pl. IX, 143). About 1 mile southeast of the Smith bank is another, No. 973. On the knobs south of Putneyville the coal makes a good showing in the road, No. 974; a little to the north is an old bank, No. 975, and on the knob to the north of the last-named point is the Saxman bank, No. 976, in the last outlier of the coal in this direction.

On the ridge north of Mahoning Creek, about 1 mile west of Putneyville, is a bank, No. 977, and in the ravine to the north is an old opening, No. 978. Farther east in the road northwest of Putneyville, No. 979, the coal shows below the Mahoning sandstone, which is here 40 feet thick. On the point one-half mile northwest of Putneyville is the Putney bank, No. 980, at which the coal is 3 feet 5 inches thick (Pl. IX, 144).

About 1 mile north of Putneyville is a bank, No. 981, at which the coal is 3 feet 9 inches thick, with sporadic partings of clay of little importance. At the head of the ravine to the north, No. 982, is an opening, probably into the Fairmount No. 4 mine. West of Little Mudlick Creek, No. 983, the blossom of the coal was seen. About 3 miles farther northeast, No. 984, the blossom was seen at two points, and there is a bank near by, No. 985. The seam just catches in the top of the high hill in the northeast corner of the quadrangle and has been opened within 30 feet of the top, No. 986. Along the ridge between Little Mudlick Creek and Pine Run the coal was noted at several points, Nos. 987 to 991. Beginning about 1 mile north of Mahoning Creek and proceeding northward these observations were as follows: At No. 987 is an old opening, at No. 988 a working bank, at No. 989 is another old opening, at No. 990 is an outcrop indicating a good thickness, and at No. 991 are fragments and the coal was reported present.

COALS IN THE REDBANK BASIN.

POCONO COAL.

The whole series of coals from the Pocono up is represented in this basin. The underclay of a Pocono coal is opened at the mouth of Rock Run, No. 992, and the coal is represented by the overlying black shale. Just north of the quadrangle and west of Leatherwood station two thin seams of impure coal of Pocono age are exposed in a railroad cut.

MERCER COAL.

What is probably the Mercer coal shows just above the railroad crossing south of Lawsonham, No. 993, where it is in two benches, separated by fire clay, the upper of which is 6 inches and the lower 2 inches thick. At the clay pits south of Climax, No. 994, the coal is 1 foot 6 inches thick. It is nowhere known to be of value in the region.

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 160.

BROOKVILLE COAL.

The blossom of the Brookville coal was noted south of Redbank Creek, near Shannon, No. 995. It is partially exposed in the road about midway between Widnoon and Lawsonham, No. 996, as a coal or coaly shale 1 to 2 feet thick, and its blossom was seen in the road one-half mile farther north, No. 997. It is not known to be of workable thickness in the basin.

CLARION COAL.

The Clarion coal was noted as a 6-inch layer in a shale cut by the road three-fourths mile south of New Bethlehem, No. 998. It is not known to be of value in the basin.

LOWER KITTANNING COAL.

The Lower Kittanning coal is a very valuable bed in the lower part of the basin. Openings were seen at several points north of the creek in the Kittanning quadrangle, Nos. 999 to 1001, and south of the creek 1 mile south of Shannon is a working bank, No. 1002. At Cingler's bank, in a ravine about 1 mile northwest of Widnoon, No. 1003, this seam is 4 feet thick (Pl. VI, 37). By the road, 1½ miles north of Widnoon is a bank, No. 1004, and across the ridge to the west is an old opening, No. 1005. South of Redbank Creek, east of Lawsonham, is an old opening, No. 1006, and a bank on the Duncan property, No. 1007, at which the coal is 4 feet 1 inch to 4 feet 6 inches thick (Pl. VI, 38). North of Redbank Creek, east of Lawsonham, are old openings, Nos. 1008 to 1010. In a ravine 1½ miles west of Kellersburg is a bank on the Maginnis property, No. 1011, at which the coal is 3 feet 9 inches thick (Pl. VI, 39). In the Maginnis well (408) this coal is reported 4 feet thick and 85 feet deep, and in the D. O. Collen well (407) near by it is reported 5 feet thick and 185 feet deep. Within 1½ miles north of Kellersburg the coal is known at a number of points as follows: At Nos. 1012 to 1014 are banks; at No. 1015 is a blossom; at No. 1016 is a bank at which the coal is reported generally poor, being from 1 foot 6 inches to 3 feet thick, and at No. 1017 is an old opening. This coal was next noted in the bluff overlooking the creek at Anthonys Bend, No. 1018. At this point the deterioration in the character of the Lower Kittanning seam, beginning in the vicinity of Kellersburg, has apparently reached its culmination, as is shown by the following section:

Lower Kittanning coal at Anthonys Bend (No. 1018), (Pl. VI, 40).

	Ft.	in.
Coal		1
Shale		3
Coal		10
Shale		2
Clay		4
Coal		3
Shale		1
	2	

East of the narrows at Climax there are old openings, Nos. 1019 and 1020. Nothing was seen of this seam between this point and the Fairmount No. 5 mine, east of New Bethlehem, near the quadrangle boundary, No. 1021. At this mine the coal shows a return to its normal thickness in the Allegheny Valley and is 3 feet 1 inch thick (Pl. VI, 41). The Lower Kittanning coal has been extensively mined immediately north of the quadrangle in this locality and is known by the fanciful name of the Fishbasket vein. Just north of the quadrangle, in the ravine 2 miles east of the west boundary of Redbank Township, the coal was noted and appears to be about 2 feet thick.

MIDDLE KITTANNING COAL.

The middle Kittanning coal was noted only north of the creek, west of Lawsonham, in the Kittanning quadrangle, where there is an old pit, No. 1022.

UPPER KITTANNING COAL.

The Upper Kittanning coal is present over a large area along the Kellersburg anticline in the northwest corner of the Rural Valley quadrangle. It does not appear to be of minable thickness, however, though it may be so in limited areas. At Widnoon, No. 1023, its blossom was noted, and it was reported to have been struck in digging the cellar of a house, and to be 1 foot 6 inches thick. It shows in the road 1 mile to the north, No. 1024, and is apparently 1 foot thick. Its blossom was noted along the road south from Widnoon, No. 1025, and in the road about 1 mile to the northeast, No. 1026. It reaches dimensions of importance, however, only farther east. In the road near Anthonys Bend on the southwest, No. 1027, is an old bank, and farther east, presumably somewhere east of the narrows, was the Anthony mine, of which Platt[a] published the following section:

Upper Kittanning coal at the Anthony mine, east of the narrows, Mahoning Township (Pl. VII, 60).

	Ft.	in.
Cannel slate		6
Soft slate and bony coal		4
Coal	3	6
	4	4

At the Bostonia mine, 2 miles south of New Bethlehem, in Mahoning Township, an effort was once made to mine this seam on a commercial scale, but the effort was a failure. This mine was located somewhere in the vicinity indicated by No. 1028. Franklin Platt[b] published the following section of the coal at this mine, which he identified as the Lower Freeport:

Upper Kittanning coal at the Bostonia mine, south of New Bethlehem (Pl. VII, 61).

	Feet.
Cannel slate	
Cannel coal	8
Bituminous coal	2
	10

He describes the cannel bench as holding its thickness along the main entry, but thinning to nothing along the cross headings, so that beyond the limits of the cannel bench the seam consists only of the 2-foot bituminous bench. Platt[b] published analyses by McCreath of samples of the different benches of coal at this mine, which are given in the table on page 98. (See analyses Nos. 8, 9, and 10.)

Platt[c] expressed doubt whether the cannel of this region, including the localities on Cathcart Run and Little Mudlick Creek, hitherto described, is to be regarded as a true cannel coal, and called it a cannel slate with a conchoidal fracture. In addition to the conchoidal fracture it is without luster. It thus possesses the physical characters by which cannel coal is usually defined. Further, that it is a coal and not a slate is conclusively shown by the following analyses:

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 198.
[b] Second Geol. Survey Pennsylvania, Rept. H, p. 240.
[c] Second Geol. Survey Pennsylvania, Rept. H5, p. 179.

Analyses of cannel coal.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Fixed carbon	27.00	53.132	52.306	46.194	52.757
Volatile hydrocarbon	59.60	37.830	32.665	30.490	37.930
Moisture	1.30	1.610	.640	.510	1.120
Ash	12.10	6.750	13.345	22.230	6.705

1. Breckenridge cannel of Kentucky.
2. Cannel bench at the Thompson bank.
3. Upper cannel bench at the Brooks bank.
4. Upper cannel bench of the Bostonia mine.
5. Upper bituminous bench of the Thompson bank (see section, p. 88).

Analysis No. 4 is of a sample of what is probably the poorest grade of cannel of the region under discussion, yet it contains over 76 per cent of combustible matter, while the cannel from the Brooks bank contains over 85 per cent, and that from the Thompson bank over 91 per cent of combustible matter, so that it is certainly inadmissible to call any of this cannel a slate. It is a coal which in some places contains an unusually high percentage of ash. In the cannel from the Brooks bank, however, the percentage of ash is but little greater than in the Breckenridge cannel coal of Kentucky, which may be taken as a typical cannel, while the cannel from the Thompson bank contains a much smaller proportion of ash than the Breckenridge coal. So far as content of ash is concerned, then, most of the Upper Kittanning cannel in this region differs little from well-recognized cannel coals of other regions, assuming, of course, that the above analyses fairly represent its character. There is, however, one marked difference between this cannel and a typical cannel, and that is in the relative proportions of fixed carbon and volatile hydrocarbons. Nearly all coals with the physical qualities of cannel contain 45 per cent or more of volatile hydrocarbons and a smaller amount of fixed carbon. In the Breckenridge cannel the volatile matter is more than twice that of the fixed carbon. In the cannel of this region, on the contrary, the fixed carbon runs about one and one-half times the amount of volatile matter. In this respect, therefore, the cannel coal in question is not entitled to the name. It differs in no way from the upper bituminous bench of the Thompson bank, the composition of which is shown in analysis No. 5, above. In fact, except for its high percentage of ash in some cases, it is almost identical in character with most of the bituminous coal from the other seams of the region, as may be seen by a study of the analyses given in the table on page 98. It might be best described by saying that it is a coal with the physical characters of cannel and the chemical composition of a more or less impure bituminous coal of the ordinary type of the region. Judging from the analyses of this coal there appears to be no reason why it would not make a good fuel for local use, where the disposal of the ash is not a factor to be considered. It could not serve the ordinary purposes of a cannel coal. It is too poor in hydrocarbons to use in the manufacture or enrichment of illuminating gas or for the distillation of oil, and probably it does not burn so freely in an open grate as cannel coal. Furthermore, on account of its high percentage of ash it would not command as high a price in the market as the purer coals, with which it would have to compete, and there is therefore no probability of its being mined on a commercial scale so long as the better coals of the region are unexhausted. It will doubtless continue to be for some time a source of local supply for domestic use.

LOWER FREEPORT COAL.

The Lower Freeport coal is of importance only in the upper part of Redbank basin, where it has considerable extent as a workable bed. It is, however, subject to great variations in thickness within rather narrow limits. In the road south of Anthonys Bend, No. 1029, it shows a thickness of 2 feet. East of New Bethlehem, near the margin of the quadrangle, is the Fairmount No. 3 mine in this coal, and a little farther east is the Fairmount

No. 2 mine, with the opening just north of the quadrangle. At the latter mine the coal is 3½ to 4 feet thick, but very badly cut up by clay veins. In this region the interval between the Upper and Lower Freeport coals is 40 feet. No. 18 of the table (p. 98) is an analysis by McCreath of a sample of this coal from the neighboring Bostonia mine, probably near that in the Upper Kittanning seam, No. 1028. At the Oak Ridge No. 2 mine, in the western part of Redbank Township, about 1 mile south of the north boundary of the quadrangle, a thickness of 4 feet 6 inches was measured (Pl. VIII, 74). This is an exceptional thickness, and the seam is reported much cut out and too thin to mine at the south end of the property. East of the Oak Ridge mine this coal has been opened on the Kunselman property, No. 1030.

UPPER FREEPORT COAL.

The Upper Freeport coal has been eroded from the region west of Oakland. Just north of Oakland are two banks, Nos. 1031, 1032. About 1 mile northeast of Oakland is a new opening of the Fairmount Mining Company, No. 1033, at which the coal is 4 feet thick (Pl. IX, 145).

The Redbank Mining Company, which operated in this locality many years ago, worked the Upper Freeport, as well as the Lower Freeport and Upper Kittaning seams. Their mine was known as the Bostonia. Platt[a] published the following section of the Upper Freeport at this mine:

Upper Freeport coal at Redbank Mining Company's mine, Bostonia (Pl. IX, 146).

	Ft.	in.
Bony coal		6
Slate		3½
Coal	3	8
	4	5½

(See analysis No. 24, p. 98, for the composition of the coal at this mine.)

About one mile south of New Bethlehem is an opening of the Fairmount No. 4 mine, No. 1034, and just south of town is an old bank, No. 1035. The seam here is seriously affected with "rock faults," which have been encountered throughout the extent of operation, covering an area of at least 2 square miles. The coal has the usual maximum thickness of 4 feet, but it does not hold this thickness far in any direction. In a few feet or rods it thins to a few inches or disappears entirely, its place being taken by the shale of the roof. This peculiarity is illustrated by figs. 7 to 10 below.

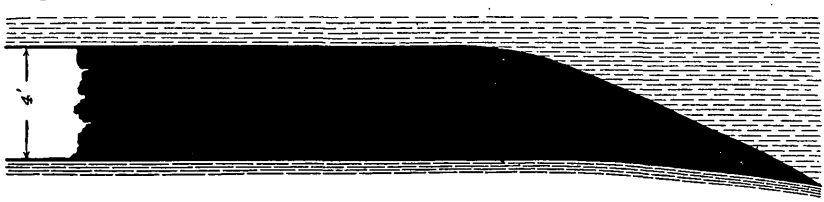


FIG. 7.—Section along main heading of Fairmount No. 4 mine, to show thinning and disappearance of coal.

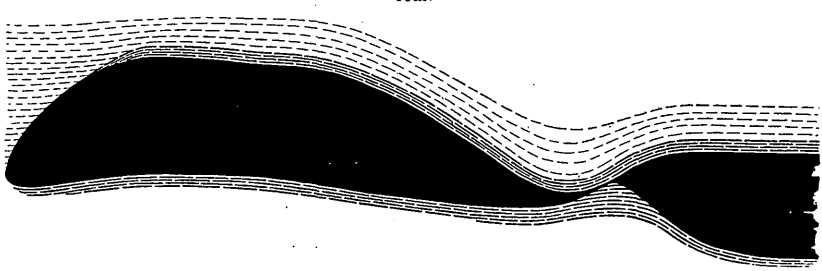


FIG. 8.—Section along main heading of Fairmount No. 4 mine, to show variations of coal and its relations to clay and shale.

[a] Second Geol. Survey Pennsylvania, Rept. H5, p. 192.

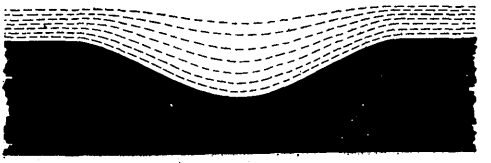


FIG. 9.

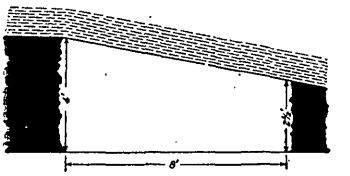


FIG. 10.

FIG. 9.—Section along main heading of Fairmount No. 4 mine, to show thinning and absence of clay.
FIG. 10.—Section across main heading of Fairmount No. 4 mine, to show rapid thinning.

In a short distance the coal reappears at the lower level of the seam and rapidly regains its full thickness. At other points the coal terminates abruptly, as shown in fig. 11. These changes are repeated over and over in all directions so that the seam is composed of irregular deposits of coal alternating in the horizontal direction. It seems probable that the vegetal matter of the coal accumulated in irregular areas of small size which were surrounded by water in which clay was simultaneously being deposited, for there are evidences along the lateral contact of the shale with the coal of an interfingering of the two substances, as if both were accumulating at the same time. This interfingering is shown in figs. 12 and 13.

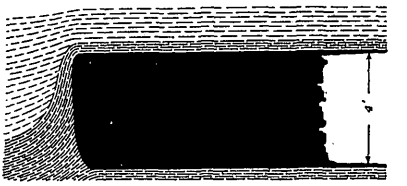


FIG. 11.—Section along main heading of Fairmount No. 4 mine, to show abrupt ending of coal.

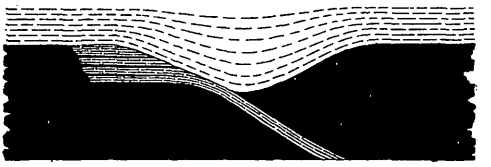


FIG. 12.

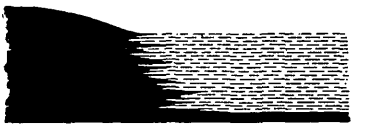


FIG. 13.

FIG. 12.—Section along main heading of Fairmount No. 4 mine, to show interfingering of coal and clay and relations of coal, clay, and shale.
FIG. 13.—Section along main heading of Fairmount No. 4 mine, to show interfingering of coal and shale.

The only other explanation that seems at all probable is that the vegetal matter accumulated uniformly over the whole area and was subsequently eroded by currents of water in the places now occupied by shale, but it is difficult to conceive how erosion could have produced such irregularities as exist over so large an area. The form and arrangement of the shale deposits replacing the coal certainly do not suggest such an origin. At any rate it is evident that the present condition of the coal seam in this locality is due to accidents of its original accumulation and not to any subsequent upheaval of the rocks or to volcanic action, as some have supposed. On account of this supposition operations have been pushed southward in the hope of reaching improved conditions in the coal to the south of a ravine cutting the property. It is of course quite possible that better conditions may exist south of the ravine, but it is evident that there is no possible connection between the character of the coal seam and any features of surface relief. These features came into existence ages after the character of the coal seam was fixed.

East of the Fairmount mines are those of the Oak Ridge Mining Company. Oak Ridge Nos. 3 and 5 mines are working this seam. At the latter mine the Upper Freeport coal is 3 feet 5 inches thick (Pl. IX, 147). South of these mines is an opening, No. 1036, probably of one of the Fairmount mines. On the Kunselman property to the east of the Oak Ridge mines is an old opening, No. 1037.

Analyses of coals in the Kittanning

No.	Name of seam.	Locality.	Owner.	Analyst.
1	Clarion	West Winfield	A. G. Morris	E. C. Sullivan, U. S. G. S.[a]
2	Lower Kittanning	Mahoning	Mahoning Coal Co	A. S. McCreath (H5, p. 232).
3	do	Rogers farm, west of Buffalo Mills, near county line.		A. S. McCreath (H5, p. 287).
4	do	Kittanning	Kittanning Clay Mfg. Co.	Geo. Steiger, U. S. G. S.[a]
5	do	Mouth of Cowanshannock Creek.		do.[a]
6	do	Craigsville	Mr. Bowser	do.[a]
7	do	¾ mile east of Greendale.	Rhea farm	A. S. McCreath
8	Upper Kittanning	Bostonia, south of New Bethlehem.	Redbank Mining Co., cannel bench, analysis No. 1.	A. S. McCreath (H., p. 240).
9	do	do	Redbank Mining Co., cannel bench, analysis No. 2.	do
10	do	do	Redbank Mining Co., bituminous bench.	do
11	do	Cathcart Run	Brooks bank	A. S. McCreath (H5, p. 180).
12	do	Little Mudlick Creek	Thompson bank, upper bench, bituminous.	do
13	do	do	Thompson bank, middle bench, cannel.	do
14	do	do	Thompson bank, lower bench, bituminous.	do
15	do	Pine Furnace		A. S. McCreath (H5, p. 123).
16	do	Yatesboro	B. Schreckengost	A. S. McCreath (H5, p. 94).
17	Lower Freeport	Cowansville	Cowansville Mining Co.	W. F. Schaller, U. S. G. S.[a]
18	do	Mahoning Furnace		A. S. McCreath (H5, p. 161).
19	do	Bostonia	Redbank Coal Co	A. S. McCreath (H5, p. 192).
20	Upper Freeport	Near Freeport, off quadrangle.		A. S. McCreath (H5, p. 262).
21	do	1½ miles southwest of North Buffalo post-office.	Bruner bank	Geo. Steiger, U. S. G. S.[a]
22	do	1 mile east of Ewing	Galbreath bank	do
23	do	Stewardson Furnace (Dee).		A. S. McCreath (H5, p. 171).
24	do	Bostonia	Redbank Coal Co	A. S. McCreath (H5, p. 193).
25	do	Mahoning Furnace	Colwell's mine	A. S. McCreath (H5, p. 160).
26	do	Mosgrove	Pittsburg Plate Glass Co.	
27	do	Yatesboro	Patterson mine	A. S. McCreath (H5, p. 91).
28	do	Blanco	Beers bank	A. S. McCreath (H5, p. 92).

[a] Collected by J. S. Burrows.

NOTE.—H and H5 in "Analyst" column refer to reports of the Second Geological Survey of Pennsylvania.

and Rural Valley quadrangles.

Fixed carbon.	Volatile combustible.	Moisture.	Ash.	Sulphur.	Phosphorus.	Total.	Color of ash.	Coke (per cent).	Character of coke.	Fuel ratio.
50.83	36.19	2.20	10.78	[b] 3.35	.....	100.00	Slightly red.	.....	Swollen, porous.	1:1.44
49.686	42.550	1.180	4.585	1.999	.0061	100.0061	Pinkish gray.	56.270	.....	1:1.17
48.747	42.720	1.160	5.065	2.313	.....	100.00	Reddish gray.	56.120	.....	1:1.14
53.59	35.09	1.61	9.71	[b] 4.62	.....	100.00	.....	.....	.....	1:1.52
49.19	32.93	3.19	14.69	[b] 7.32	.....	100.00	.....	.....	.....	1:1.49
52.97	37.06	1.89	8.08	[b] 4.41	.....	100.00	.....	.....	.....	1:1.42
52.032	38.205	.906	5.140	3.663	.....	100.00	Reddish gray.	60.835	.....	1:1.36
46.194	30.490	.510	22.230	.576	.....	100.00	.....	.....	Poor....	1:1.51
49.815	31.680	.730	17.320	.435	.....	100.980	.....	.....	....do...	1:1.54
52.716	39.120	1.650	3.880	2.634	.....	100.00	Brown..	59.23	.....	1:1.34
52.306	32.665	.640	13.345	1.044	.....	100.00	Gray....	66.695	.....	1:1.60
52.575	37.930	1.120	6.705	1.388	.....	100.00	Reddish gray.	60.850	.....	1:1.39
53.132	37.830	1.610	6.750	.678	.....	100.00	Gray....	60.560	.....	1:1.40
54.482	34.465	.810	9.655	.588	.....	100.00	....do...	64.725	.....	1:1.58
58.301	34.185	1.820	4.705	.989	.....	100.00	Cream..	63.995	.....	1:1.70
53.224	34.270	.910	9.285	2.211	.....	100.90	Gray....	.....	.....	1:1.55
53.34	31.73	2.97	11.96	[b] 3.51	.....	100.00	.....	.....	Good...	1:1.62
50.265	37.110	1.070	8.330	3.225	.0092	100.0992	Pinkish gray.	61.820	.....	1:1.35
53.960	35.940	1.690	5.040	3.380	.....	100.00	Gray....	62.370	.....	1:1.50
50.206	39.835	1.430	5.710	2.819	.....	100.00	Cream..	58.735	.....	1:1.26
51.37	29.00	2.17	17.46	[b] 2.58	.....	100.00	.....	.....	.....	1:1.77
49.78	31.65	2.72	15.85	[b] 4.06	.....	100.00	.....	.....	.....	1:1.57
55.545	35.520	1.470	6.630	.835	.0684	100.00	Yellowish gray.	63.010	.....	1:1.56
53.661	35.940	1.840	6.820	1.739	.....	100.00	Gray....	62.220	.....	1:1.49
54.996	34.810	1.450	7.690	1.054	.....	100.00	....do...	63.740	Tender.	1:1.58
51.13	34.22	2.30	10.70	1.65	.....	100.00	.....	.....	.....	1:1.48
53.569	36.995	1.020	5.775	2.461	.....	99.820	Cream..	61.981	.....	1:1.45
57.179	37.860	1.140	2.790	1.031	.....	100.00	....do...	61.000	.....	1:1.51

[b] Sulphur separately determined.

ANALYSES OF COALS.

In the foregoing tables, pages 98, 99, are a number of analyses of samples from the various coal seams of the quadrangles. With two exceptions these samples were collected in the quadrangles. Several of the analyses were made by A. S. McCreath, of the Second Geological Survey of Pennsylvania, and published in Report H5 on Armstrong County. The remainder were made by various chemists of the United States Geological Survey. These latter analyses present considerable differences from those made by McCreath. They are higher in fixed carbon and much higher in ash and sulphur. On the other hand they run much lower in volatile hydrocarbons. The fuel ratio is also much higher. These differences may be accounted for in part on the assumption that the two sets of samples were selected differently. The samples collected in the present survey were taken by cutting a section from the face of the seam about 1 inch deep and 2 inches wide, then thoroughly pulverizing this, dividing it into quarters, and rejecting opposite quarters. This process was repeated until the sample was reduced to a convenient quantity. In taking the samples such partings were rejected as are rejected in mining, so that they fairly represent the character of the seam. It seems not improbable that the specimens analyzed by McCreath were selected after the coal was mined, and therefore do not so fairly represent the seam as a whole. If this assumption is correct, it would explain the differences in the proportions of ash and sulphur.

ACREAGE AND AMOUNT OF UPPER FREEPORT AND LOWER KITTANNING SEAMS.

In the Kittanning quadrangle the total area underlain by the Upper Freeport coal is about 69,000 acres and in the Rural Valley quadrangle about 66,000 acres, making a total of 135,000 acres. In the former quadrangle the area of Lower Kittanning coal is 123,000 acres, and in the latter it is 117,000 acres, making a total of 240,000 acres.

In the Kittanning quadrangle the Upper Freeport coal is known to be too thin to mine in some localities, as appears from the details already given. It is not believed however, that the total area of such localities is large. It may amount to 10 per cent of the whole, or approximately 7,000 acres. Deducting that from the total leaves 62,000 acres of minable coal. In the Rural Valley quadrangle the whole area of Upper Freeport coal is minable, so far as known. This would make the total area of minable Upper Freeport coal in the two quadrangles 128,000 acres. According to reports from the various mines in the region, this seam yields 3,500 to 5,500 tons of run-of-mine coal to the acre, with an average in 5 mines reporting of 4,330 tons per acre. Accepting 4,000 tons per acre as a conservative estimate of the yield per acre of this seam in the quadrangles and the acreage as 128,000, as estimated above, the total minable coal in the Upper Freeport seam in the quadrangles would be 512,000,000 tons of run-of-mine coal.

In the case of the Lower Kittanning coal the territory of the quadrangles may be divided into two parts by a line drawn from Kellersburg southwest through Kittanning. West of this line all observations point to the fact that this seam is everywhere minable. This territory embraces the 123,000 acres of Lower Kittanning coal in the Kittanning quadrangle and nearly 11,000 acres of its area in the Rural Valley quadrangle, making 134,000 acres in all. The mines working the seam in this area report an average yield of 4,833 tons of run-of-mine coal to the acre. Allowing 4,500 tons as a moderate estimate, the total minable Lower Kittanning coal in this area would be 603,000,000 tons of run-of-mine coal. East of the line described above the value of the Lower Kittanning coal is more problematical, as is shown in the foregoing descriptions of the coals. According to all observations, however, the seam rarely falls below 2 feet in thickness and over a considerable part of the region it is known to be 3 feet thick, or over. Taking into consideration all actual observations in connection with such scattering and more or less unreliable measurements of the coal as are given in deep-well records, it is a fair estimate that the seam will average 2 feet 6 inches of minable coal over the area of 106,000 acres remaining after deducting the 11,000 acres mentioned above. Actual reports would indicate that each foot in thickness of this coal will yield something over 1,000 tons per acre.

Taking 1,000 tons, however, as a safe estimate, the territory under consideration will

yield 2,500 tons per acre. That would give 265,000,000 tons available coal in the Lower Kittanning seam in the Rural Valley quadrangle east of the line described above. This makes a total of 868,000,000 tons of Lower Kittanning coal in the quadrangles and a grand total of 1,380,000,000 tons in the two seams under consideration. To this must be added the coal available in the other seams. With the exception of certain areas of Lower Freeport coal, these seams are so inconstant in thickness that reliable estimates of the amount that they contain can not be made. The foregoing description and the map will, it is hoped, assist prospectors and others interested in estimating the coal resources of special areas to reach a fairly accurate conclusion as to their value. The figures given above include the coal actually recoverable by the mining methods now in vogue.

DEVELOPMENT.

Comparatively very little of the coal of these quadrangles has been taken out. Mining operations on a commercial scale have until recent years been confined to the river region from Mahoning northward, where the Lower Kittanning has been worked. A considerable quantity of coal was taken out for coking at several points during the days when iron smelting was an industry of the region. These operations were confined largely to the Upper Freeport coal at East Brady, Mahoning Furnace, and Stewardson Furnace, and to the Upper Kittanning coal at Pine Furnace. The Upper Freeport has also been rather extensively mined at Kittanning.

At present mining operations are more active and a number of well-equipped mines are working the Upper Freeport and Lower Kittanning seams. In the vicinity of Karns the Enterprise mine is working the Upper Freeport. At Kaylor the Great Lakes Coal Mining Company has opened six mines, four in the Lower Kittanning and two in the Upper Freeport. A railroad has been built connecting with the Bessemer Railroad in Butler County, and mining on a large scale is now in progress in that locality. The Keystone, Monarch, Avondale, and Riverview mines are operating in the Lower Kittanning in the northern part of the quadrangles. The Mahoning colliery is mining the same seam at Mahoning. East of New Bethlehem are the mines of the Fairmount Mining Company and the Oak Ridge Mining Company. Both companies have well-equipped plants and are mining the Upper and Lower Freeport seams. At Cowansville is a mine in the Lower Freeport from which considerable coal is taken. At Mosgrove the Pittsburg Plate Glass Company has a large mine in the Upper Freeport. At Kittanning the Kittanning Clay Manufacturing Company is taking out a good deal of coal from the Lower Kittanning. At Yatesboro are the two mines of the Cowanshannock Coal and Coke Company; these are well-equipped plants mining the Upper Freeport coal on a large scale.

CONDITIONS OF MINING.

The conditions seem to be favorable to mining in these quadrangles. All parts are easily accessible along the side valleys of the Allegheny and the problem of transportation is a simple one. The coal seams are generally overlain by shale and underlain by clay, which are fairly easy to remove, and the shale makes a comparatively stable roof. There are, of course, areas of greater or less extent for which the above statement will not hold as to one or another seam, but on the whole it is believed to be true. The geologic structure of the quadrangles is also relatively simple, the dips are low, and at many points large bodies of coal can be taken out with but little expense for haulage. It is believed that in locating mines it will be found advantageous to consider the structure or lay of the rocks as it is delineated on the map.

DISPOSITION AND USE OF COAL.

The greater part of the coal mined in this region is shipped to New York, New England, and Canada, and used for domestic and steam purposes, for which it is reported excellent. The coal is too low in volatile matter and contains too much impurity, especially in the form of sulphur, for gas making. As before stated, coal from the Upper Freeport seam was used for coke at the Mahoning and Stewardson furnaces. It was said to make rather

tender coke, but suitable for the light burdens of the furnaces. The coke contained sufficient phosphorus to damage the iron for some purposes. At Pine Furnace the Upper Kittanning coal was coked in open pits. It is probable that by the better methods practiced at the present day the coke from the Upper Freeport coal could be much improved in quality and made to answer the purpose of smelting the native ores.

PETROLEUM AND NATURAL GAS.

HISTORICAL STATEMENT.

DEVELOPMENT OF THE PETROLEUM INDUSTRY.

As will be seen by the accompanying map (fig. 14), these quadrangles lie in the belt of oil and gas producing territory extending from southwestern New York to northern West

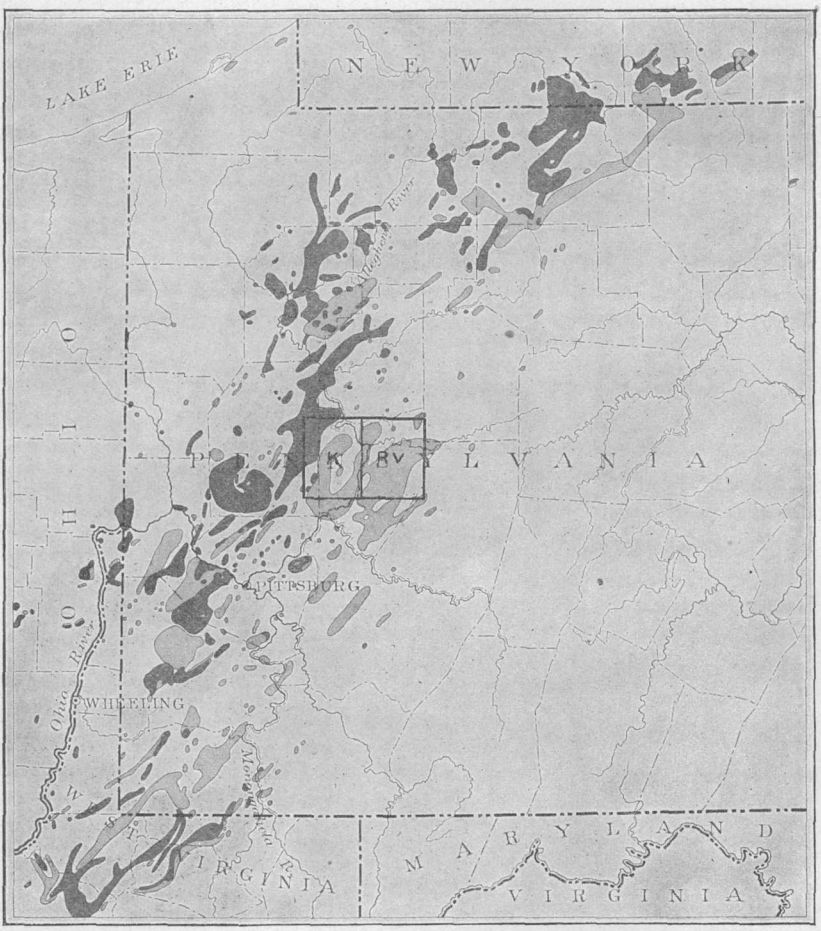


FIG. 14.—Map of the oil- and gas-bearing regions of the northern Appalachians. Light areas, gas; dark areas, oil.

Virginia. For the past thirty years petroleum has, therefore, been a most important source of wealth in the western and northwestern part of the Kittanning quadrangle. The oil-producing territory is almost entirely confined to the eastern tier of townships in Butler County and to Bradys Bend Township, in Armstrong County. Outside of this territory oil has been noted in very small quantities in an occasional gas well, but so far as known

to the writer it is produced in only two wells and these are very light. They are located, one on the Rupp and the other on the Brown farm, near the southeast corner of Rayburn Township, in the Rural Valley quadrangle. The first oil wells in the Kittanning quadrangle were drilled in 1873 at Karns. Developments proceeded rapidly, and by 1875 the most productive parts of the quadrangle had been discovered and drilled over. Much of the territory was enormously productive at first, the yield of individual wells ranging from 100 to 2,000 barrels per day. One well near Chicora, though possibly not in the quadrangle, is reported to have produced 150,000 barrels of oil in nineteen months. At first the wells flowed, but as the flow decreased they were pumped, and as production diminished still further, torpedoing was resorted to in order to keep up the production. Since the early days the yield has steadily diminished, until now it is but a small part of the original amount. Many of the wells drilled at that time, however, are still pumping small quantities of oil.

Drilling has never fully ceased in the region. Additional small pools have been developed, and between the main pools many wells have been drilled which would have been unprofitable in the early days, but which, with cheaper methods of drilling and production and careful management, yield fair returns. It seems probable that there are small areas of such territory in the quadrangle still awaiting the drill and that, while the palmy days of the industry have passed, oil will long continue to be an important though constantly diminishing source of wealth in this quadrangle.

DEVELOPMENT OF THE NATURAL-GAS INDUSTRY.

Since sometime in the eighties the production of natural gas has been an important industry in the quadrangles. Gas was first encountered in drilling for oil. It was for a time allowed to go to waste, but as soon as its value for fuel and power and its suitability for use in various lines of manufacturing came to be appreciated, and methods of handling it were developed, active operations began in search of gas itself. These operations were highly successful in many localities. Large reservoirs of gas were tapped and much wealth has been derived from that source. Great activity in drilling followed the discovery of the principal reservoirs and so many wells had been sunk by 1895 that the supply from the shallow sands of the more important fields began to show signs of exhaustion. Within the last eight years much drilling has been done in all directions, with varying success, in the endeavor to maintain the supply. A good many scattering wells giving a fair yield have been struck. Some productive reservoirs of small extent have been discovered, like those at Ford City, and some of the older fields extended, like the Cowanshannock field in the direction of Muff and Belknap.

Notwithstanding all the drilling that has been done, it has been found impossible to keep up the supply and nearly all companies report a falling off. One company reports a decrease of 20 per cent in the last year. A number of wells have been drilled to the Speechley sand within the last three years and some notable strikes have been made, especially at Slate Lick and Worthington and in the vicinity of Muff. The Kerr well at Worthington, drilled in October, 1902, is a good example of the possibilities of the Speechley sand. This well started off at an estimated flow of from 22,000,000 to 30,000,000 cubic feet in twenty-four hours. One company operating in the vicinity of Muff reports that it has been able to shut in all its shallow sand wells and to supply its needs from the deeper sands. The amount produced individually by these wells is not known to the writer, but it is reported on good authority that up to June, 1903, with the exception of the Kerr well, none giving more than 1,000,000 to 2,000,000 cubic feet in twenty-four hours had ever been struck in the Speechley sand, and wells have been drilled into it in many parts of the quadrangles. Probably the larger number of wells in this sand have been complete failures. While, therefore, a big well like the Kerr, and some moderately productive wells may be found occasionally in the deeper sands, and smaller ones in the upper sands in territory that has not been thoroughly drilled, it seems improbable that any more large and highly productive reservoirs will be discovered, and thus the production of natural gas is bound to become a much less important source of wealth than it has been in the past.

GEOLOGIC OCCURRENCE OF OIL AND GAS.

In this region oil and gas occur in porous sandstone at a considerable depth below the surface. In descending order these sands are known to the driller as the Butler, Murrysville or Salt sand, Second or Hundred-foot sand, Thirty-foot sand, Third sand, Fourth sand, Fifth sand, Speechley sand, and Tiona sand.

The Murrysville and Hundred-foot sands have been the main gas producers in the past, but so many wells have been drilled into them that their production has decreased greatly and is still diminishing. A few wells have secured a good flow of gas from the Thirty-foot, and fewer still from the Fifth sand. The Fourth sand is not a gas-producing sand. Within the past few years much drilling has been done to the Speechley sand with results that have been stated above. In the vicinity of Goheenville the Tiona sand has recently attracted considerable attention and some good wells are reported in it. In a very few wells gas has been recorded in sands above the Murrysville, but generally in small quantities. So far as the writer is aware, no important supply of gas has been found in the upper sands except in the William Wadding well, in Wayne Township. This well started off with a production of about 1,000,000 cubic feet of gas in twenty-four hours from a sand about 300 feet above the Murrysville and about 600 feet below the Vanport limestone. The gas was soon exhausted.

DESCRIPTIONS OF OIL- AND GAS-BEARING ROCKS.

The oil- and gas-bearing rocks of central western Pennsylvania are deeply buried beneath the surface and their character and position are known only from the records of the numerous wells that have been drilled in search of oil and gas. In prospecting for these valuable products the Vanport (Ferriferous) limestone generally has been taken as a key stratum, and the identification of the oil and gas sands has largely depended upon their distance and sequence below this bed. The well sections on Pls. I to IV and the table of partial well records on pages 110 to 161 will be found useful for reference in reading this chapter.

MURRYSVILLE GAS SAND.

The first or uppermost member of the oil- and gas-bearing rocks is the Murrysville gas sand. In the Allegheny Valley proper this sand is generally known as the Butler gas sand, but to avoid confusion with the name Butler sandstone as applied to a member of the Allegheny formation, the name Murrysville is here used, because the first gas field in this sand was developed at Murrysville, in Westmoreland County.

In a large part of the territory the Murrysville sand is an important source of gas, but in other parts it is of much less importance than some of the underlying Venango oil sands, especially the Hundred-foot sand at the top of the group.

Depth below Vanport limestone.—The Murrysville sand was first noted as a separate and well-recognized gas-bearing stratum in some of the oil wells near the original oil pool developed in the northeast corner of Butler County. In the wells about Petrolia and Karns, this sand is probably represented by the "Thousand-foot shells." In this region the top of the sand varies from 760 to 825 feet below the Vanport limestone, and from 125 to 160 feet above the top of the Venango oil sands. North of this field it probably has no representative, or at least no sand occurs at this horizon that is at all continuous or well marked. In the southern part of the Kittanning quadrangle the interval between this sand and the Vanport limestone is 930 feet, and the interval between it and the oil sands is about 60 feet.

Assuming that the sands identified as Murrysville throughout the quadrangles are parts of a persistent stratum, a doubtful assumption, there is a gradual increase in its depth below the limestone from north to south and a gradual approach to the top of the Venango oil sands. In Allegheny Furnace No. 3 (262) and Montgomery No. 3 (298) wells, both near the boundary between the quadrangles, the Murrysville sand seems to be almost immediately on top of the Hundred-foot sand, or to be separated from it by only a few feet of shale, a condition that is of frequent occurrence in the Rural Valley quadrangle.

In 52 wells selected from various parts of the Kittanning quadrangle, the average interval between the Vanport limestone and the Murrysville sand is 862 feet, and in 45 wells in the Rural Valley quadrangle the average interval is 850 feet.

Thickness.—The thickness of the Murrysville sand varies as greatly as the intervals above described. In some wells it reaches a thickness of 100 feet. In others it is thin or broken into two benches by a bed of shale of varying thickness, and in still others it was not found at all. The mean thickness of the sand in 44 wells in the Rural Valley quadrangle is 49 feet.

Extent.—So far as available records show, the Murrysville sand can not be identified even as a gas-bearing horizon very far north of these quadrangles, although gas is occasionally noted in the rocks above the Venango sands in that region. To the south and east it persists as an important gas-producing rock at least as far as Murrysville, in Westmoreland County.

Variations.—It is much to be doubted whether the Murrysville sand as noted in the various well records is really one and the same continuous stratum. It seems highly probable that the sands occur as lenses rather than as beds of even thickness and wide distribution. Moreover, it may be doubted whether these lenses occupy the same geologic plane and are contemporaneous deposits.

The actual condition seems to be that beds of gas-bearing sandstone occur at various levels in the 200 feet of strata immediately overlying the Venango oil sands, the higher beds generally lying to the north and the lower beds to the south, and that the first of these gas-bearing sands encountered in drilling is always called the Murrysville sand.

VENANGO OIL SANDS.

As already noted, the oil in this region occurs in a well-defined group of sandstone beds, which has long been known as the "Venango oil-sand group."[a] This group of oil-bearing rocks is composed of beds of coarse sandstone alternating with bands of shale of various colors, among which red probably predominates. The sand beds rarely exceed 50 feet in thickness, and they vary in texture from fine-grained sandstone to coarse conglomerates. The characteristic features of the mass are the abundance of sand beds and the red shales with which they alternate.

The sands are known as the Second or Hundred-foot, Blue Monday, Boulder, Stray, Third, and Fourth sands. The upper members of this group are generally nonproductive, but the Stray, Third, and Fourth sands constitute the great oil reservoirs of this part of the Allegheny Valley.

Thickness and depth below the Vanport limestone.—The top of the Hundred-foot, the uppermost of the Venango oil sands, varies from 920 feet below the Vanport limestone in the northwestern part of the Kittanning quadrangle to 1,090 feet in the southern part. The former interval is shown in the Hazlewood and Evans wells near Karns, just north of the quadrangle, and the latter, which is an extreme measure, in the Rayburn well near Slate Lick. In 61 wells in the Kittanning quadrangle the mean interval is 985 feet, and in 45 wells in the Rural Valley quadrangle it is 954 feet. The bottom of the Fourth sand, which seems to be the lowest oil-producing rock, is here regarded as the bottom of the group. It varies from 1,250 feet below the limestone in the northwest corner of the area, as shown in the Hazlewood and Evans wells, to 1,490 feet in the Lewis Baker well near Slate Lick. Owing to the difficulty of identifying this sand outside of the oil-producing territory, there may be a misinterpretation of the record of the Baker well and a lower sand mistaken for the Fourth. However that may be, the interval from the limestone to the bottom of the Fourth sand, and therefore to the bottom of the group, increases from north to south just as the intervals to the top of the Murrysville sand and to the top of the Venango sands increase.

In the Rural Valley quadrangle the lowest sands of the group are not well developed, and the Fourth sand generally can not be identified. In 16 wells the bottom of the Fourth

[a] Carll, John F., Second Geol. Survey Pennsylvania, Rept. XIII, p. 130.

sand varies from 1,262 to 1,435 feet. In the same wells the thickness of the group varies from 306 to 485 feet, the mean thickness being 386 feet. Thirty-four wells in the Kittanning quadrangle give an average interval of 1,347 feet between the limestone and the bottom of the Fourth sand, and an average thickness for the group of 363 feet.

Second or Hundred-foot sand.—The uppermost of the Venango oil sands is a bed of sandstone which is called the Second sand in the oil region of northern Butler County, and Hundred-foot sand throughout the gas-bearing territory of Armstrong County. It was regarded by Carll as the equivalent of the First sand of Venango County, the change in name being due to a mistake in the identification of sands when drilling began in northern Butler County. In many places this sand is an unbroken bed 150 feet thick, but in others it is separated by thin bands of shale into two or three members, which in descending order are called Second or Hundred-foot sand, Fifty-foot sand, and Thirty-foot sand. So far as the writer is aware, this bed has never produced oil in these quadrangles, but it is one of the important gas-bearing rocks of Armstrong County.

Blue Monday and Boulder sands.—Near the center of the group are two thin sand beds, which in descending order are known as the Blue Monday and Boulder sands. Generally they are nonproductive and of no economic importance.

Stray, Third, and Fourth sands.—These are the great oil-bearing beds, and they constitute the lower part of the group. When drilling began in Butler County, the first oil-bearing sand was called the Venango Third sand. Later a lower productive sand was discovered, which was then called the Fourth sand. Carll [a] believes, with good reason, that the correlation of the Third sands of Butler and Venango counties is a mistake; that the Butler Third is equivalent to the Venango Second sand, and that the Butler Fourth is represented by the Venango Third sand. However that may be, the names originally adopted for the sands in this region will be used here. These names have been applied to the various oil-producing sands of the region according as the drillers believed that they could identify them as the one or the other, and consequently the oil-producing territory has been divided into Third sand pools, Fourth sand pools, etc. Where the sand could not be referred to either of these two main beds, the name of Stray sand has been adopted, making here and there a Stray sand pool. The Stray sand is regarded as occupying a higher position than the Third sand.

Outside of the pool in northern Butler County, where the names were first applied and where both the Third and Fourth sands occur, the one above the other, it is doubtful whether the different sands can be identified with any degree of certainty, or whether the Third sand of one locality is the same as the Third sand of another locality, and so on.

The Third sand yields a little gas in a few wells in the southern part of the Kittanning quadrangle.

Variations.—The remarks concerning the variability of the Murrysville sand apply equally well to the various Venango sands. The latter are not persistent but fugitive beds. They appear, increase in thickness, thin out, disappear, and their places are taken by other beds of similar character at a little higher or a little lower horizon, or farther on at the same horizon. Thin beds of sandstone may be separated by thin bands of shale, the shale bands may disappear, and a thick bed of sandstone take their places, or vice versa. Thus there are endless variations, such as may be seen where the beds can be traced at the surface. About the most that can be safely said is that in some localities one or more of the sandstone beds occurring toward the bottom of the group bears oil in paying quantities.

FIFTH SAND.

The fifth sand is recorded in various wells from 50 to 100 feet below the oil sands. It is generally thin. It is an important source of gas in a number of wells in the southern part of the quadrangles.

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[a] Carll, John F., Second Geol. Survey Pennsylvania, Rept. XIII, p. 130.

SPEECHLEY SAND.

This is called the Speechley sand because it is correlated with the sand of that name in Venango and Forest counties. Whether or not that correlation is correct can not at present be determined, but the name is accepted here.

This sand lies at varying depths below the Vanport limestone. In the Amos Steele well (245) in Bradys Bend Township, a sand at 2,030 feet below the Vanport limestone was called the Speechley sand; in the Rayburn well (182) near Slate Lick, the Speechley was recorded at 2,309 feet below the limestone. In six wells in the Rural Valley quadrangle the interval between the limestone and the Speechley sand varies only between 2,210 and 2,240 feet. The mean interval between the two beds in nine wells in the Kittanning quadrangle is 2,200 feet and in six wells in the Rural Valley quadrangle is 2,227 feet. The Speechley rarely exceeds a thickness of 50 feet and is frequently less. In the Colwell well (543) at Mahoning Furnace, two benches of sandstone in contact are recorded, the lower of which is called the Speechley. It seems more likely that the two should be regarded as the Speechley, and that it has here an unusual thickness. In the Moore well (485) a thin sand, called the Second Speechley, is recorded, 100 feet below the Speechley.

TIONA SANDS.

Within 150 feet below the Second Speechley lie the first and second "Tiona" sands. This name probably expresses the belief that these sands are to be correlated with the Tiona oil sands of Warren County. Such long-distance correlation has, however, but little value. The sand noted as Speechley in the Colwell well (543) is probably one of the Tiona sands, while the thin sand 150 feet above is probably the true Speechley. The facts appear to be that the zone 200 feet thick, beginning above with the first Speechley sand, is marked by beds of sandstone of greater or less development, one or more of which may be locally good gas producers.

As already stated, the Speechley sand is an important gas producer only in the vicinity of Slate Lick and Worthington, in the Kittanning quadrangle, and near Muff, in the Rural Valley quadrangle. According to the latest information received by the writer, the Tiona sand yields gas only in the vicinity of Gohcenville.

NO GAS BELOW THE TIONA SANDS.

Several wells in the two quadrangles have penetrated over 1,000 feet below the Speechley and Tiona sands without reporting either gas or oil, and the probabilities seem strongly against either ever being found in commercial quantities below the level of those sands.

STRATIGRAPHIC RELATIONS OF OIL AND GAS SANDS.

As fully shown on page 26, in the discussion of rocks not exposed, it seems probable that the Murrysville sand, the Hundred-foot sand, including its lower bench, and the Thirty-foot sand are included in the lower portion of the Pocono formation, the lower oil sands to the bottom of the Fourth sand are included in the Catskill formation, and the Speechley and Tiona sands occur at considerable depth in the Chemung formation.

AREAL DISTRIBUTION OF OIL AND GAS.

Oil pools.—By examining the structure-economic map it can be seen that the oil and gas of the quadrangles are not distributed uniformly throughout the beds in which they occur. In the first place, the portions of the quadrangles yielding the two substances are rather sharply separated, the oil-producing territory being confined to the western side, to the northwest corner, and to the northern margin west of Allegheny River. Throughout the remainder of the quadrangles only gas occurs.

Within the oil-producing territory the drill has revealed the fact that in certain well-defined areas the oil has accumulated in much greater quantities than in the surrounding

areas, in which oil wells are comparatively scattering and much less productive. These very productive areas are generally elongated and comparatively norrow, and are called belts or pools. What is true of the accumulation of oil is also true of the accumulation of gas, as shown below on this page. The mapping of the oil pools is based upon the grouping of producing wells at the present day, and may not fully represent the pools as they existed previous to the drilling of the territory. It is probable that many more large wells were drilled between Chicora and Karns than now remain, and that that region constituted one of the most important belts of the quadrangle.

Gas fields.—The gas-bearing territory of the quadrangles is more or less completely separated into several fields by areas of comparatively unproductive territory. These are the Winfield field, lying in Winfield, West Franklin, and North Buffalo townships; the Madison field, lying in Madison, Washington, and the northern part of East Franklin townships; the Glade Run field, lying to the west of Glade Run in eastern North Buffalo and southern East Franklin townships; the Limestone Run field, near the mouth of that stream, and the Cowanshannock field, including most of Kittanning, Cowanshannock, Valley, Boggs, and Wayne townships. In addition to these there are several smaller fields—one just east of Ford City, one along Garrett Run, one at Atwood, another north of Mahoning Furnace, and one in Redbank Township in the northeast corner of the Rural Valley quadrangle. All these contain comparatively few wells, and the product of these is generally not large. The one east of Ford City, developed in 1902, is the most important. A number of good wells were drilled, but the field proved to be of small extent.

Gas does not occur in the deepest parts of the synclines, though there are some apparent exceptions to the rule. In the vicinity of Slate Lick a few paying wells have been drilled to the Speechley sand in the bottom of the Boggsville syncline. Even here, however, the rocks are rising from the deeper part of the syncline to the locality of the well. A number of good wells were obtained in the Murrysville sand at Ford City, near the axis of the Fairmount syncline, but they are 100 feet above the bottom of the syncline. The two wells on the Starr farm south of Hays Run are on the axis of the Fairmount syncline, but on the crest of a low cross anticline that separates the depression on Pine Creek from the portion of the syncline farther south. The wells in the vicinity of Mosgrove and on Garrett Run, though near the synclinal axis, are still about 100 feet above the bottom of the basin. Southeast of Blanco there are two light wells in the Apollo syncline, but here again is a low cross anticline. In the vicinity of Rural Valley there are a few wells in the flat-lying strata fringing the base of the Greendale anticline, but dry holes have been the general result of drilling at greater distances from the anticline. Near Atwood a few wells have been obtained, but the records of these wells indicate a slight anticlinal structure at that place. The wells in the northeast corner of the Rural Valley quadrangle are near the crest of a pronounced anticline.

The conclusion can safely be drawn that gas has, in the main, accumulated along the anticlines and that the synclines are practically barren, though how far down on the flanks of the anticlines gas may have accumulated in paying quantities only the drill can reveal. It is now a generally accepted theory that structure exercises an important influence upon the accumulation of gas and oil, which tend to accumulate on the crests and along the flanks of the anticlines—gas at the top, oil next below, and water at the bottom, this distribution being in accordance with the relative densities of the substances. This is known as the anticlinal theory. Structure, however, is not the only determining factor in the accumulation of gas, for dry holes are occasionally drilled on the crests of anticlines, as is shown in this region by the Ruffner well, in Kittanning Township, and the H. S. Pontius well, in Wayne Township east of Belknap. In such cases the sands may be absent or not of sufficiently open or porous character to receive the gas and yield it up readily when tapped.

It has been customary in the past to locate wells with reference to a line drawn at some particular angle from another well, as along a line extending through a well at an angle of N. 30° or 45° E., etc., probably on the assumption that structure lines followed the straight

courses mapped by the Second Geological Survey of Pennsylvania. The better knowledge of the structure of the region now available shows the futility of such a method.

Possible extension of gas fields.—The anticlinal theory seems to be supported by all the developments in these quadrangles, and the directions in which future drilling may be done with a reasonable hope of success can be readily determined by the study of the map, which shows the position of the anticlines and the location of most of the existing wells. The writer would venture to suggest a few areas in which drilling might be done with favorable results. One such area of large extent lies along the southeastern flank of the Kellersburg anticline from Mahoning to New Bethlehem. Another extends along the northwestern flank of the Greendale anticline from Goheenville to the eastern margin of the Rural Valley quadrangle, with a mostly untested area of considerable breadth extending southward by Belknap to North Branch of South Fork of Pine Creek. The region along the Kellersburg anticline from Craigsville to the river does not appear to have been very thoroughly drilled, and might repay further testing. Those interested can easily find other areas of undrilled territory along the anticlines.

PARTIAL RECORDS OF OIL AND GAS WELLS.

Partial records of 549 wells in the Kittanning and Rural Valley quadrangles are given below in tabular form. These records have been kindly furnished by the larger companies, private individuals, and contractors, and as a general thing are published by permission. The table includes the depth and thickness of all economic beds given in the records, such as coal seams, limestones, and oil and gas sands. It is hoped that this information may prove helpful to those interested in developing the mineral resources of the quadrangles.

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles.

WINFIELD TOWNSHIP.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet*		*Feet.*	*Feet.*	*Feet.*	
1	Ellis Hasselgesser	Pittsburg Plate Glass Co.	1,250				Vanport	540	15	Murrysville	1,459	26	2,067	Little gas in Fourth sand.
							Mercer?	730?		Hundred-foot	1,614	65		
										Third	1,775	37		
										Fourth	1,912	21		
2	Casper Freehling No. 3	do	1,290	Upper Freeport	250	3	Freeport?	253	5	Murrysville	1,430	15	1,700	Moderate gas in Murrysville at 1,430.
							Vanport	545	15	Hundred-foot	1,588	112		
3	Casper Freehling No. 1	American Natural Gas Co.	1,250							Murrysville	1,367	21	1,521	Gas in Hundred-foot at 1,521.
										Hundred-foot	1,507			
4	Painter heirs	Pittsburg Plate Glass Co.	1,190	Upper Freeport	200	3	Vanport	453	15	Murrysville	1,338	25	1,575	Considerable gas in Murrysville.
							Mercer	613	17	Hundred-foot	1,498	54		
5	J. B. Bricker's heirs	do	1,260				Freeport	247		Murrysville	1,355	30	2,000	Gas in Hundred-foot at 1,515.
							Vanport	484	10	Hundred-foot	1,493	79		
							Mercer	655	12	Fourth	1,805	60		
										Fifth?	1,960	10		
6	H. E. Heller No. 2	G. L. Cabot	1,280				Vanport	510	20	Murrysville	1,385	20	1,952	
										Hundred-foot	1,530	70		
										Third	1,800	30		
										Fourth	1,860	35		
										Fifth	1,920	20		
7	Calvin Cruikshank	Pittsburg Plate Glass Co.	1,310	Brush Creek?	149	1	do	463	11	Murrysville	1,320	150	1,525	
										Hundred-foot	1,510			
8	P. J. Heck No. 1	G. L. Cabot	1,295				do	423	20	do	1,460	80	1,906	Gas in Hundred-foot at 1,470; gas in Fifth sand at 1,862.
										Fourth	1,750	18		
										Fifth	1,855	40		

9	Robt. Smith	Pittsburg Plate Glass Co.	1,360				do	475		Murrysville	1,372	15	3,571	A little gas in Speechley.
										Hundred-foot	1,514	86		
										Third	1,780	10		
										Fourth	1,815	25		
										Fifth?	1,875	25		
										Speechley	2,700	23		
10	H. E. Heller No. 1	G. L. Cabot	1,200				do	375	15	Murrysville	1,270	20	2,680	Gas at 2,641.
										Hundred-foot	1,410	80		
										Third	1,700	18		
										Fourth	1,736	20		
										Fifth	1,795	20		
										Speechley	2,627	31		
11	Bower No. 2	Home Gas Co.	1,070				do	312		Murrysville	1,170		1,756	Gas in Murrysville at 1,180; gas in Hundred-foot at 1,370.
										Hundred-foot	1,350			
										Fourth	1,670			
										Fifth	1,730			
12	Joshua Gilreath No. 1	G. L. Cabot	1,040				do	310		Hundred-foot	1,370		1,808	Gas at 1,180; gas in Hundred-foot at 1,350; rock pressure 300 pounds.
										Fifth	1,735			
13	J. G. Freehling	do	1,230				do	458		Murrysville	1,355		1,587	Gas in Hundred-foot at 1,510.
										Hundred-foot	1,470			
14	C. J. Noble	Pittsburg Plate Glass Co.	1,340				do	478	12	Murrysville	1,304	30	1,467+	Gas in Murrysville at 1,315; good gas in Hundred-foot at 1,467; rock pressure 80 pounds.
							Mercer?	603		Hundred-foot	1,453			
15	J. M. Smith	G. L. Cabot	1,345				Vanport	410	20	Murrysville	1,205		1,285+	Gas in Murrysville at 1,267 and 1,285.
16	Geo. W. Watson No. 1	American Natural Gas Co.	1,360							do	1,330		1,558	Gas in Hundred-foot at 1,510.
										Hundred-foot	1,470			
17	John F. Bricker No. 1	do	1,340				Vanport	445		Murrysville	1,340		1,761	Gas in Murrysville at 1,345.
18	Henry Ronneigh No. 1	T. W. Phillips	1,310							Hundred-foot	1,500		1,939	Gas at 1,344.
19	J. M. Smith No. 4	G. L. Cabot	1,340							Murrysville	1,268	25	1,605	Gas in Murrysville at 1,290; gas in Thirty-foot at 1,450.
										Hundred-foot	1,365	70		
										Thirty-foot	1,445	35		

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

WINFIELD TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Thickness.	Depth.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
20	J. M. Smith No. 1	G. L. Cabot	1,410				Vanport	455	18	Murrysville	1,300	25	1,971	Gas in Murrysville at 1,305; gas in Fifth at 1,868.
										Hundred-foot	1,480	80		
										Third	1,685	15		
										Fourth	1,800	20		
										Fifth	1,865	15		
21	John F. Bricker No. 2	American Natural Gas Co.	1,410							Murrysville	1,290	40	1,523	Gas in Murrysville at 1,295.
										Hundred-foot	1,470	53		
22	W. L. Gibson No. 1	G. L. Cabot	1,320				Vanport	453	18	Murrysville	1,330	20	1,572	Produces gas.
										Hundred-foot	1,470	50		
23	L. H. Bicker No. 2	do	1,420				do	452		Murrysville	1,335		1,922	Do.
										Fifth	1,880			
24	L. H. Bicker No. 1	do	1,330				do	370	20	Murrysville	1,200		1,807	Gas in Murrysville at 1,200; gas in Hundred-foot at 1,400; gas in Fifth at 1,790.
										Hundred-foot	1,380			
										Fifth	1,785			
25	F. Witte No. 4	do	1,370				do	400		Murrysville	1,290			Dry.
										Hundred-foot	1,400			
										Fourth	1,760			
										Fifth	1,827			
26	Clymer No. 1	American Natural Gas Co.	1,070				do	155		Murrysville			1,050	Gas in Murrysville at 1,041.
27	McKee Furnace No. 2	do	880							Hundred-foot	1,000		1,053	Gas in Hundred-foot at 1,026.
28	McKee Furnace No. 1	do	920							Murrysville	845		1,050+	Gas in Murrysville at 855; gas in Hundred-foot at 1,050.
										Hundred-foot	1,016			

29	McComb Painter No. 2	Home Gas Co	1,385							Fourth?	1,790		1,855	Gas at 1,300; gas at 1,610; gas in Fifth at 1,828.
										Fifth	1,824			
30	Henry Ronneigh heirs No. 1.	G. L. Cabot	1,390				Vanport	410						
31	McKee Furnace No. 3.	American Natural Gas Co.	980							Murrysville	835		1,030	Gas in Hundred-foot at 1,020.
										Hundred-foot	1,000			
32	McComb Painter No. 1	Home Gas Co	1,180							do	1,245			Gas at 1,050; gas in Hundred-foot at 1,625 and 1,260.
33	John Denny No. 1	John Denny	1,010				Vanport	25						
34	Lewis Heim No. 1		1,060				do	85		Murrysville	965		1,620	Gas in Third? at 1,300.
										Hundred-foot	1,137			
										?	1,300			
										Fourth?	1,433			
										Fifth?	1,488	30		
35	Laurence Denny	T. W. Phillips	1,070				do	175						
36	Steven McCafferty	Home Gas Co								Murrysville	1,005	66	1,550	Gas in Murrysville at 1,010.
										Hundred-foot	1,160			
										Third?	1,447			
										Fourth?	1,505			
37	John Denny No. 2	T. W. Phillips	1,235							Hundred-foot	1,445		1,853	Gas at 1,290; gas in Fifth at 1,825.
										Third?	1,700	30		
										Fourth?	1,749	41		
										Fifth	1,825			
38	McLafferty	Home Gas Co	1,380				Vanport	344		Murrysville	1,252		1,280	Produces gas.
39	J. M. McLaughlin	do	1,200?				do	170		do	1,057		1,087	Do.
40	Daniel McLaughlin	do	1,220?				do	178		do	1,051		1,077	Do.
41	Wm. A. Magee No. 2	Pittsburg Plate Glass Co.	1,115				do	85	22	do	950	40	1,159	Gas in Murrysville at 960; gas in Hundred-foot at 1,090.
										Hundred-foot	1,085	10		
42	Wm. A. Magee No. 3	do	1,230				do	172	22	Murrysville	1,040	10	1,070	Gas in Murrysville at 1,040.
43	M. J. Sloan No. 1	T. W. Phillips	1,330							Hundred-foot	1,317		1,667	Oil in Fourth at 1,672; flowed 7 barrels.
										Third	1,651			
										Fourth	1,667	50		

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

CLEARFIELD TOWNSHIP.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
44	Donahue No. 4	T. W. Phillips	1,330							Hundred-foot	1,388		1,713	Oil at 1,689.
										Fourth?	1,685			
45	Wm. A. Magee No. 1	Pittsburg Plate Glass Co.	1,250				Vanport	180	25	Hundred-foot	1,225	65	1,753	Gas in Hundred-foot at 1,235; gas in Fifth at 1,605.
										Third?	1,530	15		
										Fourth?	1,538	27		
										Fifth?	1,600	12		
46	Patrick Logue No. 3	T. W. Phillips	1,240							Hundred-foot	1,262		1,650	Oil in Third sand pumped 10 barrels.
										Third	1,578			
										Fourth	1,609	37		
47	Patrick Logue No. 4	do	1,300							Hundred-foot	1,355		1,745	Gas in Hundred-foot at 1,395; oil in Fourth, sand at 1,709; pumped 25 barrels.
										Third	1,670			
										Fourth	1,705	38		
48	McGucken	do	1,290				Vanport	200?		Hundred-foot	1,245			
										Fourth	1,511	59		
										Fifth	1,615	10		
49	John McLaughlin	do	1,330				do	270		Hundred-foot	1,265		1,931	Dry.
										Third	1,570			
										Fourth	1,608	32		
50	H. McCrea No. 3	Hildebrand Oil Co.	1,400				do	412		Hundred-foot	1,400			Produces oil.
										Fourth	1,748			
51	H. McCrea No. 2	do	1,400				do	400						Do.
52	H. McCrea No. 1	do	1,380				do	380						Do.
53	John Swain No. 1		1,380				do	396						Do.

54	Patrick McBride No. 1	T. W. Phillips	1,310							Hundred-foot	1,410		1,900	Produces gas.
										Third	1,725	25		
										Fourth	1,770	33		
55	M. Weiland	Frank McBride	1,280	Upper Freeport.	170	4?	Vanport	380?	15	Hundred-foot	1,415	120	1,808	A little gas in Hundred-foot at 1,420.
				Upper Kittanning?	310	12?				Third	1,690			
										Fourth	1,773	27		A little oil at 1,698; abandoned.
56	McShane No. 4	Reese, Marshall & McCollum.	1,315	Upper Freeport.	188	5	Vanport	470	15	Murrysville	1,300	60	1,925	Oil in Third sand.
										Hundred-foot	1,415	95		
										Third	1,680	45		
										Fourth	1,726	44		
57	Coyle No. 1	Fisher Oil Co.	1,245				do	359	24	Murrysville	1,225	65		Oil in Third.
										Hundred-foot	1,355	50		
										Third	1,614	52		
58	Chas. Reiley No. 8	Campbell & Murphy	1,185				do	265	20	Murrysville	1,115	30	1,529	Gas in Murrysville at 1,120.
										Hundred-foot	1,240	90		
										Third	1,496	33		Oil in Third at 1,506 to 1,514.
59	Chas. Reiley No. 5	do	1,290				do	390	20	Murrysville	1,230	35	1,650	Oil in Third at 1,630 to 1,640; gas at 1,255 and 1,375.
										Hundred-foot	1,350	50		
										Third	1,621	29		
60	Chas. Reiley No. 6	do	1,280				do	388	20	Murrysville	1,230	30		Oil at 1,628 to 1,635.
										Hundred-foot	1,340	60		
										Third	1,618	33		
61	Chas. Reiley No. 4	do	1,290				do	388	20	Murrysville	1,210	40	1,625	Oil at 1,610 to 1,614; gas at 1,215 and 1,355.
										Hundred-foot	1,305	65		
										Third	1,598	27		
62	Chas. Reiley No. 2	do	1,260				do	350	20	Murrysville	1,200	30	1,618	Oil at 1,594 to 1,602; gas at 1,205.
										Hundred-foot	1,320	60		
										Third	1,582	36		
63	Chas. Reiley No. 7	do	1,230				do	343	20	Murrysville	1,110	100		Oil at 1,568 to 1,574; flowed 80 barrels first 24 hours.
										Hundred-foot	1,290	95		
										Third	1,553	31		

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

DONEGAL TOWNSHIP.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
64	Harvey & Dolan No.3.	Thos. F. Harvey	1,280				Vanport	376		Third	1,600		1,639	Oil at 1,608.
65	Fisher No. 1	do	1,215				do	280		Murrysville	1,137		1,584	Oil in Third sand.
										Hundred-foot	1,265	100		
										Third	1,512	72		
66	Brady & Simpson No.1	do	1,225				do	246		do	1,470		1,539	Do.
67	Harvey & Dolan No.2.	do	1,280				do	335		do	1,586		1,632	Oil at 1,591.
68	Reep & Sutton No. 1	do	1,190				do	258		do	1,481		1,528	Oil at 1,491.
69	Hickey No. 3	Fisher Oil Co	1,150				do	352	22	Murrysville	1,170	50		
										Hundred-foot	1,365	50		
										Third	1,609			
70	Brady & Simpson No.2	Thos. F. Harvey	1,225				do	262		do	1,485		1,542	Oil at 1,493.
71	Hickey No. 12 ?	Fisher Oil Co	1,120				do	440	20	Hundred-foot	1,360	95	1,740	
										Fourth?	1,679	51		
72	Hickey No. 7	do	1,130				do	380	20	Murrysville	1,217	25		Oil in Third sand at 1,603.
										Hundred-foot	1,418	90		
										Third	1,627	33		
73	Breadon No. 1	Finnessy & Young	1,160				do	238		do	1,493		1,525	Oil at 1,501.
74	Gillespie No. 1	do	1,075				do	160		do	1,400	14	1,426	
75	Michael Maley No. 1	John Black & Co	1,290	Lower Kittanning.	193	4	do	217	20	Fourth?	1,467			
76	Daniel Goldlinger No.2	do	1,360	do	284	4	do	324	20	do	1,594			Produces oil.
77	Daniel Goldlinger No.1	do	1,350	do	320	4	do	360	20	Fourth	1,630	43		Do.
78	Hildebrant No. 4	Seybert Bros	1,360				do	416		Hundred-foot	1,406			Do.
										Third	1,565			

79	Hildebrant No. 7	do	1,340				do	396		Hundred-foot	1,386			Do
										Third	1,636			
80	Hildebrant No. 6	do	1,341				do	404		Hundred-foot	1,394			Do.
										Third	1,642			
81	Hildebrant No. 1	do	1,311				do	348		Hundred-foot	1,358			Do.
										Third	1,595	42		
82	Hildebrant No. 3	do	1,266				do	322		Hundred-foot	1,312			Do.
										Third	1,560			
83	Hildebrant No 2	do	1,270				do	323		Hundred-foot	1,313			
										Third	1,561	42		
84	Hildebrant No. 5	do	1,250				do	297		Hundred-foot	1,287			Do.
										Third	1,532			
85	Chas. Duffy No. 1	Christian Garing								do	1,400			Do.
86	Jno. King No. 4	Scharbach & Co	1,220	Lower Kittanning.	192		Vanport	232		do	1,487	38		Oil at 1,501.
87	Jno. King No. 3	do	1,235	do	226	4	do	264		do	1,505	34		Oil at 1,515.
88	Jno. King No. 2	do	1,320	do	292	4	do	332	20	do	1,573	33		Oil at 1,583.
89	Thos. Rogers No. 1	do	1,185				do	205						
90	Bradys Bend tract No. 18.	Hunter & Cummings	1,150	Lower Kittanning.	60	2	do	210	20	Hundred-foot	1,151			
										Third	1,461	23		Produces oil.
91	Bradys Bend tract No. 21.	do	1,140?				do	190		do	1,446	27		Do.
92	Bradys Bend tract No. 20.	do					do	257		Third?	1,473	50?		Do.
93	Bradys Bend tract No. 19 (Robt. Munroe's).	do	1,265				do	315	20	Murrysville	1,140	30		Abandoned.
										Hundred-foot	1,270			
										Third	1,536	54		
94	Ransell No. 2	Christian Garing	1,240							do	1,547			
95	John Black No. 5	John A. Black & Co	1,140				Vanport	159		do	1,436	40		
96	Black No. 4	do	1,150				do	164		do	1,422	35		
97	McKeever No. 1?	Jno. P. McKeever	1,210				do	240?						
98	Will No. 1	Daniel Burns	1,285				do	270	19	Third	1,520	22		Oil at 1,524 to 1,530.
99	Will No. 2	do	1,350				do	325	20	do	1,576	22		Oil at 1,579 to 1,594.
100	James L. Double	Wm. Peters	1,390				do	372						

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

DONEGAL TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
101	Chris. Michaels No. 1.	P. L. Burns	1,275				Vanport	245	21	Third	1,468	21		Oil in Third at 1,473.
102	A. Black No. 1		1,300	Lower Kittanning.	295		do	335		do	1,571	33		
103	C. F. Vensel No. 1	C. F. Vensel	1,370				do	381		do	1,598		1,652	Oil at 1,610 and 1,620.
104	C. F. Vensel No. 2	do	1,370				do	390		Murrysville	1,220			
										Hundred-foot	1,365			Gas in Murrysville.
										Third	1,607	51		Produces oil.
105	Pontius No. 3			Lower Kittanning.	255		do	295		do	1,530			
106	Henry PontiusNo. 2	Westermann Bros	1,320							do	1,525			
107	Henry Pontius No. 1	do	1,290							do	1,511	43		Oil at 1,513.
108	S. L. Pontius No. 4	Hunter & Cummings	1,390				Vanport	428	20	do	1,640	61		
109	S. L. Pontius No. 2	do	1,380				do	402	18	do	1,610?	61		
110	S. L. Pontius No. 1	do	1,350	Upper Freeport.	120	2	do	366	18	Hundred-foot	1,330	80		
				Lower Freeport	142	8?				Third?	1,561	36		
				Upper Kittanning.	249	4								
				Lower Kittanning.	325	3								
				Clarion	410	2								
				Brookville	448	2								
111	S. L. Pontius No. 10	do	1,330?							Third	1,510	113		
										Fourth	1,640	14		
112	I. Reep No. 3	Westermann Bros	1,395							Fourth	1,701	16	1,730	
113	I. Reep No. 5	do	1,370							Fourth	1,701	20		Produces oil.

114	I. Reep No. 6	do	1,390						do	1,710	14	1,688	Do.
115	Will No. 3	Titley & Co	1,360						Fourth?	1,652			Do.
116	Myers No. 1	do	1,370						Fourth	1,660			Do.
117	Shakeley No. 2	do	1,405						Third	1,642			Do.
118	Kammerer No. 4	do	1,410			Vanport	402		do	1,621			Do.
119	Kammerer No. 1	S. H. Kammerer & Co	1,410			do	424?		do	1,614			Do.
120	Graveyard well	do	1,360						do	1,585			Do.
121	Amos Reep No. 1	Kammerer Bros	1,430						do	1,673			Do.
122	Sain No. 1	S. H. Kammerer & Co.	1,400						do	1,607			Do.

FAIRVIEW TOWNSHIP.

123	S. W. McCullough	Pontius, McCullough & Co.	1,310						Third	1,532			Dry.
124	S. H. Kammerer No. 1	S. H. Kammerer	1,370						do	1,592	29		Produces oil.
125	King heirs No. 1	Seybert Bros	1,375						Hundred-foot	1,322			Do.
									Third	1,562	28		
126	Wm. Kammerer heirs No. 1.	Kammerer Bros	1,350			Vanport	370		do	1,564			Do.
127	D. & J. King No. 1	Seybert Bros	1,280						Hundred-foot	1,232			Do.
									Third	1,474	27		
128	King heirs No. 2	do	1,370						Hundred-foot	1,330			Do.
									Third	1,570	24		
129	Kaylor No. 4	do	1,370			Vanport	368		Hundred-foot	1,330			Do.
									Third	1,561	26		
130	John Kaylor	W. S. McCullough & Sons.	1,360			do	320						Do.
131	Kaylor No 3	Seybert Bros	1,305			do	323		Hundred-foot	1,283			Do.
									Third	1,512	26		
132	Kaylor No. 1	do	1,345			do	320		Hundred-foot	1,282			Do.
									Third	1,510	28		
133	Kaylor No. 2	do	1,365			do	345		Hundred-foot	1,316			Do.
									Third	1,544	24	1,647	
134	E. G. Frederick	Westermann Bros	1,460			do	460						Do.
135	Geo. Kemer	J. C. Widger	1,420			do	447					1,717	Do.

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

FAIRVIEW TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
136	Thorn	Westermann Bros.	1,436				Vanport	460		Third	1,643			Produces oil.
										Fourth	1,720		1,736	
137	Gilbert Bros. No. 2		1,295				do	299	23	Third	1,469	15		
										Fourth	1,537	12		
138	Sendler	McMeckin Bros.	1,360							Third	1,550		1,632	
139	Harrington	Mrs. John Clark	1,410?				Vanport	448	10	do	1,650			
140	Lawrence McLaughlin.	Producers' Oil Co.	1,410	Upper Freeport?	150		do	430						
				Lower Kittanning?	375									
				Clarion ?	477									
141	Andrew Mays No. 1	Davis Bros.	1,270				do	212		Hundred-foot	1,212		1,536	Oil at 1,524.
										Fourth	1,512			
142	Andrew Mays No. 2	do	1,310				do	287		Hundred-foot	1,287		1,604	Oil at 1,594.
										Fourth	1,587			
143	Andrew Mays No. 3	do	1,350				do	294		Hundred-foot	1,294		1,618	Oil at 1,598 to 1,618.
										Fourth	1,594			
144	David Kaylor No. 2	C. W. S. Peters	1,460				do	410		Hundred-foot	1,352			Produces oil.
										Fourth	1,685			
145	David Kaylor No. 3	do	1,458				do	410		Hundred-foot	1,356			Do.
										Fourth	1,681			
146	David Kaylor No. 4	do	1,460				do	416		Hundred-foot	1,362			Do.
										Fourth	1,689			
147	W. H. H. Riddle No. 5	T. R. Storey	1,400				do	413		Third	1,590			Do.
										Fourth	1,660			

148	W. H. H. Riddle No. 6.	do	1,460				do	471		Third	1,648			Do.
										Fourth	1,711			
149	W. H. H. Riddle No. 7.	do	1,400?				do	438		Third	1,681			Do.
150	W. H. H. Riddle No. 1.	do	1,230				do	243		do	1,420	15	1,438	Do.
151	W. H. H. Riddle No. 2.	do	1,250				do	255		do	1,432	13		Do.
152	W. H. H. Riddle No. 3	Riddle Farm Oil Co	1,280				do	280		do	1,457	19	2,460	Oil in Third and Fourth sands; a little gas in Speechley.
										Fourth	1,524	19		
										Speechley?	2,380	3		
153	S. Riddle No. 7	Hazelwood Oil Co	1,350?							Third	1,525		1,591	Produces oil.
154	Harmon No. 1	do	1,315							do	1,500		1,514	Drilled to Fourth, but no oil.
155	Storey No. 5	do	1,470							do	1,662		1,697	Do.
156	Storey No. 4	do								do	1,586		1,671	Do.
157	McClyman	Mattison & McDonald	1,244?				Vanport	165	20	do	1,390	12		Oil, 75 barrels per day.
										Fourth	1,470	20		
158	Madison well	E. E. Abrams	1,235				do	204		Hundred-foot	1,135	100		
										Third	1,377	20		
										Fourth	1,447			
159	Armenia well	do	1,195							Third	1,364	14		
160	P. R. Burke No. 1	P. R. Burke					Vanport	223	23	Hundred-foot	1,153	100	1,510	Dry.
										Third	1,408	20		
										Fourth	1,476	30		
161	Bermuda well	E. E. Abrams								Third	1,407	20		Produces oil.

SOUTH BUFFALO TOWNSHIP.

162	D. C. Boggs	Pittsburg Plate Glass Co.	890				Loyalhanna??	470	25	Third?	1,530	10		Murrysville and Hundred-foot both absent from this record.
163	Drake No. 1	American Natural Gas Co.	860				Vanport	165	18	Murrysville	1,095	30		
										Hundred-foot	1,160	100		Gas in Murrysville at 1,130.
										Third	1,590	25		
										Fourth	1,650	90		
164	Bickett Bros. No. 1	do	867							Murrysville	1,094	26		Produces gas.
165	H. C. Bricker	do	900				Vanport	220						Do.

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

SOUTH BUFFALO TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
166	Samuel Burnes No. 1.	American Natural Gas Co.	882	.....	.....	.....	.....	.....	.....	Murrysville...	1,120	.....	1,140	Produces gas.
167	Chas. Myers.....	Pittsburg Plate Glass Co.	1,195	Upper Freeport.	193	3	Vanport..	456	16	.....do.....	1,360	30	.....	
				Lower Freeport?	250	5	.....	.....	.....	Hundred-foot	1,460	105	.....	
										Fourth.....	1,895	12	2,014	Dry.

NORTH BUFFALO TOWNSHIP.

No.	Name.	Owner.	Elevation.	Coal seams. Name.	Depth.	Thickness.	Limestones. Name.	Depth.	Thickness.	Oil and gas sands. Name.	Depth.	Thickness.	Total depth of well.	Product.
168	J. Weaver No. 1.....	Carnegie Natural Gas Co.	1,213	Upper Freeport.	255	4	.....	.....	.....	Hundred-foot	1,540	100	2,890	Gas in Speechley; minute pressure: $\frac{1}{20}$, $\frac{2}{40}$, $\frac{3}{50}$, $\frac{4}{60}$, $\frac{5}{80}$; rock pressure 900 pounds.
										Third.....	1,830	25		
										Fourth.....	1,900	40		
										Fifth.....	2,000	20		
										Speechley.....	2,813	50		
169	R. Z. McClatchey.....	Pittsburg Plate Glass Co.	1,213	Brush Creek ?..	180	5	.....	.....	.....	Hundred-foot	1,560	135	2,868	Gas in Hundred-foot at 1,600; gas at 1,940; gas in Speechley at 2,820 and 2,835.
				Upper Kittanning?	400	5	.....	.....	.....	Third.....	1,830	20		
										Fourth.....	1,915	55		
										Fifth.....	2,000	10		
										Speechley.....	2,818	42		
170	Ralston heirs No. 1..	.....do.....	1,175	Lower Kittanning?	340?	4	Vanport..	374	21	Murrysville...	1,270	55	.....	Gas in Hundred-foot at 1,490; considered dry.
				Clarion.....	410	3	Mercer? ..	545	25	Hundred-foot	1,395	110		
										Third.....	1,705	30		
										Fourth.....	1,785	61		
										Fifth.....	1,905	15		

171	Pump Station No. 1 well.	do	900	Clarion	20	4				Murrysville	865	45	1,555	Gas in Hundred-foot at 1,065; gas in Fifth at 1,415.
										Hundred-foot	1,000	100		
										Third ?	1,250	83		
										Fifth ?	1,415	25		
172	T. J. Ewing No. 2	do	1,120	Upper Kittanning?	145	5	Vanport	262	23	Murrysville	1,155	50	1,820	Gas in Hundred-foot at 1,360; gas at 1,503; gas at 1,708.
				Clarion	305	5				Hundred-foot	1,285	145		
										Third ?	1,570	125		
										Fifth	1,705	25		
173	T. J. Ewing No. 1	do	1,230				Vanport	380	23	Murrysville	1,315	15		Gas in Hundred-foot and Thirty-foot.
										Hundred-foot	1,440	85		
										Thirty-foot ?	1,595	40		
										Third	1,718	20		
										Fourth	1,770	30		
										Fifth	1,825	25		
174	Lewis Baker	do	1,150?	Upper Freeport	125	4	do	375	10	Murrysville	1,300	70	2,775	Dry. A little gas in Fourth sand.
							Lime (block).	412	18	Hundred-foot	1,395	90		
										Third	1,678	18		
										Fourth	1,835	40		
										Fifth	1,938	15		
										Speechley	2,665	35		
175	John H. Blane	do	1,000	Lower Kittanning.	75	4	Mercer?	291	19	Hundred-foot	1,140	160		Dry hole.
										Third?	1,360	35		
										Fourth	1,450	12		
										Fifth	1,476	31		
176	Bridget McMackin No. 1?	do	1,160?				Vanport?	200	20	Hundred-foot	1,190	80		Very small gas well.
										Third	1,540	130		
										Fourth	1,734	31		
177	L. A. Meals No. 1	do	930?				Vanport	205						
178	do	do	1,010	Upper Freeport?	65	5	do	265	20	Murrysville	1,170	50		Gas in Hundred-foot at 1,384. Rock pressure 400 to 500 pounds.
				Coal?	285	3				Hundred-foot	1,280	108		
										Third	1,620	44		
										Fourth	1,685	24		

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

NORTH BUFFALO TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
179	James Thompson	Pittsburg Plate Glass Co.	1,100?							Murrysville	1,100	20	1,450	Slight gas at 1,072, 1,104, 1,300, and 1,433.
										Hundred-foot	1,200	105?		
										Third?	1,420	30		
180	Fink No. 2	do	980	Lower Kittanning?	39	3	Limestone.	27	12					
							Vanport?	60	40	Murrysville	969	48	1,017	Gas in Murrysville at 1,017.
181	Jacob Bricker No. 1	G. L. Cabot	1,000				Vanport	80		Third	1,310			
										Fifth	1,535	18	1,563	Gas at 972 and 1,000; gas in Third sand; gas at 1,545.
182	Rayburn heirs No. 1	Carnegie Natural Gas Co.	1,140	Lower Freeport?	145	4	do	360	16	Murrysville	1,245	105	2,740	Gas at 2,685 to 2,710.
										Hundred-foot	1,450	55		
										Fourth	1,740	20		
										Fifth	1,770	80		
										Speechley	2,685	55		
183	Dumbaugh heirs No. 1	do	1,110	Brookville?	464	4	do	385		Hundred-foot	1,375		2,910	Gas in Speechley; minute pressure: 1/55, 2/75, 3/90, 4/105, 5/120; rock pressure 940 pounds.
										Third	1,745	25		
										Fourth	1,830	65		
										Speechley	2,691	25		
184	Geo. M. McCracken	Philadelphia Co	1,050				Freeport?	32	12	Murrysville	1,277	33	2,790	Gas at 2,625; minute pressure: 1/40, 2/60, 5/120, 10/210, 20/360, 30/460.
										Hundred-foot	1,350	120		
										Third	1,555	25		
										Fourth	1,650	20		
										Fifth	1,727	35		
										Speechley	2,625	43		
185	W. A. Jack No. 1	Pittsburg Plate Glass Co.	1,090	Upper Freeport.	80	4	do	100	18	Murrysville	1,262	5	1,896	

				Upper Kittanning?	165	4	Vanport..	338	20	Hundred-foot	1,340	110?		
										Third?.....	1,550	18		
										Fourth?.....	1,730	15		
										Fifth.....	1,765	23		
186	John Miller No. 1.....	.....do.....	1,180	Upper Freeport.	192	4	.....	.....	.....	.....	.....	.....		
				Lower Kittanning.	362	4	Vanport..	402	18	Murrysville...	1,374	20	1,840	Gas at 1,384, 1,503, 1,514, and 1,840.
										Hundred-foot	1,402	50		
										Thirty-foot...	1,485	43		
										Fourth?.....	1,785	22		
										Fifth.....	1,827	13		
187	S. A. McClelland No. 2.	.....do.....	1,310	Upper Freeport.	265	4	.....do....	515	35	Murrysville...	1,405	65	.....	Gas at 1,940.
							Mercer?...	705	15	Hundred-foot	1,490	100		
										Third?.....	1,870	22		
										Fourth.....	1,925	35		
188	J. V. Easley No. 1.....	.....do.....	1,312	.....do.....	272	.....	Freeport..	280	6	Hundred-foot	1,500	80	1,980	Dry.
							Vanport..	522	25	Third.....	1,892	20		
										Fourth.....	1,942	34		
189	S. A. McClelland No. 1.	.....do.....	1,160	.....do.....	150	.....	.....	.....	.....	Murrysville...	1,245	22	1,812	
										Hundred-foot	1,380	80		
										Third.....	1,645	38		
										Fourth	1,692	14		
										Fifth.....	1,783	15		
190	Stonecipher	.....do.....	.....	Lower Kittanning?	190	.....	.....	.....	.....	.....	.....	.....	.....	Dry.
191	Samuel Gray No. 1 ...	American Window Glass Co.	1,150	Upper Freeport.	110	4	Freeport..	118	12	.....	.....	.....		
				Lower Freeport.	160	5	Vanport..	372	15	Murrysville...	1,280	18	2,791	Gas in Speechley.
				Middle Kittanning?	282	5	.....	.....	.....	Hundred-foot	1,366	62		
										Third?.....	1,620	46		
										Fifth?.....	1,845	5		
										Speechley.....	2,562	23		
192	Calvin Sarver No. 2..	.....do.....	980?	Upper Freeport.	31	5	? Limestone.	115	30	Murrysville...	1,195	20	1,835	
							Vanport..	285	20	Hundred-foot	1,335	72		
							? Limestone.	333	11	Third?.....	1,660	29		
										Fourth.....	1,749	20		
										Fifth.....	1,804	5		

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

NORTH BUFFALO TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
193	W. J. Bowser	American Window Glass Co.	1,090	Upper Freeport.	55	3	Freeport	65	9	Murrysville	1,226	12	1,259	Strong gas in Murrysville.
				Lower Kittanning.	280	4	Vanport	310	20					
194	Margaret Zimmer	do		Upper Freeport.	125	3	Freeport	135	7	Murrysville	1,295	12	2,720	Produces gas.
							Vanport	380	18	Hundred-foot	1,362	125		
										Fourth	1,778	24		
										Fifth	198	5		
										Speechley	2,596	60		
195	J. M. McKee	Pittsburg Plate Glass Co.	998	do	52	3	Freeport	66	16				83	Diamond drill.
196	Sturgeon No. 1	do	960?				Vanport	175	25				1,475	Abandoned.
197	R. W. Cowan No. 1	J. C. Walley & Co	1,040				do	280	15	Murrysville	1,210	55	1,420	Gas in Hundred-foot at 1,390 to 1,410.
										Hundred-foot	1,278	122		
198	Robert Larden	Pittsburg Plate Glass Co.	920				do	140	20	Murrysville?	1,110	146	1,297	Abandoned.
199	W. C. Reed	do	1,120				do	325	20	Hundred-foot	1,365	55	1,679	Do.
200	W. C. Barnett	do	1,090	Lower Freeport.	721	9							114	Diamond drill.
201	Wm. Cowan No. 1	J. C. Walley & Co					Vanport	320	15	Murrysville	1,240	62	1,487	Strong gas in Hundred-foot at 1,365.
										Hundred-foot	1,335	121		
202	James Bruner	American Window Glass Co.	1,160				Freeport	62	7	Third	1,600	11	1,871	
							Vanport	317	18	Fourth	1,700	30		
										Fifth	1,832	6		
203	Wm. J. Bowser	Wm. J. Bowser								Murrysville	1,241	59		
										Hundred-foot	1,315	80	1,735	
										Third?	1,610	15		

204	David R. Bowser, No. 3.	Apollo Gas Co	1,142	Upper Freeport.	80	3	Vanport	285	20	Murrysville	1,200	75	1,607	Gas in Murrysville, Hundred-foot, Thirty-foot and Third? sand.
										Hundred-foot	1,295	60		
										Thirty-foot	1,440	30		
										Third?	1,580	22		
205	E. B. Bowser	do	1,180	do	76	6				Murrysville	1,175	65	1,630	Produces gas; rock pressure 70 pounds.
										Hundred-foot	1,265	60		
										Third?	1,535	20		
										Fourth?	1,590	25		
206	Sarah C. Donze	do	1,140							Murrysville	1,159			Poor record.
										Hundred-foot	1,262			
207	David R. Bowser No. 2.	do	1,015	Lower Kittanning?	60	5	Vanport?	90	25	Murrysville?	1,044	102	1,405	Produces gas; minute pressure 105 pounds.
										Hundred-foot?	1,190	20		
										Third?	1,388	17		
208	Geo. Jack	J. C. Walley & Co	1,140				do	335	15	Murrysville	1,280	50	1,526	Gas at 1,400.
										Hundred-foot	1,385	131		
209	John Gearry	do	1,115				do	305	15	Murrysville	1,240	60		
										Hundred-foot	1,345	115	1,480	Gas in Hundred-foot at 1,350; minute pressure 40 pounds.
210	Dr. Allison, No. 1	do					do	330	15	Murrysville	1,208	57	1,480	
										Hundred-foot	1,303	97		
211	T. H. Allison	Pittsburg Plate Glass Co.	1,095	Lower Freeport.	22	1½							106	Diamond drill.

WEST FRANKLIN TOWNSHIP.

212	Jos. Brannen	Pittsburg Plate Glass Co.	1,300				Vanport	200	22	Murrysville	1,120	20		Gas at 1,120; abandoned.
										Hundred-foot	1,345	85		
										Third?	1,500	60		
										Fourth?	1,568	27		
										Fifth?	1,630	8		
213	M. E. Smith	do	1,170	Lower Freeport?	30	4	do	213	22	Murrysville	1,120	40	1,781	Gas in Murrysville; gas in Third sand at 1,515 to 1,575; gas in Fifth sand at 1,675.
										Hundred-foot	1,240	105		
										Third	1,515	105		
										Fourth	1,625	30		
										Fifth	1,670	25		

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

WEST FRANKLIN TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
214	J. K. Maxwell No. 3	G. L. Cabot	1,010				Vanport	23	20	Murrysville	965	20	1,515	Produces gas.
										Hundred-foot	1,085	75		
										Third	1,362	30		
										Fourth	1,441	15		
										Fifth	1,486	22		
215	J. K. Maxwell No. 4	do	1,160				do	247	16	Murrysville	1,130	15	1,728	Gas in Hundred-foot at 1,333; gas in Thirty-foot at 1,413; gas in Third at 1,591.
										Hundred-foot	1,225	110		
										Thirty-foot	1,375	45		
										Third	1,584	28		
										Fourth	1,630	10		
										Fifth	1,690	15		
216	J. K. Maxwell No. 2	do	990							Hundred-foot	985	95	1,505	
										Third	1,325	25		
										Fourth	1,360	.....		
										Fifth	1,420	.....		
217	J. K. Maxwell No. 1	do	1,000							Hundred-foot	915	95	.....	Gas in Stray sand at 1,218.
										Stray	1,198	.....		
										Third	1,245	48		
										Fourth	1,342	14		
										Fifth	1,406	28		
218	Peter Graff No. 5	Graff estate	1,015							Murrysville	890	20	1,458	Produces gas.
										Hundred-foot	930	70		
										Third	1,292	48		
										Fourth	1,342	14		
										Fifth	1,390	25		

219	Peter Graff No. 4	do	1,040							Murrysville	915	15	1,407	Gas in Fifth sand.
										Hundred-foot	955	95		
										Third	1,260	40		
										Fourth	1,303	33		
										Fifth	1,373	23		
220	Peter Graff No. 3	do	1,040							Murrysville?	836	15	2,003	
										Hundred-foot	955	100		
										Third	1,255	43		
										Fourth	1,306	18		
										Fifth	1,370	20		Best gas in Fifth sand.
221	Leslie Long No. 1	do	1,125	Upper Freeport	40		Vanport	305	20	Murrysville?	1,200	3	1,680	Poor record; dry.
				Lower Freeport	100					Hundred-foot	1,280	60		
										Third	1,550	23		
										Fourth	158	18		
										Fifth	1,655	23		
222	S. B. Claypool	American Window Glass Co.	1,200	Upper Freeport	130	3	Freeport	137?	28?	Murrysville	1,300	120	2,956	Produces gas.
				Lower Freeport	170	4	Vanport	370	10	Hundred-foot	1,430	110		
										Fourth	1,630	45		
										Fifth?	1,725	100		
										Speechley??	2,340	85		
										Prob. Speechley.	2,644	36		
223	Peter Kerr No. 1	T. W. Phillips	1,250							Hundred-foot	1,450			Gas in Speechley; one of the largest gas wells ever struck.
										Third?	1,700			
										Fifth?	1,800			
										Speechley	2,680			
224	Wm. McCully	Peter Graff & Co	1,420							Third?	1,445	52	1,497	Produces gas.
225	Riley & McCormick No. 3.?	Pittsburg Plate Glass Co.					Vanport	110	18	Murrysville	1,008	40	1,149	Gas in Murrysville; doubt as to correctness of location.

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

SUGAR CREEK TOWNSHIP.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
226	N. Keener No. 1	Limestone Natural Gas Co.	1,460	Lower Kittanning.	100	4?				Murrysville	1,100	10	1,300	A little gas at 1,105; abandoned.
227	James Crawford	do	1,490	do	100					Murrysville?	1,090		1,100	Strong gas at 1,090; pressure, 250 pounds first minute in casing.
228	S. F. Booher No. 2	do	1,435	do	110	4				doc	1,100	10	1,605	Gas in Murrysville, 30 pounds first minute; gas in Fifth sand at 1,565.
										Hundred-foot	1,270			
										Fifth	1,560	40		
229	Thos. A. Foster No. 2	Hunter & Cummings.	1,320							Fourth?	1,468	21		
230	Thos. A. Foster No. 1	do	1,340							Third?	1,970	23	1,543?	Produces gas.
										Fourth	1,501	25		
										Fifth	1,533	10		
231	C. W. Foster No. 4	do	1,360							Fourth	1,534	21	1,612?	
										Fifth	1,607	7		
232	James Henry	John Wick, Woll & Co.	1,410	Lower Kittanning.	140	4	Vanport	185		Hundred-foot	1,250		1,618	Gas in Murrysville? at 1,070; gas in Hundred-foot at 1,295.
233	John Patton	United Natural Gas Co.	1,220	do	58	4	do	85	22	do	1,110	105	1,550	Produces gas.
										Third	1,345	9		
										Fourth	1,443	20		
234	Scott Hepler	do	1,290	do	140	4	do	185	18	Hundred-foot	1,170		2,451	Gas in Speechley at 2,420.
										Third	1,420			
										Fourth	1,526			
										Speechley	2,410	10	1,708	Produces gas
235	Atkinson	do	1,310				do	280	5	Hundred-foot?	1,230	72		

										Third?	1,572	7		
236	John Adams No. 1	Hunter & Cummings	1,295	Lower Kittanning?	215	4	do	285	16	Murrysville	1,114	20	2,525	Do.
										Hundred-foot	1,295	90		
										Third	1,546	10		
										Fourth	1,604	12		
										Speechley	2,446	18		
237	Pontius No. 7	Westermann Bros	1,345				do	380	18	Third	1,596	45	1,641?	Produces oil.
238	Pontius No. 6	Hunter & Cummings	1,370				do	400	18	do	1,628	47	1,675?	Do.
239	Pontius No. 9	Westermann Bros	1,320				do	336	18	do	1,546	43	1,589?	Do.
240	Pontius No. 8	Hunter & Cummings	1,370				do	415	18	do	1,643	39	1,582	Do.
241	Pontius No. 11	do	1,380				do	420	20	do	1,628	61	1,768	Do.
										Fourth	1,703	15		Gas at 1,745.
										Fifth	1,743	25?		
242	Michael McCray No. 5	do	1,270	Upper Freeport.	30	6	do	260	38	Murrysville	1,068	2	1,490?	Produces oil.
										Hundred-foot	1,232	30		
										Stray	1,480	10		
243	I. Reep	Westermann Bros	1,320							Fourth	1,647	15	1,662?	Do.

BRADYS BEND TOWNSHIP.

244	Sauerkraut No. 1	Seybert Bros	1,350							Hundred-foot	1,316		1,583	Produces oil.
										Third	1,561	22		
245	Amos Steele	American Window Glass Co.	1,360	Upper Freeport.	100	5	Vanport	360	20	Hundred-foot	1,420	85	2,573	
				Middle Kittanning.	280	5				Third	1,578	22		
				Lower Kittanning.	320	4				Fourth	1,669	6		
										Speechley?	2,531	25		
246	Mary & G. W. Kepple No. 1.	Philadelphia Co	1,380?	Upper Freeport.	100	3	Vanport	353	19	Murrysville	1,200	20	3,202	Abandoned.
				Upper Kittanning.	235	2				Hundred-foot	1,295	105		
				Lower Kittanning.	310	3½				Third	1,570	15		
										Fourth	1,635	10		
										Speechley	2,522	14		
										Tiona?	2,710	35		

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

BRADYS BEND TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
247	Bradys Bend Iron Co. No. 4.	Bradys Bend Iron Co.	840?	.....	.....	.....	.....	.....	.....	Third.....	965	.....	1,260	Produced oil.
										Fourth.....	998	17		
248	Bradys Bend Iron Co. No. 5.	.....do.....	852	.....	.....	.....	.....	.....	.....	Hundred-foot?	715	20	1,100	Do.
										Third.....	1,026	24		
										Fourth.....	1,075	25		

EAST FRANKLIN TOWNSHIP.

249	David C. Bowser.....	Apollo Gas Co.....	1,025	.....	.....	.....	Vanport?.	125	.....	Third.....	1,440	.....	.....	Light gas at 1,060 to 1.155; gas in Third sand.
250	Thos. Hays No. 3.....	.....do.....	1,150	.....	.....	.....	Vanport..	245	37	Murrysville...	1,146	100	1,563?	Gas in Murrysville and Third sands.
										Hundred-foot	1,275	96		
										Third.....	1,535	25		
251	Thos. Hays No. 2.....	.....do.....	1,140	.....	.....	.....	.....do....	291	15	Murrysville...	1,210	26	.....	Gas in Third sand.
										Hundred-foot	1,305	40		
										Third.....	1,582	53		
252	David R. Bowser No. 1	.....do.....	1,090	.....	.....	.....	.....do....	160	25	Murrysville...	1,075	15	1,470?	Gas in top of Third sand; rock pressure 550 pounds.
										Hundred-foot	1,140	111		
										Third.....	1,455	15		
253	Thos. Hays No. 1.....	.....do.....	1,160	Lower Freeport?	91	3	.....do....	281	31	Murrysville...	1,190	40	1,892	Gas in Hundred-foot and Third sands; abandoned.
										Hundred-foot	1,230	144		
										Third.....	1,578	38		
										Fourth.....	1,680	30		
										Fifth.....	1,760	12		

254	Thos. Hays No. 4	do	1,000							Murrysville	948	106		Gas in Murrysville and Third sands.
										Hundred-foot	1,060	90		
										Third	1,368	71		
255	Ellermeyer No. 1	Manufacturers' Natural Gas Co.	1,160	Lower Freeport	40	4	Vanport	290	25	Murrysville	1,162	27		Gas in Murrysville and Hundred-foot and Thirty-foot sands; little gas in Burgoon sand.
				Middle Kittanning?	200	4				Hundred-foot	1,200	20		
										Thirty-foot	1,290	50		
										Third?	1,562	26		
256	James Wible No. 1	Kittanning Iron and Steel Co.	1,133				do	290	20	Murrysville	1,125	25	1,153	Produces gas.
257	Blair	do	1,100	Upper Freeport	90		do	325						Do.
258	J. B. Drake	Pittsburg Plate Glass Co.	1,185	do	22	3⅓							247	Diamond drill.
				Lower Freeport	77	4								
				Upper Kittanning	112	2⅓								
				Middle Kittanning	176	2 1/12								
				Lower Kittanning	235	3¼								
259	W. P. Bowser	do	1,285	Upper Freeport	210	1⅓							264	Do.
				Lower Freeport	257	3¼								
260	J. H. Guthrie	do	1,080	Middle Kittanning?	155	3				Murrysville	1,165	25	1,652	
				Lower Kittanning	205	4				Hundred-foot	1,260	25		Dry.
										Third?	1,605	25		
261	J. A. Patton	Local company	1,180	Lower Freeport	60		Freeport	30	15	Hundred-foot	1,275	25	2,402	Dry; supposed to be drilled to Speechley sand at 2,230.
				Lower Kittanning	235	6				Third?	1,525	25		
										Fourth?	1,620	20		
										Fifth?	1,620	20		
										? sand	2,230	60		
262	Allegheny Furnace No. 3.	Kittanning Iron and Steel Co.	875							Murrysville	780	20	1,253	Gas at 780.
										Hundred-foot?	885	55		
										Speechley	2,194	47		
263	Arnold No. 5	do	800							Murrysville?	635	175	1,288	Gas at 786 and above.
										Hundred-foot?	825	75		
										Thirty-foot	915	95		

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

EAST FRANKLIN TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
264	McGinnis	Limestone Natural Gas Co.	880							Murrysville	800	45	1,504	Gas in Murrysville at 805 and 855; show of gas at 1,280; rock pressure 140 pounds.
										Hundred-foot	885	90		
										Third	1,140	20		
										Fourth?	1,230	10		
										Fifth?	1,280	5		
265	Arnold No. 4	Kittanning Iron and Steel Co.	820							Murrysville	705	20	2,266	A little gas in Murrysville, Hundred-foot, and Fourth sands.
										Hundred-foot	803	67		
										Third? sand	1,060	35		
										Fourth	1,220	25		
266	Arnold No. 3	do	890							Murrysville	830	20	971	A little gas in Murrysville and strong gas in Hundred-foot.
										Hundred-foot	915	35		
267	Arnold No. 2	do	830							Murrysville	766	25	861	Gas in Murrysville at 766 to 776, and in Hundred-foot; pressure 76 pounds.
										Hundred-foot?	836	25		
268	Richardson No. 1	do	880							Hundred-foot	950	15	1,254	Dry.
										Third?	1,155	55		
269	W. R. Lemon	do	880							Hundred-foot	880	75	1,110	Gas in Hundred-foot between 880 and 905, at 925, and in Thirty-foot.
										Thirty-foot	965	25		
270	A. B. Wyant No. 1	Limestone Natural Gas Co.	1,160	Lower Kittanning.	190	4	Vanport	235	18	Murrysville	1,100	10	1,745	A little gas at 1,100.
										Hundred-foot	1,230	50		
										Third	1,575	20		
										Fourth	1,635			

271	H. E. Zellifrow	Apollo Gas Co	1,160	do	175		Vanport	190?		Hundred-foot	1,207		1,515	
										Third	1,470			
										Fourth	1,515			
272	Geo. McCracken No. 1.	Pittsburg Plate Glass Co.	1,130	do	170	4				Murrysville	1,002	15	1,530	Dry; Murrysville in three benches; a little gas in upper and lower benches.
										do	1,027	77		
										do	1,122	34		
										Hundred-foot	1,175	110		
										Fourth	1,520	8		
273	James Toy	Apollo Gas Co	1,320	Upper Freeport.	110	4				Murrysville	1,197	10	1,345	Light gas at 1,032; strong gas at 1,272.
										do	1,222	30		
										do	1,272	10		
274	J. B. Neal	Philadelphia Co		do	55	4	Vanport	310	8	Hundred-foot	1,250	65	2,800	Produces gas.
				Upper Kittanning.	140	2				Third	1,575	33		
				Lower Kittanning.	269	3				Fourth	1,630	5		
										Fifth?	1,775	10		
										Speechley?	2,444	8		
										do	2,550	70		
										Tiona?	2,635	15		
275	Riley & McCormick No. 2.	Pittsburg Plate Glass Co.	1,450				Vanport	140	15	Murrysville	1,032	42	1,079	Gas at 1,032 to 1,037 and 1,042 to 1,054.
276	Elder	Limestone Natural Gas Co.	810							do	740	25	880	Gas in Murrysville at 740 and 785, and in Hundred-foot at 860; rock pressure 135 pounds.
										do	773	35		
										Hundred-foot?	828	52		
277	D. D. Quigley	Reese Bros	850							Murrysville	795	27	928	Gas in Murrysville at 803, in Hundred-foot at 895 and 928; rock pressure 130 pounds.
										do	830	25		
										Hundred-foot?	875	53		
278	Mateer	Limestone Natural Gas Co.	1,000							Murrysville?	940	35	1,358	Gas at 900; light gas at 945, 1,165, and 1,332.
										do	985	15		
										Hundred-foot	1,020	20		
										Third	1,330	8		
279	Hooks	do	810							Murrysville	810	92		Gas at 728, 810, and 855. Rock pressure 155 pounds.

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

EAST FRANKLIN TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
280	Patton	Limestone Natural Gas Co.	810							Murrysville	810	30	1,344	Gas at 875, 1,010, and 1,310.
										do	865	25		
										Hundred-foot	910	50		
										Third?	1,120	10		
										Fourth?	1,180	15		
										Fifth	1,302	20		

WASHINGTON TOWNSHIP.

282	Dickey No. 1	Limestone Natural Gas Co.	810							Murrysville	715	20	900	Gas at 720, 810, and 870; rock pressure, 155 pounds.
										do	800	40		
										Hundred-foot	860	40		
281	Dickey No. 2	do	810							Murrysville	695	55	895	Gas at 815 and 861 to 881; rock pressure, 155 pounds; dry well.
										do	775	10		
										Hundred-foot	861	20		
283	Myers	Apollo Gas Co	1,250	Upper Kittanning?	140	3	Vanport	259	15	Murrysville	1,154	56	1,396	Produces gas.
				Lower Kittanning?	235	4				Hundred-foot	1,225	75		
284	Miller Bowser	do	1,360	Upper Kittanning?	240	5				Murrysville	1,225	74	1,380	Do.
										Hundred-foot	1,340	20		
285	Wm. Johns	do	1,260	Lower Freeport	75	3	Freeport	11	12	Murrysville	1,080	40	1,175	Gas at 1,170.
				Middle Kittanning?	166	4	Vanport	244	8	do	1,140	30		

286	Montgomery No. 4	Limestone Natural Gas Co.	990				do	40		do	925		1,600	Gas at 1,120 and 1,425.
										do	955			
										Hundred-foot	1,020			
287	Abraham Chrisman	Apollo Gas Co	1,310	Lower Freeport.	60	3	do	269	5	Murrysville	1,160	45	1,806	Gas in Murrysville
				Lower Kittanning.	230	4				Hundred-foot	1,276	59		
										Fourth?	1,605	60		
288	J. A. Colwell	do	810							Murrysville	610	50		Dry.
										Hundred-foot	833	143		
										Fourth?	1,132	38		
										Speechley	2,000	18		
										Tiona	2,175	55		
289	W. E. Titley	Limestone Natural Gas Co.	1,320	Middle Kittanning.	16					Murrysville	995		1,588	Do.
										Hundred-foot	1,150			
290	Thos. Templeton No. 1	Pittsburg Plate Glass Co.	1,240				Vanport	16	18?	Murrysville	944	34		
										Hundred-foot	1,037	99	1,514	

MANOR TOWNSHIP.

291	J. A. Logan	Philadelphia Co	1,050	Lower Freeport?	244	4				Murrysville	1,282	78	1,522	Gas in Murrysville at 1,341; minute pressure: 1/185; 2/290, 3/420; rock pressure, 500 pounds.
				Lower Kittanning?	360	3				Hundred-foot?	1,382	108		
292	T. Heilman	Pittsburg Plate Glass Co.	1,050				Vanport	326?	11	Murrysville?	1,320	35	2,036	Dry.
										Hundred-foot?	1,475	30		
293	John Heilman	do	985	Lower Kittanning.	225	5	Freeport	63	22	Murrysville	1,190		1,217	Gas at 1,192.
							Vanport	244	18					
294	Chas. Heilman No. 1	do	980	Lower Freeport.	125	5	Freeport	70	20	Hundred-foot	1,188		1,208	Gas at 1,188.
							Vanport	290	20					
295	Robert Heilman	Philadelphia Co	960				Freeport	26		Murrysville	1,196	79	1,420	Minute pressure: 1/120, 2/175, 5/220, 10/235; rock pressure, 250 pounds.
							Vanport	310?		Hundred-foot	1,290	85		
										Thirty-foot	1,393	10		
296	J. R. Christy	do	945								1,223			Minute pressure: ½/200, 1/280, 2/325, 4/340, 10/345; rock pressure, 400 pounds.
297	Montgomery No. 1	Pittsburg Plate Glass Co.	965				Vanport	310	15	Murrysville	1,205	10	1,215	Gas at 1,215.

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

MANOR TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
298	Montgomery No. 3	Pittsburg Plate Glass Co.	950				Vanport	305	20	Murrysville	1,200	90		Gas at 1,228 and 1,325.
										Hundred-foot	1,295	95		
299	Montgomery No. 2	do	1,000	Lower Kittanning.	296	4	Freeport	94	30	Murrysville	1,231		1,240	Gas at 1,231.
							Vanport	334	15					
300	Thos. Smith	Philadelphia Co	1,000	Upper Kittanning?	205	4				Murrysville	1,230	90	2,035	Gas at 1,450; minute pressure: 1/65, 2/115, 5/210, 10/280, 20/315.
				Brookville?	380	3				Hundred-foot	1,340	100		
										Thirty-foot	1,450	21		
301	J. and T. Heilman	do	1,010							Murrysville	1,222	56		Produces gas.
										Hundred-foot	1,293	84		
										Thirty-foot	1,410	28		
302	Geo. Aye	(?)	1,010	Lower Freeport.	120	6	Freeport	95	15	Murrysville	1,254	95	1,335	Produces gas; minute pressure: 1/74.
				Brookville?	470	7	Vanport	350	20	Hundred-foot	1,369	60		
303	Crytzer well	Pittsburg Plate Glass Co.	1,140	Upper Freeport.	175	6	Freeport	185	12	Murrysville	1,240	20	1,320	Gas below 1,290.
							Vanport	375	12	do	1,290	30		
304	Jacob Hobaugh No. 2.	Ford China Co	970				Freeport	15	5?	do	1,150	72	1,397	Produces gas.
										Hundred-foot	1,300			
305	Jacob Hobaugh No. 1.	do	920	Lower Kittanning.	115	5				Murrysville	1,073	70		Gas at 1,103 and 1,175.
306	Cronin No. 2	do	950				Vanport	125		do	1,090	82	1,205	Heavy gas at 1,184 to 1,205.
										Hundred-foot	1,157	48		
307	Rupert No. 1	Pittsburg Plate Glass Co.	820							Murrysville			1,315	Gas at 1,190 and 1,240; record probably unreliable.
										Hundred-foot	1,026	249		

RAYBURN TOWNSHIP.

308	McNees & Painter	Kittanning Clay Manufacturing Co.	850				Vanport	40	10	Murrysville	930	20	1,228	A little gas at 980.
							Mercer?	225	15	do	980	5		
										Hundred-foot	1,015	80		
309	A. Starr No. 1	Kittanning Plate Glass Co.	1,240				Vanport	300		Murrysville	1,283		1,503	Produces gas.
310	A. Starr No. 2	do	1,240				do	30		do	1,288		1,901	Gas at 1,288.

KITTANNING TOWNSHIP.

311	C. Heilman No. 1	Pittsburg Plate Glass Co.	1,260	Upper Freeport.	80	5	Freeport	400	13	Murrysville	1,255	75	1,944	Gas in 30 feet.
										Hundred-foot	1,340	95		
										Thirty-foot	1,450	30		
										Fourth?	1,670	10		
										Fifth	1,855	56		
312	C. Heilman No. 2	do	1,360	do	226	5				Murrysville	1,360	80	80	Produces gas.
										Hundred-foot	1,950	100		
										Thirty-foot	1,560	30		
										Fifth?	1,960	55		
313	Peter Heilman No. 2	(?)	1,260	Upper Kittanning?	110	3	Limestone?	123	7	Murrysville	1,166	64	1,970	Do.
				Lower Kittanning.	225	4	Vanport	260	10	Hundred-foot	1,275	40		
										Fifth	1,798	20		
314	John Schaffer No. 2	Pittsburg Plate Glass Co.	1,300				do	370	15	Murrysville	1,225	27	1,252	Gas in Murrysville.
315	Geo. L. Blose	Philadelphia Co	1,200	Lower Kittanning?	220					do	1,185	105	1,857	Gas at 1,210, 1,323, and 1,849.
										Hundred-foot	1,295	120		
										Fifth?	1,844	13		
316	McElroy	do	1,350	Upper Freeport.	70	3				Murrysville	1,215	55	1,926	Gas at 1,215; minute pressure: 1/20, 2/30, 3/58, 10/53; rock pressure, 73 pounds.
				Lower Kittanning?	275	3				Hundred-foot	1,295	135		
										Fifth?	1,877	16		
317	Sarah Everhart	do	1,225							Murrysville	1,160	68	3,014	Produces gas.
										Hundred-foot	1,238	117		
										Speechley	2,560	40		
										Tiona	2,700	20		
										do	2,740	50		

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

KITTANNING TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
318	Margaret Wallace	Philadelphia Co.	1,300	Upper Freeport.	80	4?				Murrysville	1,180	105	2,863	
										Hundred-foot	1,295	125		
										Fifth	1,830	38		
										Speechley	2,633	27		
										Tiona	2,750	12		
										do	2,772	76		
319	G. S. Rohrer	do	1,230	do	80	4?				Murrysville	1,230	35	2,905	
										Hundred-foot	1,280	150		
										Thirty-foot	1,455	15		
										Fifth	1,820	10		
										Speechley	2,630	30		
										Tiona	2,800	60		
320	Jos. H. Sowers No. 2	Pittsburg Plate Glass Co.	1,470				Freeport	207	15	Murrysville	1,330	50	1,548	Produces gas.
							Vanport	437	8					
321	Collum No. 1	Manufacturers' Natural Gas Co.	1,470	Upper Freeport.	100	4	Freeport	104	8	Murrysville	1,269	60	1,924	Gas in Murrysville, Hundred-foot, Thirty-foot, and Fifth.
				Lower Kittanning.	295	5	Vanport	295	5	do	1,345	55		
										Thirty-foot	1,430	75		
										Fifth	(?)	(?)		
322	Moorehead No. 1	do	1,480				Freeport	30	10	Murrysville	1,231	47	1,498	Gas in Murrysville.
										Hundred-foot	1,288	100		
										Murrysville	1,050	20		Light gas in Murrysville, strong gas in Thirty-foot.
323	Shelton No. 3	do	1,360							Hundred-foot	1,157	58		
										Thirty-foot	1,340	75	1,455	

324	Sullivan No. 1	Manufacturers' Natural Gas Co.	1,470	Upper Freeport	185	2	Vanport	360	7	Murrysville	1,288	33	1,529	Light gas in Murrysville.
										Hundred-foot	1,357	40		
										Thirty-foot	1,475	46		
325	Shelton No. 1	do	1,500				do	340	10	Murrysville	1,260	40	1,533	Gas in top and bottom of Murrysville.
										Hundred-foot	1,325	100		
326	Goldstrom No. 2	do	1,300				do	140	10	Murrysville	1,022	30	1,410	Gas in top of Murrysville; main gas in Thirty-foot.
										Hundred-foot	1,078	102		
										Thirty-foot	1,193	107		
327	Gitel No. 1	do	1,410				do	272	12	Murrysville	1,150	50	1,867	Gas in top and bottom of Murrysville.
										Hundred-foot	1,225	106		
										Thirty-foot	1,450	119		
										Fifth	1,770	15		
328	Cravener No. 1	Pittsburg Plate Glass Co.	1,160				do	10	7	Murrysville	880	105	1,618	Gas at 890, 1,125, and 1,203.
										Hundred-foot	988	154		
										Thirty-foot	1,166	49		
329	B. S. Cook	Philadelphia Co	1,480							Murrysville	1,323			Produces gas.
										Hundred-foot	1,455			
330	L. Smith No. 2	Eastern Oil Co	1,410	Upper Freeport	108		Freeport	130		Murrysville	1,250	68	1,447?	Gas at 1,265 and 1,430.
										Hundred-foot	1,360	87		
331	J. Rosenberger	do	1,440	do	105		do	125		Murrysville	1,252		1,445	Gas in Murrysville at 1,255 and 1,278; in Hundred-foot at 1,422 and 1,432.
										Hundred-foot	1,344			

VALLEY TOWNSHIP.

332	Goldstrom No. 1	Manufacturers' Natural Gas Co.	1,120							Murrysville	913	31	1,126	Gas in top and bottom of Murrysville in Hundred-foot and in Thirty-foot so strong as nearly to blow tools from hole.
										Hundred-foot	959	119		
										Thirty-foot	1,114	12		
333	Bishoff No. 1	do	1,300				Vanport	165	8	Murrysville	1,072	30	1,291	Gas in Murrysville and Hundred-foot.
										Hundred-foot	1,122	169		

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

VALLEY TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
334	Shelton No. 2	Manufacturers' Natural Gas Co.	1,100							Murrysville	855	35	1,533	Gas in top and bottom of Murrysville.
										Hundred-foot	915	135		
										Thirty-foot	1,060	58		
										Fourth?	1,400	40		
										Fifth?	1,508	15		
335	Turney No. 1?	Pittsburg Plate Glass Co.	1,090?							Murrysville	820?	45	1,605	Gas at 893, 912, and 920.
										Hundred-foot	893	97		
										Thirty-foot?	1,030	145		
										Fifth?	1,470	10		
336	J. J. McAfee No. 2	People's Natural Gas Co.	1,005							Murrysville	885	35	1,568	Gas at 920 to 1,070.
										Hundred-foot	960	65		
										Fifth?	1,496	19		
337	J. J. McAfee No. 1	Pittsburg Plate Glass Co.	980							Murrysville	890	30	1,600	Light gas in Murrysville and in Hundred-foot at 995.
										Hundred-foot	980	80		
										Fourth?	1,435	20		
338	Henry Bear	Eastern Oil Co	1,230							Murrysville	990		1,204	Gas at 990 and 1,114 light.
										Hundred-foot	1,109			
339	James Hawkins	do	1,430							Murrysville	1,153	93?	1,385	Gas at 1,153, 1,158, and 1,360.
										Hundred-foot	1,256	129?		
340	Jno. McIlwain No. 1	People's Natural Gas Co.	1,340							Murrysville	995	70	1,289	Gas at 1,065, 1,080, 1,130, and 1,275.
										Hundred-foot	1,165	124		
341	J. N. Southworth?	Eastern Oil Co	1,360	Lower Kittanning.	158					Murrysville	1,121	1??	1,351	Produces gas 600,000 feet in 24 hours.
										Hundred-foot	1,237	13		

342	J. Sinclair No. 2	do	1,440				Vanport	420?		Murrysville	1,165	70	1,309	Gas at 1,165, 15 pounds; gas at 1,280, 34 pounds.
										Hundred-foot	1,340	66		
343	James Adams	Greenbaum, Runyan & Co.	1,340							Murrysville	1,083		1,358	Dry.
										Hundred-foot	1,180			
344	Peter Schreckengost	Eastern Oil Co	1,400							Murrysville	1,121		1,352	Gas at 1,151, 1,228, and 1,282; pressure in 10 minutes, 100 pounds.
										Hundred-foot	1,228	54		
345	J. Zimmerman	do	1,280				Vanport	105		Murrysville	990	100	1,224	Gas at 995 and 1,025.
										Hundred-foot	1,110	85		
346	Samuel Runyan	do	1,560				do	314		Murrysville	1,240	91	1,478	Gas at 1,247 and 1,360.
										Hundred-foot	1,348	63		
										Thirty-foot	1,417	10		
347	E. C. & J. E. McIlwain.	People's Natural Gas Co.	1,380							Murrysville	1,080	45	1,230	Gas at 1,200 to 1,230.
										Hundred-foot	1,200			
348	R. R. Barker No. 2	Eastern Oil Co	1,430							Murrysville	1,156	81	1,364	Gas at 1,156, 1,262, and 1,284.
										Hundred-foot	1,246	104		
349	B. Nulton	do	1,300				Vanport	90		Murrysville	1,010	80	1,268	Gas at 1,110.
										Hundred-foot	1,110	80		
350	E. C. & J. E. McIlwain.	People's Natural Gas Co.	1,200				do	40	8	Murrysville	865	30	1,140	Gas at 865.
										Hundred-foot	925	30		
351	Wm. Brunt	Philadelphia Co	1,250	Lower Freeport	143	3?				Murrysville	1,250	82	2,981	Produces gas.
										Hundred-foot	1,342	108		
										Speechley	2,665	19		
352	Thos. N. Bowser No. 1	do	1,260	Upper Kittanning.	218	4?				Murrysville	1,275	80	1,501	Do.
										Hundred-foot	1,385	60		
										Thirty-foot	1,475	23		
353	Daniel Slagle	Eastern Oil Co	1,355				Vanport	330		Murrysville	1,260	95	1,528	Gas at 1,270 and 1,345.
										Hundred-foot	1,375	80		
										Thirty-foot	1,468	17		
354	Thos. N. Bowser No. 2	Philadelphia Co	1,300	Upper Freeport	100	3?				Murrysville	1,269	98	1,531	Produces gas.
				Upper Kittanning.	204	4?				Hundred-foot	1,377	63		
										Thirty-foot	1,459	41		
355	Homer Rhodes No. 2	Kittanning Plate Glass Co.	1,280							Murrysville	1,238		1,262	Gas in top of Murrysville.
356	John Rhodes	Philadelphia Co	1,210	Upper Freeport	95	3?				do	1,164	77		Produces gas.

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

VALLEY TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
357	Mosgrove No. 2	People's Natural Gas Co.	1,010				Vanport	24	8	do	875	65	1,133	Gas at 875 and 1,080.
										Hundred-foot	960	100		
										Thirty-foot	1,075			
358	H. S. Slease No. 3	Pittsburg Plate Glass Co.	1,150	Lower Kittanning?	160	4	do	180	10	Murrysville	1,036	40	1,093	Gas at 1,040.
359	Mosgrove No. 1	People's Natural Gas Co.	1,020							do	890	10	900	Gas at 890.

BOGGS TOWNSHIP.

360	Peart No. 2	Pittsburg Plate Glass Co.	1,070							Murrysville	750	130	1,463	Gas at 750.
										Hundred-foot	940	40		
										Fourth?	1,284	12		
										Fifth?	1,350	25		
361	J. & F. Powers?	Philadelphia Co	1,060	Brookville?	60	2				Murrysville	787	117	2,305	A little gas in top of Hundred-foot.
										Hundred-foot	925	90		
										Fifth	1,405	10		
										Speechley	2,185	31		
362	Mosgrove No. 2	People's Natural Gas Co.	1,080				Vanport	90		Murrysville	900	115	1,130	Gas at 905 and 1,105.
363	John Moore	Greenbaum, Runyan & Co.	1,220	Mercer?	128	4?				do	822		850	Produces gas.
364	John Dill No. 1	People's Natural Gas Co.	1,340							do	840	70	2,270	Gas at 2,254.
										Hundred-foot	920	95		
										Fifth	1,440	15		

										Speechley?	2,178	40		
										do	2,243	17		
365	Robt. Martin No. 1	do	1,270	Lower Kittanning.	80	4				Murrysville	940	45	1,286	Dry.
										Hundred-foot	1,050	50		
366	David Dever No. 1	do	1,225?				Freeport	25	10	Murrysville	1,045	75	2,800	Gas at 1,050 and 1,185.
										Hundred-foot	1,140	20		
										Fourth	1,600	15		
										Speechley	2,525	50		
367	J. E. B. Mateer No. 2?	do	1,280				Vanport	225	8	Murrysville	1,065	45	1,370	Gas at 1,065, 1,105, 1,125 and 1,275.
										Hundred-foot	1,125	20		
										Thirty-foot	1,270	45		
368	David Dever No. 4	do	1,290							Murrysville	1,140	40	1,460	Gas at 1,140 and 1,250.
										Hundred-foot	1,250	75		
369	J. M. McCullough No. 1.						Vanport	40		Murrysville	895	45	1,232	Gas at 895, 1,060, and 1,158.
										Hundred-foot	1,060	30		
										Thirty-foot	1,120	38		
370	J. E. B. Mateer No. 3	People's Natural Gas Co.	1,100	Clarion	190					Murrysville	1,050	15	1,268	Dry.
										Hundred-foot	1,090	40		
371	L. B. Bowser No. 2	do	1,010							Murrysville	870	50	1,109	
										Hundred-foot	930	115		
372	John Upperman No. 1	do	1,030				Vanport	20	20	Murrysville	880	20	1,092	Produces gas at 1,060 to 1,092.
										Hundred-foot	920	110		
										Thirty-foot	1,060			
373	Hugh and Sarah Heffelfinger.	do	1,050							Murrysville	857	73	1,087	Gas at 915 and 1,055.
										Hundred-foot	963	92		
374	J. E. B. Mateer No. 1?	do	1,200?	Upper Kittanning?	100	4				Murrysville	1,110	50	1,329	Gas at 1,110, 1,180, and 1,305.
				Lower Kittanning?	210	4				Hundred-foot	1,175	105		
										Thirty-foot	1,300			
375	J. W. Baum	do	1,070							Murrysville	830	70	2,315	Produces gas.
										Hundred-foot	930	30		
										Thirty-foot	1,010	5		
										Speechley	2,220	22		
376	L. Bowser No. 1	do	1,170							Murrysville	800		2,565	Gas at 830 and 2,200.
										Speechley	2,200	35		

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

BOGGS TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
377	A. Heffelfinger No. 2	Apollo Gas Co	1,200	Brookville?	80	4				Murrysville	850	15	868	
378	Frank B. Martin No. 1	People's Natural Gas Co.	1,170	do.?	60	6?				do	817	15	832	Gas at 817 to 832.
379	Wm. Martin No. 1	do	1,160							do	1,070	25	1,396	Gas at 1,070, 1,230, and 1,270.
										Hundred-foot	1,200	50		
										Thirty-foot	1,270	50		
380	Frank B. Martin No. 2	do	1,190							Murrysville	754	18	772	Gas at 754.
381	Mrs. Rumbaugh No. 1	do	1,215							do	750	45	847	Gas at 750.
										Hundred-foot	815	32?		
382	J. A. White No. 1	Apollo Gas Co	1,260?							Murrysville	770	50	900	Gas in Murrysville.
										Hundred-foot	840	25		
383	Wm. Martin No. 2	do	1,440?	Lower Kittanning.	185		Vanport	212		Murrysville	1,060	65	2,648	Strong gas in Tiona sand.
										Hundred-foot	1,140	100		
										Thirty-foot	1,255	30		
										Speechley	2,440	60		
										Tiona	2,625	23		
384	Geo. W. Sowers No. 1	People's Natural Gas Co.	1,470	Upper Freeport.	80	4	do	303	6	Murrysville	1,060		1,076	Gas at 1,060.
385	D. C. White No. 1	do	1,550	Upper Kittanning?	180		do	320		do	1,160	90	1,370	Gas at 1,160, 1,250, and 1,335.
										Hundred-foot	1,260	75		
386	Jackson Zimmerman	do	1,270				do	217	8	Murrysville	1,050	50	1,317	Gas at 1,050 and 1,110.
										Hundred-foot	1,110	175		
387	Benj. Evans No. 1	Apollo Gas Co	1,325				do	180	9	Murrysville	1,000	32	1,037	Gas in Murrysville.
388	Benj. Evans No. 2	do	1,385				do	200	10	do	1,030	18	1,058	Do.

389	David Dever No. 2	People's Natural Gas Co.	1,300?				Freeport	120	5	do	1,040	25	1,395	Dry.
										Hundred-foot	1,180			
										Thirty-foot	1,308	37		
390	David Dever No. 3	do	1,370	Upper Freeport	30	4				Murrysville	1,100	80	1,385	Gas at 1,100 and 1,285.
										Hundred-foot	1,219	90		
										Thirty-foot	1,320	20		
391	J. A. White	Goheenville Gas Co	1,100				Vanport	20		Murrysville	870?	25	1,030	Gas at 955; increasing downward.
										Hundred-foot	950	80		
392	J. P. Kammerdiener	Apollo Gas Co	1,150	Lower Kittanning.	35	4	do	70	8	Murrysville	917	18		Gas in Murrysville.
										Hundred-foot	987	70		
										Thirty-foot	1,095	60		
393	Henry Houser heirs	do	1,340	do	260	4	do	300	8	Murrysville	1,140	25	1,771	Do.
										Hundred-foot	1,180	70		
										Thirty-foot	1,260	90		
										Third?	1,600	10		
										Fourth	1,670	15		
394	Robert McAfoose	do	1,030				do	40	8	Murrysville	884	15	907	Do.
395	W. H. Kuhns	do	1,080	Clarion	90	2	do	40	15	do	890	25	1,560	Do.
										do	935	40		
										Hundred-foot	975	100		
										Thirty-foot	1,085	60		
										Fourth?	1,346	36		
										Fifth?	1,530	15		
396	J. M. Halderman	do	1,280	Upper Freeport	40	3	do	285	8	Murrysville	1,127	50	2,804	Dry; a little gas in Murrysville.
										Hundred-foot	1,187	40		
										do	1,257	25		
										Thirty-foot	1,322	85		
										Third?	1,602	10		
										Fourth?	1,687	10		
										Speechley	2,527	35		
397	John Brosius No. 2?	do	1,330	Lower Freeport?	94	5	Freeport	70	4	Murrysville	1,180	12	1,767	Gas in Murrysville.
				Lower Kittanning?	289	4	Vanport	330	9	Hundred-foot	1,247	45		
										Thirty-foot	1,300	115		
										Fourth	1,725	20		

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

BOGGS TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
398	John Brosius No. 1...	Apollo Gas Co.....	1,330	Lower Freeport?	90	4	Freeport..	64	6	Murrysville...	1,165	55	1,310	Gas at 1,298; minute pressure: 1/130, 2/200, 5/270; rock pressure 350 pounds.
										Hundred-foot	1,250	100		

MADISON TOWNSHIP.

399	O. Gray No. 1.....	Apollo Gas Co.....	1,320?	.....	.....	.....	Vanport..	48	12	Murrysville...	896	17	1,615	A little gas in Murrysville. Gas in Fourth, 15 pounds per minute; 300 pounds rock pressure.
										Hundred-foot	1,030	90	1	
										Fourth?.....	1,379	30		
400	Harvey Gray heirs...	.....do.....	1,360	Lower Kittanning.	90	4	.....do....	114	20	Murrysville...	960	35	1,554	Produces gas.
										Hundred-foot	1,095	35		
										Fourth?.....	1,435	30		
401	Geo. A. Balsiger.....	.....do.....	1,450	.....do.....	170	4	.....do....	200	10	Murrysville...	1,038	30	1,068	Do.
402	J. H. Chrisman.....	.....do.....	1,460	.....	.....	.....	.....do....	190	20	.....do.....	1,050	40	1,582	Do.
										Hundred-foot	1,160	75	1	
403	C. M. Smith.....	.....do.....	1,180	.....	.....	.....	.....do....	35	10	Murrysville...	890	30	1,439	Do.
										Hundred-foot	1,035	40		
										Fourth?.....	1,405	35		
404	Hamilton Chrisman..	.....do.....	1,110	.....	.....	.....	.....	.....	.....	Murrysville...	755	50	1,453	Do.
										Hundred-foot	915	40		
										.....do.....	985	30		
405	James D. Cobbett....	.....do.....	1,080	.....	.....	.....	.....	.....	.....	Murrysville...	740	30	1,311	Gas in Murrysville at 808 to 838.
										.....do.....	808	30		
										Hundred-foot	843	28		

406	S. E. Balsiger	do	1,470				Vanport	130?	10	Murrysville	1,014	26	1,540	Produces gas.
										Hundred-foot	1,080	110		
										Fourth?	1,490	50		
407	D. O. Collen	do	1,500	Lower Kittanning.	180	5	do	205	15	Murrysville	1,044	70	1,606	Gas at 1,076 and 1,583.
										Third?	1,475	20		
										Fourth?	1,538	68		
408	Maginnis	do	1,460	do	85	4	do	109	15	Murrysville	960	52		
										Hundred-foot	1,097	20	1,123	Gas in Murrysville.
409	J. E. Shoemaker	do	1,300?	Upper Kittanning?	50		do	196	8	Murrysville	1,026	126	2,505	A little gas at 1,590; abandoned.
										Hundred-foot	1,160			
										Fourth?	1,555	50		
										Fifth?	1,670	10		
										Speechley	2,415	40		
410	H. Pence	Climax Fire Brick Co.	1,370							Murrysville	867	68	1,421	Gas at 867.
411	Hettrick	do	1,340							do	780	45	872	Gas at 815.
412	Croson No. 2	do	1,390							Murrysville (part of).	904	16	1,428	Gas at 860.
										Hundred-foot	1,080	100		
413	Meredith	do	1,460				Vanport	50		Murrysville	955	45	1,502	Gas at 915 and 1,137.
										Hundred-foot	1,130			
414	Croson No. 1	do	1,300							Murrysville	762	17?	1,281	Gas at 820 and 850. Record defective.
										Hundred-foot	1,150	10?		
415	Stuart	do	1,330							Murrysville?	830	53	1,027	Gas at 780, 830 and 1,002. Record defective.
										Hundred-foot	1,002	10		

PLUM CREEK TOWNSHIP.

416	John Boyer	Eastern Oil Co.	1,440	Upper Freeport.	360		Freeport	375		Murrysville	1,475		1,499	Gas at 1,482.
				Lower Freeport	420									
				Middle Kittanning?	515									
417	P. Rearick	do	1,250	Lower Freeport	200					do	1,275		1,888	Gas at 1,070, 1,140, and 1,445.
										Hundred-foot	1,365			

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

PLUM CREEK TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
418	Burns	Eastern Oil Co	1,350	Coal?	388	5	Vanport	393	10	Murrysville	1,290	46	1,958	Gas in Murrysville; gas at 1,462 and 1,631.
										Hundred-foot	1,432	54		
										Third?	1,604	32		
419	John Bell	do	1,345	Upper Freeport?	180	4	?Limestone	340		Murrysville	1,295			Gas at 1,435, 1,633, and 1,665.
										Hundred-foot	1,430	88	1,719	
										Third?	1,605	35		
										Fourth?	1,660	40		
420	Madison Wagoner	do	1,460	do	285					Hundred-foot?	1,450	20		Gas at 1,456, 1,720, and 1,770.
				Upper Kittanning?	400					Third?	1,716			
										Fourth?	1,768	4		

COWANSHANNOCK TOWNSHIP.

421	N. H. Duff	Philadelphia Co	1,260	Upper Freeport?	294	5?				Murrysville			3,055	Produces gas.
										Hundred-foot	1,380	210		
										Fifth?	2,030	75		
										Tiona?	2,820	50		
422	David McCullough heirs.	do	1,150							Murrysville	1,274	64	2,084	Do.
										Hundred-foot	1,348	82		
										Fifth?	1,960	3		
423	Caroline Fisher	do	1,130	Upper Freeport.	75	5				Murrysville	1,185	97	1,854	Produces gas; minute pressure: 1/41, 2/65 5/135, 10/215.
										Hundred-foot	1,285	100		
										Fifth	1,814	11		

424	A. A. Marshall	do	1,080	do	70	3				Murrysville	1,190	97		Produces gas.
										Hundred-foot	1,297	120	1,618	
425	W. C. Devinney	do	1,150	do	265	5				Murrysville	1,218	42	1,563	Do.
										Hundred-foot	1,270	105		
426	Wm. Bell	Eastern Oil Co	1,390	do	207		Freeport	215		Murrysville	1,244	93	1,682	Gas at 1,670.
										Hundred-foot	1,370	60		
										Third?	1,585	50		
										Fourth?	1,650	32		
427	Jacob Espey	do	1,220	Upper Kittanning?	215					Murrysville	1,230		1,595	Gas at 1,413 and 1,460; very light.
										Hundred-foot	1,348			
										Thirty-foot	1,455			
428	Wm. Boyer No. 1	do	1,220				Vanport	314	10	Murrysville	1,245	95	1,586	Gas at 1,245, 1,409, and 1,479.
										Hundred-foot	1,345	82		
										Thirty-foot	1,479			
429	J. H. Sowers No. 1	Pittsburg Plate Glass Co.	1,470				Freeport	290	15	Murrysville	1,405	50	2,094	Produces gas.
							Vanport	515	15	Hundred-foot	1,525	110		
										Fifth?	2,078	2		
430	McCurdy	Eastern Oil Co	1,410				Vanport	385		Murrysville	1,288	55	1,557	A little gas at 1,160; gas in Thirty-foot at 1,458.
										Hundred-foot	1,348	105		
										Thirty-foot	1,458	94		
431	S. & A. McCurdy No. 2.	Pittsburg Plate Glass Co.	1,460	Upper Freeport.	159	4	Freeport	168	15	Murrysville	1,308	27	1,588	Produces gas.
										Hundred-foot	1,445	61		
432	S. & A. McCurdy No. 1.	do	1,450	do	155	4	do	170	15	Murrysville	1,305	60	1,569	Do.
										Hundred-foot	1,400	75		
433	Smith No. 1	Eastern Oil Co	1,240	do. ?	21	1				Murrysville	1,110	37	1,167	Gas at 1,110, 1,150, and 1,160.
				Upper Kittanning.	90	4	Vanport	216						
434	Seitz No. 1	do	1,120				do	130	10	do	1,020	71	1,231	Gas at 1,020 and 1,140.
										Hundred-foot	1,096	115	1	
435	John Glazier	do	1,410				do	417		Murrysville	1,307	100	1,518	Gas at 1,307 and 1,462.
										Hundred-foot	1,427	86		
436	Louster Bros. No. 1	Pittsburg Plate Glass Co.	1,190							Murrysville	1,060	25	1,722	Produces gas.
										Hundred-foot	1,250	30		
437	J. S. Raraigh	Eastern Oil Co	1,160							Fourth?	1,508	30	1,646	Gas at 1,300; movement of upper sands.
										Fifth?	1,610	20		

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

COWANSHANNOCK TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
438	Samuel Raraigh	Eastern Oil Co	1,140				Vanport	100		Murrysville	1,000		1,296	Produces gas.
										Hundred-foot	1,180			
439	Rainer	do	1,165				do	140	20	Murrysville	1,046	74	1,260	Gas in Hundred-foot.
										Hundred-foot	1,206	54		
440	C. Shetler	do	1,370				do	380		Murrysville	(?)		1,500	Gas at 1,286, 1,465, and 1,470.
										Hundred-foot	1,390			
441	H. Wampler	Pittsburg Plate Glass Co.	1,350	Upper Freeport	200	5	Freeport	215	8	Murrysville	1,318	82	2,040	Dry.
				Upper Kittanning?	268	5	Vanport	440	10	Hundred-foot	1,438	90		
442	J. W. McIntosh	Eastern Oil Co	1,240							Murrysville	1,210	75	1,427	Gas at 1,210, 1,366, and 1,378.
										Hundred-foot	1,328	70		
443	J. A. Bowser	do	1,280	Upper Freeport	155	4	Vanport	400		Murrysville	1,268	68	1,494	Gas at 1,278 and 1,440.
				Upper Kittanning?	228	4				Hundred-foot	1,373	103		
444	Robt. Bowser	do	1,370				Vanport	510		Murrysville	1,419		1,628	Produces gas.
										Hundred-foot	1,522			
445	James Peters	do	1,390	Upper Freeport	270		do	470		Murrysville	1,315	78	1,837	Gas at 1,419 and 1,595.
										Hundred-foot	1,532	100		
446	McKelvay	do	1,150				do	325		Murrysville	1,220		1,265	Gas at 1,220 and 1,236.
447	Crothers No. 1	Pittsburg Plate Glass Co.	1,310				do	345	18	do	1,268	89	1,969	
										Hundred-foot	1,398	115		
448	Pettigrew	Eastern Oil Co	1,070							Murrysville	1,887	24	1,126	Produces gas.
										Hundred-foot	1,065			
449	J. W. Kennerdell	Pittsburg Plate Glass Co.	1,090				Vanport	120	20	Murrysville	1,990	100	1,240	Gas at 995 and 1,176.
										Hundred-foot	1,100	140		

450	Reisinger	do	1,100	Lower Kittanning.	105	6	do	111	41??	Murrysville	1,015	100	1,763	Gas at 1,242.
										Hundred-foot	1,155	97		
										Fifth?	1,687	15		
451	Neil No. 2	Eastern Oil Co	1,125							Murrysville	1,154		1,359	Gas at 1,153 and 1,322.
										Hundred-foot	1,299	105	1	
452	Crow No. 1	do	1,300	Upper Freeport	282	2	Vanport	498	18	Murrysville	1,376	71	1,625	
										Hundred-foot	1,480	115		
453	Gourley heirs	do	1,180	do	150	4	Freeport	160	15	Murrysville	1,260	65	1,427	Gas at 1,155 and 1,260.
				Upper Kittanning.	221	7				Hundred-foot	1,360	30		
				Lower Kittanning.	320	3								
454	Goldstein No. 2	do	1,160				Vanport	110		Murrysville	1,017		1,237	Gas at 1,030, 1,200, and 1,216.
										Hundred-foot	1,125			
455	Daniel Schreckengost No. 1.	do	1,275	Upper Freeport	80	4	do	320	20	Murrysville	1,165	85	1,276	Gas, at 1,210, and 1,230 to 1,240.
456	H. J. Hill	Pittsburg Plate Glass Co.	1,170				do	172	10	do	1,062	63	1,235	Gas at 1,077.
										Hundred-foot	1,185	50		
457	J. B. Powers	Eastern Oil Co	1,180				do	232		Murrysville	1,118	59	1,288	Gas at 1,281 and 1,287.
										Hundred-foot	1,185	98		
458	Jerry Elgin	Pittsburg Plate Glass Co.	1,230				do	246	10	Murrysville	1,134	76	1,345	Gas at 1,136 and 1,330.
										Hundred-foot	1,255	90		
459	A. Sowers	Eastern Oil Co	1,185				do	237		Murrysville	1,130	90	1,335	Gas at 1,130, 1,142, 1,294, and 1,309.
										Hundred-foot	1,235			
460	Jerry Elgin No. 2	Pittsburg Plate Glass Co.	1,360	Upper Freeport	105	5				Murrysville	1,255	65	1,480	Gas at 1,220, 1,436, 1,442, and 1,463.
										Hundred-foot	1,385	95		
461	Wm. Schreckengost No. 1.	do	1,375	do	165	4	Vanport	444	10	Murrysville	1,322	28	1,590	
				do. ?	240	4				Hundred-foot	1,434	56		
				Upper Kittanning.	308	4								
462	Bittinger	Eastern Oil Co	1,335							Murrysville	1,260	100	1,471	Gas at 1,260 and 1,440.
										Hundred-foot	1,385	86		
463	Wm. Schreckengost No. 2.	Pittsburg Plate Glass Co.	1,360	Upper Freeport	90	3	Vanport	366	20	Murrysville	1,260	100	1,917	Gas at 1,260 and 1,430.
										Hundred-foot	1,415	65		
464	Wm. Schreckengost No. 3.	do	1,300	do	100	4	do	390	25	Murrysville	1,345	60	1,526	Gas at 1,345, 1,458, and 1,472.
										Hundred-foot	1,425	97		

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

COWANSHANNOCK TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
465	D. A. McAfoose No. 1.	Pittsburg Plate Glass Co.	1,410	Brookville?	455	5	Upper Freeport.	380	5	Murrysville	1,310	85	1,480	Produces gas.
										Hundred-foot	1,410	70		
466	Torney heirs	Eastern Oil Co	1,438				do	395		Murrysville	1,255			Abandoned.
467	D. Oplinger	do	1,440				Freeport	116		do	1,240	74	1,527	Gas at 1,100, 1,240, 1,415, and 1,439; very light; abandoned.
										Hundred-foot	1,337	39		
										do	1,400	47		
468	Ben Hill No. 1	Pittsburg Plate Glass Co.	1,420	Upper Kittanning?	142	3				Murrysville	1,195	141	1,777	Gas at 1,199 and 1,373.
										Hundred-foot	1,373	62		
469	D. T. Schreckengost No. 4.	Eastern Oil Co	1,220							Murrysville	1,165		1,425	Gas in Murrysville at 1,210; in Hundred-foot at 1,355.
										Hundred-foot	1,275			
470	D. E. Schreckengost No. 1.	Pittsburg Plate Glass Co.	1,235				Vanport	70		Murrysville	970		1,262	Gas at 975.
										Hundred-foot	1,075	135		
471	Peart No. 5	do	1,110							Murrysville	850	83	1,174	Gas at 1,047 and 1,126.
										Hundred-foot	953	69		
472	A. Bowser	Eastern Oil Co	1,445	Lower Kittanning.	260					Murrysville	1,190	75	1,416	Gas at 1,229 to 1,251 and at 1,395.
										Hundred-foot	1,331	85?		
473	Brown	do	1,160	Brush Creek	50	2	Freeport	165	7	Murrysville	1,284	20	1,496	Gas at 1,284.
				Upper Freeport.	150	4	Vanport	400	15	do	1,320	30		
				Upper Kittanning.	210	8				Hundred-foot	1,370	30		
				Lower Kittanning.	330	3								

474	Kelm heirs	do	1,240				Vanport	415		Murrysville	1,270	75	1,500	Gas at 1,270, and 1,454 to 1,464.
										Hundred-foot	1,350	95		
										Thirty-foot	1,454	44		
475	P. & J. Brown No. 1	do	1,260	Lower Freeport	165	5	do	350	5	Murrysville	1,244	85	1,472	Gas at 1,244, 1,252, 1,448, and 1,460.
										Hundred-foot	1,325	75		
										Thirty-foot	1,420	52		
476	Robt. Lynes	do	1,260	do	180	3	do	365	20	Murrysville and Hundred-foot.	1,250	218	1,904	
477	C. O. Schreckengost	Pittsburg Plate Glass Co.	1,240				do	275	30	Murrysville	1,155	90	1,396	Gas at 1,157 and 1,366; abandoned.
										Hundred-foot	1,270	96		
478	E. Schreckengost heirs	Eastern Oil Co	1,200				do	232		Murrysville	1,117	93	1,340	Gas at 1,140 and 1,310.
										Hundred-foot	1,225	60		
										Thirty-foot	1,302	38		
479	Cogley	do	1,385				do	510		Murrysville	1,395		1,441	Gas at 1,395 to 1,423.
480	Kelly heirs No. 1	Pittsburg Plate Glass Co.	1,380	Upper Freeport.	230	7	Freeport	255	15	do	1,350	70	1,470	Gas at 1,190.?
							Vanport	490	10					
481	E. Z. Schreckengost	Eastern Oil Co	1,210				do	285					1,342	Gas at 1,170 and 1,342.
482	J. Carson	Pittsburg Plate Glass Co.	1,155	Middle Kittanning?	125	5								
				Brookville?	310	5	do	204	8	Murrysville	1,065	55	1,100?	Gas at 1,090 and 1,100.
483	Samuel H. Gourley	Eastern Oil Co	1,225				do	320		do	1,185		1,450	Gas at 1,355 and 1,388.
484	James	do	1,160				do	195		do	1,062	98	1,300	Gas at 1,114 and 1,281.
										Hundred-foot	1,175	80		
485	Samuel Moore	Cowanshannock Gas Co.	1,170	Upper Freeport.	80	4	do	290	10	Murrysville?	1,135	40	2,810	Dry.
										Hundred-foot	1,230	105		
										Thirty-foot	1,345	35		
										Fifth?	1,760	40		
										Speechley	2,535	25		
										do	2,630	20		
										Tiona	2,680	40		
										do	2,760	30		

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

WAYNE TOWNSHIP.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
486	Wm. McIntire No. 3	Eastern Oil Co	1,480							Murrysville Hundred-foot	1,230 1,353		1,440	Murrysville gas at 1,230 (show); Hundred-foot gas at 1,418; gas at 1,100.
487	Peart No. 4	Pittsburg Plate Glass Co.	1,405							Murrysville Hundred-foot Thirty-foot	1,108 1,215 1,305	56 42 54	1,359	Gas at 1,136 and 1,307.
488	Wm. McIntire No. 2	Eastern Oil Co	1,380				Vanport	230		Murrysville Hundred-foot	1,120 1,235		1,305	Gas at 965, 1,120, and 1,290.
489	M. L. McIntire No. 2	do	1,320				do	120		Murrysville	1,030		1,265	Murrysville gas at 1,030 (show); Hundred-foot gas at 1,225, and 1,245.
490	Trautman No. 1	do	1,480				Vanport	370		Murrysville Hundred-foot	1,233 1,330		1,445	Gas at 1,417 and 1,430.
491	M. L. McIntire No. 1	do	1,490							Murrysville Hundred-foot Thirty-foot	1,080 1,172 1,248	68 46 37	1,304	Gas at 1,260.
492	Jacob Rupp	do	1,400							Murrysville Hundred-foot	1,165 1,275		1,414	Gas in Hundred-foot at 1,278 to 1,395; minute pressure: 1/25, 5/105, 10/152.
493	Wm. McIntire No. 1	do	1,330				Vanport	130	5	Murrysville Hundred-foot	1,055 1,168	80 104	1,272	Gas at 1,060, 1,230, and 1,245; pressure: 1½/200.
494	W. L. Peart No. 1	Pittsburg Plate Glass Co.	1,170							Murrysville Hundred-foot Thirty-foot	870 1,000 1,068	63 53 44	1,112	Gas at 878 and 1,096.

495	W. L. Peart No. 3	do	1,170							Murrysville	900	30		Gas at 782, 925, 1,003, and 1,030.
										Hundred-foot	961	51		
										do	1,012	40		
										Thirty-foot	1,109			
496	W. H. Beck No. 2	People's Natural Gas Co.	1,090							Murrysville?	670	279	998	Gas at 675 and 993.
										Hundred-foot	965			
497	Mary A. Campbell	Eastern Oil Co	1,320	Upper Freeport?	75?		Vanport	320		Murrysville	1,146	94	1,405	Gas at 1,169, 1,326, 1,346, and 1,390.
										Hundred-foot	1,248	152		
498	Alec Brice No. 1	Pittsburg Plate Glass Co.	1,215	Upper Kittanning.	110	5	do	255	10	Murrysville	1,114	56		Dry.
										Hundred-foot	1,200	141		
										Thirty-foot	1,361	30		
										Fourth?	1,550	20		
499	Laura Pontius	Eastern Oil Co	1,260	Middle Kittanning.	170		do	248		Murrysville	1,120		2,681	Produces a little gas.
										Hundred-foot	1,200			
										Thirty-foot	1,360			
										Fourth	1,580			
										Fifth	1,732			
										Speechley?	2,410			
										Tiona?	2,600			
500	Wm. Wadding	do	1,400	Middle Kittanning?	220		do	300		?	980		1,035	Heavy gas in sand at 980, but soon exhausted. This is not the Murrysville sand.
501	N. H. Rupp	do	1,430	Upper Kittanning?	160	5	do	330	10	Murrysville	1,192	36	1,399	Produces gas.
										Hundred-foot	1,290	65		
										Thirty-foot	1,325	20		
502	S. S. Schreckengost	do	1,220				do	120		Murrysville	980	40	1,020	Gas at 1,000.
503	Stoops	People's Natural Gas Co.	1,220	Brookville	185	3	do	92	12	do	910	25	2,380	Dry.
										do	950	30		
										Fourth?	1,420	20		
										Speechley??	2,100	20		Probably not Speechley.
504	Williamson Bros. No. 1?	do	1,180				do	40?		Murrysville	940	30	1,225	Gas at 940.
										do	990	40		
										Hundred-foot	1,050	40		
										Thirty-foot	1,120	90		

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

WAYNE TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
505	Joshua Foster No. 2	Apollo Gas Co	1,300							Murrysville	911	58	1,090	Dry.
										Hundred-foot	984	22		
										Thirty-foot	1,024	40		
506	Leopold Drohn	People's Natural Gas Co.	1,250							Murrysville	915	32	1,141	Do.
										Hundred-foot	1,020	100		
										Thirty-foot	1,115	75		
507	J. A. White	Apollo Gas Co	1,330							Murrysville	785	27	817	Gas in Murrysville.
508	Sarah White	People's Natural Gas Co.	1,350				Vanport	65		do	900		925	Gas at 900.
509	David White No. 1	Apollo Gas Co	1,405							Murrysville	800	18		
										Hundred-foot	860	28	888	Gas in Hundred-foot.
510	David White No. 3	do	1,600							Murrysville	1,060	15	1,093	Gas at 930 and in Murrysville.
511	David White No. 2	do	1,460				Vanport	45	8	Murrysville	922	20	942	Gas at 795; gas in Murrysville.
512	J. W. Halderman	do	1,470	Clarion	108	3	do	70	8	do	946	15	961	Gas in Murrysville; minute pressure: 1/195, 2/245, 5/272.
513	John Snyder No. 1	People's Natural Gas Co.	1,440				do	70						Produces gas.
514	Rebecca Martin No. 2	Apollo Gas Co	1,440	Brookville	150	3	do	45	8	?	765	10	775	Gas at 765.
515	Rebecca Martin No. 1	do	1,500	Lower Kittanning.	59	3	do	92	10	Murrysville	967	19	1,139	Gas in Murrysville.
										Hundred-foot	1,016	103		
516	J. A. White No. 2	do	1,610	do	140	4								
				Brookville	274	6				Murrysville	1,080	16	1,112	Gas at 1,096.

517	Thomas Alcorn	Pittsburg Plate Glass Co.	1,425				Vanport	115		do.?	951		1,662	Dry.
										Hundred-foot	1,130			
518	W. F. Snyder No. 1	do	1,473				do	83		Murrysville ?	915		944	Produces gas.
519	C. Snyder No. 1	People's Natural Gas Co.	1,480				do	45	10	do.?	915		930	Do.
520	G. C. Stockdill No. 1	Apollo Gas Co	1,548				do	175	8	Murrysville	1,037	18		
										do	1,065	8	1,080	Gas in Murrysville.
521	G. C. Stockdill No. 2	do	1,500?	Lower Kittanning.	104	4	do	132	8	do	980	15	1,158	Gas at 1,015; minute pressure: 1/37, 2/60, 5/125; rock pressure, 280 pounds.
										do	1,005	20		
										Hundred-foot	1,035	85		
										Thirty-foot	1,130	20		
522	John Snyder	do	1,513	do	100	3	do	130	8	Murrysville	978	20	998	Gas in Murrysville.
523	G. C. Stockdill No. 3	do	1,533	do	100	2	do	158	7	do	999	23	1,027	Gas at 906 and in Murrysville.
524	Concord Church	Pittsburg Plate Glass Co.	1,660	Middle Kittanning?	190		Freeport	40	10					
							Vanport	270		Murrysville	1,115		1,685	Gas in Murrysville.
										Hundred-foot	1,215			
										Fourth ?	1,605			
525	Jos. Clever No. 2	Apollo Gas Co	1,560	do	100	2	do	190	10	Murrysville	1,050	32	1,229	
										do	1,128	31		
										Hundred-foot	1,171	38		
526	Geo. Reeseman	do	1,320							Murrysville	880?	70?	1,200	Produces gas.
										Hundred-foot	970	63		
										Thirty-foot	1,065	43		
527	Jos. Clever No. 1	do	1,420				Vanport	50	10	Murrysville	900	65	1,637	Dry.
										do	975	35		
										Hundred-foot	1,025	20		
										do	1,060	25		
										Thirty-foot	1,115	30		
528	James Butler	Philadelphia Co	1,500				do	195	10	Murrysville	1,025	115	1,375	A little gas at 1,090.
										Hundred-foot and Thirty-foot.	1,145	205		
529	Conrad Berline	People's Natural Gas Co.	1,400	Brookville	139	3				Murrysville	925	55	1,080	
										Hundred-foot	925	35		
										Thirty-foot	1,055	20		

Partial records of oil and gas wells in the Kittanning and Rural Valley quadrangles—Continued.

WAYNE TOWNSHIP—Continued.

No.	Name.	Owner.	Elevation.	Coal seams.			Limestones.			Oil and gas sands.			Total depth of well.	Product.
				Name.	Depth.	Thickness.	Name.	Depth.	Thickness.	Name.	Depth.	Thickness.		
			Feet.		*Feet.*	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*	
530	H. S. Pontius No. 1	People's Natural Gas Co.	1,370							Murrysville	835	95	2,327	Dry.
										Hundred-foot	935	60		
										Fourth	1,250	30		
										Speechley	2,200	60		
531	D. Snowden	do	1,460				Vanport	60	10	Murrysville	918	10	928	Gas at 918.
532	Jewell heirs	do	1,550	Lower Kittanning.	36	3	do	83	8	do	966	59	1,220	
										Hundred-foot	1,056	74		
										Thirty-foot	1,155	20		
533	A. H. West	do	1,430	do	28					Murrysville	854		870	Gas at 859.
534	W. S. McCullough No. 1.	do	1,450				Vanport	67		do	880	10	890	Gas at 880.
535	Daniel West	do	1,415	Brookville ?	129	6				do	850	75		
										Hundred-foot	945	80	1,069	Gas at 855, 875, and 955.
536	H. L. & G. M. Ellenberger.	do	1,430				Vanport	40		Murrysville	852		865	Gas at 852.
537	Catherine Bittinger	do	1,300	Brookville	22					Murrysville	790	75	991	Produces gas.
										Hundred-foot	882	87		
538	W. J. Bargerstock	do	1,390	Mercer ?	181		Vanport	30	10	Murrysville	888	52	2,373	Gas at 926.
										Hundred-foot	977	123		
										Thirty-foot	1,115	20		
										Fifth	1,520	40		
										Speechley	2,308	35		
539	Wall and Kammerdiener.	Apollo Gas Co	1,520				do	217	6	Murrysville	1,035	51	1,281	Gas at 1,090 and 1,185.
										Hundred-foot	1,120	95		
										Thirty-foot	1,225	31		

540	Hoffman No. 1	Pittsburg Plate Glass Co.	1,520				do	210	8	Murrysville	1,070	30	1,545	Abandoned.
										Hundred-foot	1,146	104		
										Thirty-foot	1,308	17		
541	Geo. Reeseman No. 1	do	1,500?				do	25	7	Murrysville	1,120	50	1,308	Gas at 1,120 and 1,220.
										Hundred-foot	1,250	50		Location uncertain.
						MAHONING TOWNSHIP.								
542	Stockdill ?	People's Natural Gas Co.	1,190				Vanport	35	4					
543	John Colwell	Carnegie Natural Gas Co.	920							Murrysville	808		2,719	Produces gas.
										Hundred-foot	930	85		
										Fourth	1,302	48		
										Speechley	2,104	70		
										Tiona	2,270	50		
544	Colwell No. 4	Bethlehem Gas Co.	1,200	Mercer ?	391		Vanport	236						
545	Anna Doverspike	People's Natural Gas Co.	1,030				Mercer	60	12	Murrysville	853	24	2,636	Gas in Murrysville and Hundred-foot.
										Hundred-foot	960	115		
										Speechley ?	2,235	40		
										Tiona ?	2,585	17		
						REDBANK TOWNSHIP.								
546	John Shaffer	Redbank Natural Gas Co.	1,160				Vanport	20					1,133	Dry.
547	Avon Hulbin	do	1,240				do	48		Murrysville	860?		1,207	Gas at 860.
548	Geo. Shaffer	do	1,250				do	30					1,100	Gas at 1,070.
549	Lankerd heirs	Fairmount Gas Co	1,480				Mercer ?	280		Murrysville	1,035		1,222	Gas at 1,130 and 1,182.
										Hundred-foot	1,118	40		
										Thirty-foot	1,170	42		

CLAY AND SHALE.

An abundance of clay exists in these quadrangles as the underclays of several of the coal seams. The most important of these and the only ones utilized at present are the Mercer fire clay of the Pottsville formation and the Clarion and Lower Kittanning fire clays of the Allegheny formation. The Upper Freeport fire clay, however, is generally of good thickness, and might be used to advantage under favorable conditions. The shale at present used in the quadrangles comes from the Allegheny formation, and abundant supplies can doubtless be obtained at easily accessible points. The sandy shales so abundant in the Conemaugh formation in several parts of the quadrangles might also be found suitable for the manufacture of certain grades of brick.

From its very nature clay does not tend to outcrop boldly or clearly, so that while its presence may be indicated in road cuttings or hillside washings it is seldom that these give an accurate idea of its thickness or quality. For that reason, while this report indicates the areas where the different clays outcrop above drainage and briefly their positions from point to point in those areas, accurate information as to their thickness and quality outside of the areas of development can only be obtained by actual prospecting on the part of those interested. Again, it should be recalled that in a majority of cases the only true test of the quality of a clay is in the kiln, where private interests take the initiative. From the close association of the clays with the coals it is possible to see on the geologic maps their lines of outcrop. Thus the line on the map separating the Conemaugh and Allegheny formations gives with great accuracy the position of the outcrop of the Upper Freeport clay. The position of the Lower Kittanning clay is likewise readily traced by following the line of outcrop of the Lower Kittanning coal, marked (lk) on the maps. The position of the Clarion is about 30 feet below the Vanport limestone, the outcrop of which is shown on the maps by the green line near the bottom of the Allegheny formation. By measuring down from the green line 1½ contour intervals its position at any point is easily determined. In the case of the Mercer clay its position will be closely shown by drawing a line through the middle of the Pottsville outcrop.

As an aid to finding these outcrops on the maps as well as on the ground brief descriptions of the distribution of the different clays are given in this report.

MERCER FIRE CLAY.

Stratigraphic position.—This occurs in the Pottsville formation in the shaly interval between the Homewood and Connoquenessing sandstones (see section on page 30). It is correlated with the Mount Savage fire clay of Allegheny County, Md.

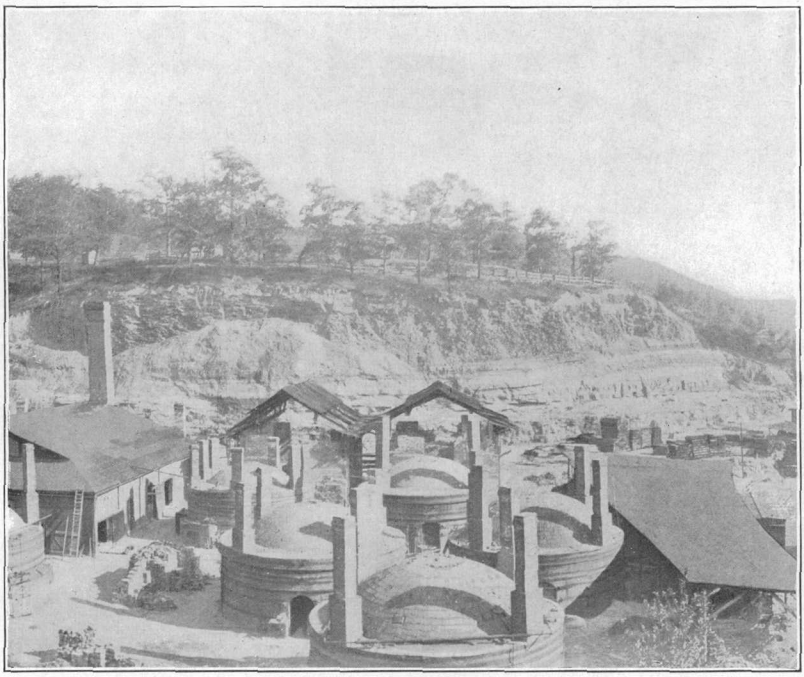
Thickness and character.—This clay is not well known outside of the district of its development on Redbank Creek. At St. Charles it has a thickness up to 8 or 10 feet. At the pit mouth it is 6 feet thick with 2½ feet of flint clay at bottom; further in, where worked at present by the Clarion Fire Brick Company, it is all a flint clay, though of varying quality. Formerly the plastic clay used for bond by this company was imported, but recently a mine has been opened directly opposite the plant in a bed of plastic clay. This clay is at the same horizon as the flint clay, or at a closely adjacent horizon in the Mercer. At Climax the clay has a thickness of 12 feet and is composed of flint and plastic clay in varying proportions. The relations of the two kinds of clay also vary greatly; the flint clay may be at the top, middle, or bottom; it may be wanting in parts of the bed or may make up the full thickness in others. As a rule the flint clay makes up about one-third of the whole. Only the lower part of the plastic clay is mined.

The supply at St. Charles is said to be holding out well toward the south and west, and it is also satisfactory at Climax, though said to be cut out by other rock in certain directions.

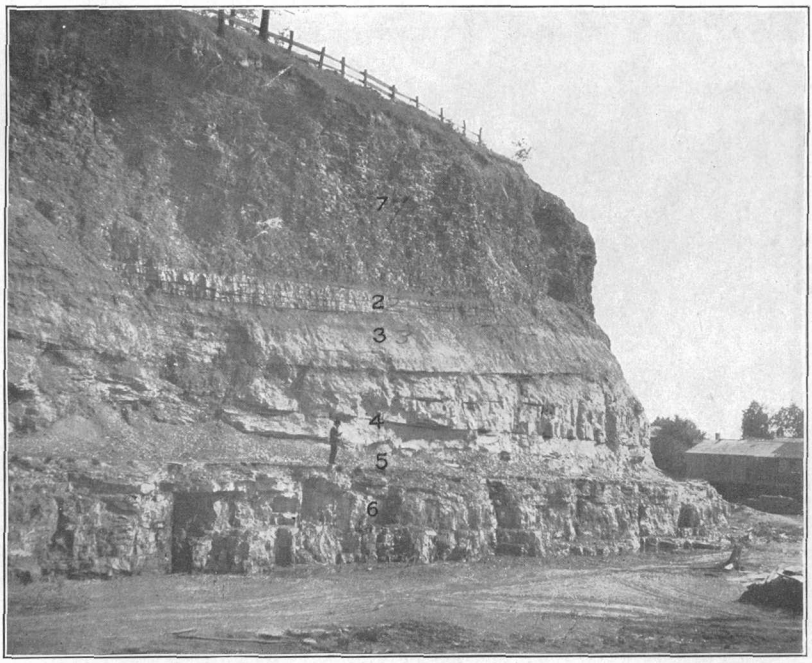
Below is an analysis of the Mercer clay from the vicinity of Climax, made by A. S. McCreath:

Analysis of Mercer clay.

Silica	44.610
Alumina	38.010
Protoxide of iron	1.251
Titanic acid	1.020



A. VIEW OF KITTANNING CLAY MANUFACTURING COMPANY'S WORKS AT KITTANNING.



B. VIEW OF KITTANNING CLAY MANUFACTURING COMPANY'S QUARRY AT KITTANNING.

Lime	.080
Magnesia	.407
Alkalies	1.735
Water and organic matter	13.630
	100.743

Distribution.—The Mercer clay has as yet been but little exploited in these qaudrangles, present developments being confined to the vicinity of St. Charles and Climax, on Redbank Creek. The horizon of this clay is above drainage in the region about Craigsville, on Buffalo and Patterson creeks, and should be found about 100 feet above drainage near the junction of Patterson Creek and Long Run, under the Kellersburg anticline. It descends rapidly from this maximum elevation and passes below drainage about a mile to the north, a short distance south of Craigsville and about a mile west of Craigsville, on Buffalo Creek. No Mercer clay is known in this region.

On the Allegheny River the horizon of this clay appears above drainage at Templeton and rises rapidly until it is about 300 feet above river level over the Kellersburg anticline; then it descends slowly until in the vicinity of East Brady it is about 100 feet above the river. Up Redbank Creek this clay horizon is above drainage as far as the southern point of Anthonys Bend, a short distance above Climax. At St. Charles the clay is about 240 feet above the creek. At Climax it has descended until not far above creek level. Below St. Charles the clay horizon gradually descends until about 100 feet above the creek at Lawsonham. Some question exists as to the continuity of this clay between Climax and St. Charles. On the other hand prospecting is said to show the presence of the clay for a distance of 10 miles above and below St. Charles. On Mahoning Creek this clay horizon is above drainage from the mouth to a short distance above Dee. It reappears a short distance east and runs up a branch to the north to within a mile of Kellersburg. It is about at drainage level for a distance below Putneyville. About 1 mile northeast of Putneyville it rises above the creek and continues to get higher in the hills to the eastern edge of the quadrangle, where it is about 200 feet up the hills. No clay, however, is known to occur at this horizon in Mahoning Creek, nor any of value along the river.

CLARION FIRE CLAY.

Stratigraphic position.—At Kittanning and vicinity the Clarion fire clay and the fire clay and shale associated with the Lower Kittanning coal are being utilized largely in the manufacture of brick. The relationship of the Clarion clay bed to the rocks above, as they are developed at Kittanning, is shown in the following section:

Section showing Clarion fire clay and associated rocks at Kittanning.

	Feet.
1. Dark clay shale	25
2. Lower Kittanning coal	3-3½
3. Kittanning fire clay	12
4. Sandy shale	10
5. Buhrstone ore	1
6. Vanport (Ferriferous) limestone	9
7. Dark sandy shale or shaly sandstone	10
8. Shale or slate	20
9. Little or no coal	
10. Clarion fire clay	8-10

The beds, 1 to 6, inclusive, are exposed in the quarry of the Kittanning Clay Manufacturing Company, as shown in the accompanying illustrations (Pl. X).

As shown in the section the Clarion clay lies about 30 feet below the Vanport limestone. It is usually overlain by a thin coal seam, the Clarion coal.

Thickness and character.—The Clarion clay generally occurs as a high-grade plastic clay, although some flint clay occurs at this horizon. It is suited for use in making gray or buff building brick, sewer pipe, and as a bond for fire brick. It has also been successfully used

in the manufacture of tile and pottery. Along the Allegheny River most of this clay is drab in color, breaking along slickensided surfaces. Toward the top the clay tends to be darker in color, while toward the bottom it tends to become sandy. The best clay usually has a pearly luster and smooth soapy feeling.

At West Winfield the Clarion clay is 4 to 8 feet thick. The best clay is at the top, the bottom being more sandy. At Buffalo Mills the following exposure occurs one-fourth mile south of the bridge over the creek:

Section of Clarion clay at Buffalo Mills.

	Ft.	in.
1. Coal (Clarion)	1	8
2. Clay, black, slightly sandy		8
3. Clay, drab, crumbly, sulphur stain (from coal?)	2	7
4. Clay, dark gray, sandy	1	
5. Clay, drab		9
6. Clay, gray, very sandy	2	
7. Clay, gray, smooth (best)	2	6
8. Clay, drab, smooth	1	
9. Clay, dark gray, sandy	2	6
Sandstone.		

The section shows about 8 feet of good plastic clay. In this region the Clarion clay is said to average 6 or 7 feet thick. At a 2-foot exposure of this clay on the west side of Allegheny River, three-fourths mile north of the bridge at Kittanning, the clay appears to be of excellent quality, containing only a trace of sand and but little carbonaceous matter, apparently stem remains. In the mines at Neale (Ewing) this clay is 9 to 10 feet thick and holds this average well. The upper 4 feet of the clay is black. This is not mined when the clay is to be used as a bond for fire brick. At the Cowanshannock mine the clay is 8 feet thick, including 12 to 15 inches of black clay at top not mined. The clay becomes sandy 100 yards in the hill on the south side of the creek, but holds good for 300 yards in on the north side. At Templeton the clay is 10 feet thick, all white. The upper black layer present at Neale is absent here. At both places the clay is hard enough to require blasting in the mines.

Eastward from the Allegheny River the few exposures of this clay seen did not promise as good quality as along the river. Just north of South Bethlehem this clay is more sandy and harder. Outcrops of the clay were noted along Mahoning, Pine, and Cowanshannock creeks, but usually only in the form of weathered blooms from which little idea of the thickness or quality could be gained.

The chemical character of this clay is shown by the following analyses. The first is by McCreath (H5, p. 246), of a specimen from Kittanning. The second is from a specimen from Mahoning Creek. The third is given as an average analysis for the Allegheny River region.

Analyses of Clarion clay.

Constituent.	1.	2.	3.
Silica	58.750	56.350	57.00
Alumina	25.170	28.064	28.00
Protoxide of iron	2.195	3.237	2.80
Protoxide of manganese	Trace.		
Titanic acid	1.050		
Lime	.710	.520	.50
Magnesia	.936	.646	.60
Alkalies	3.535	2.925	2.40
Water	8.110	8.400	8.70
	100.456	100.142	100.00

Distribution.—Starting from the west, this clay outcrops in these quadrangles on Buffalo Creek. It is above drainage over two areas, the first in the vicinity of West Winfield, the second above Buffalo Mills. In the lower area it appears above water level at the mouth of Rough Run. It can be traced up Rough Run for 1½ miles, up Buffalo Creek to the mouth of the next run to the north, and up that run for a mile. Where worked at West Winfield it is 20 feet above the creek, and over the whole area it hardly gets more than 40 feet above drainage. At the sandstone quarry at West Winfield the clay is on top of the sandstone at an elevation of about 40 feet above Rough Run. In the Buffalo Mills area it appears from one-half mile to a mile below Buffalo Mills, and extends nearly to Fosters Mills, near Patterson Creek, on the north, and nearly to the county line on the west on Buffalo Creek. At Buffalo Mills it outcrops one-fourth mile below the bridge, being well exposed in a 13-foot cut (section, p. 164) about 15 feet above Buffalo Creek. It has been opened on a branch west of Buffalo Mills. It reaches 200 feet above drainage on the arch of the Kellersburg anticline.

The clay next outcrops in the immediate valley of Allegheny River. On the west side of the river the clay appears above the bottoms three-fourths mile above the bridge at Kittanning. It rises rapidly to the north. It is about 120 feet above the river at the mouth of Limestone Run, and extends up the run to Adrian. It shows one-fourth mile north of the Buffalo, Rochester and Pittsburg Railroad bridge, and goes under the bottoms a mile north of that bridge. It emerges again opposite the lower island south of Templeton, and is exposed north of the upper island in a slide. From here it rises under the Kellersburg anticline until opposite Rimer it is well up in the hilltops about 400 feet above the river. From there it descends to East Brady, where it is about 150 feet above river level. It extends up Huling Run to Sherrett, and up Sugar Creek to the mouth of Pine Run.

On the east side of Allegheny River the Clarion clay has been found in a shaft of the Kittanning Clay Manufacturing Company at 30 feet below the limestone at the bottom of the quarry. It emerges above the bottom lands at the northern edge of Kittanning. At Wickboro it is mined at an elevation of 866 feet above tide, nearly 100 feet above the river, the latter being about 772 feet. At Neale (Ewing) the clay is worked, the elevation being a little higher. It is reported to reach its maximum elevation (886 feet) just back of the Cowanshannock station. Up Cowanshannock Creek it goes below the surface four-fifths of a mile from the mouth. Continuing up the Allegheny the clay descends and passes below the bottoms 500 feet south of the Buffalo, Rochester and Pittsburg Railroad bridge at Mosgrove. It is well exposed back of the power house south of the station.

It is again brought up by the Kellersburg anticline. It first appears about 2 miles south of Templeton. At the old mine a little southeast of the station at Templeton its elevation is 943 feet above tide. It extends up Whisky Run about three-fifths of a mile. Up Mahoning Creek the clay has been traced to the mouth of Scrubgrass Creek. Its horizon keeps above drainage level of Mahoning Creek to the eastern edge of the Rural Valley quadrangle. Up Scrubgrass Creek it passes below drainage a short distance above the mouth. It reappears on the same creek a mile above Goheenville, and is above but close to drainage for nearly 2 miles. On Mahoning Creek the clay keeps within 100 feet above drainage, averaging about 60 feet to a point above Mahoning Furnace. It shows well in the road near the bridge over the creek 2 miles south of Deanville. From Mahoning Furnace to the edge of the quadrangle it rises toward the Greendale anticline, being about 100 feet above creek level at Putneyville, and rising until it is about 350 feet above the creek at the eastern margin of the quadrangle. It extends up all the branches of Mahoning Creek for varying distances.

Above Mahoning up the Allegheny River the Clarion clay horizon reaches an altitude of 1,200 feet, or 400 feet above the river. This elevation is maintained nearly to the mouth of Redbank Creek. Going up Redbank Creek its elevation increases until at St. Charles it is nearly 1,400 feet above tide, or still 400 feet above drainage. Thence it descends until at South Bethlehem it is less than 100 feet above creek level. Above the mouth of Redbank

Creek the clay descends to an elevation below 1,100 feet, which elevation it keeps all about East Brady and to the edge of the quadrangle.

The Greendale anticline brings the clay up in the valleys of Pine and Cowanshannock creeks. On the North Fork of Pine Creek this clay is above drainage for half a mile below and a mile above Slabtown. On the South Fork of Pine Creek it appears above creek level near Pine Furnace and passes under a half mile below Echo. At Oscar it is about 100 feet above creek level. The clay was noted at numerous points between Pine Furnace and Echo. On Cowanshannock Creek the clay rises within a mile below Stone House, and passes under the bottoms just above Greendale. It shows well in the road bank opposite the schoolhouse one-fourth mile west of Greendale.

KITTANNING FIRE CLAY.

Stratigraphic position.—The Kittanning clay immediately underlies the Lower Kittanning coal, as shown in the section below.

Thickness and character.—The clay is usually a plastic clay, though it carries some flint clay locally. As a rule it appears to be inferior to the Clarion. It is not as regular in thickness as the Clarion, being pockety; and, while up to 12 feet thick in places, is largely cut out by shale in other areas not far away.

At West Winfield the Kittanning clay is 11½ feet thick. It was formerly worked here, but is not now used. It is more suitable for tile than brick, since it does not make an article of uniform color. Around Buffalo Mills it is stated that the Kittanning clay and the underlying shale together average about 30 feet. Around Kittanning this clay has been extensively worked in connection with the shale below the coal. In the quarry of the Kittanning Clay Manufacturing Company it shows a maximum thickness of 12 feet, but as shown in Pl. X, *A*, it thins out rapidly along the dip to the east. The whole thickness of the clay at the Kittanning Clay Manufacturing Company's plant is plastic. The fire clay above makes buff building brick. A small amount has been used in connection with imported flint clays in making fire brick. In the southern part of the quarry at the Daugherty Brothers' plant at Kittanning some of the red shale above the Vanport limestone is replaced by plastic clay. This clay is of a better quality than the clay above, which comes just below the Lower Kittanning coal. It, however, contains iron concretions that have to be picked out. Between the upper and lower beds of plastic clay there also is a pocket of flint clay. A section in this quarry shows as follows:

Section of rocks in Daugherty Brothers' quarry, Kittanning, Pa.

	Ft.	in.
1. Coal, Lower Kittanning	4	
2. Fire clay, "bastard"	5	
3. Flint clay	1	6
4. Coal		4
5. Clay, buff	1	
6. Sandstone	1	
7. Coal		8
8. Fire clay, soft	8	
9. Shale, red	2	
10. Limestone, Vanport (Ferriferous)	7	

A short distance north of this the red shale is 10 feet thick and apparently cuts out the 8 feet of clay above, while between the "bastard" fire clay and the red shale is 18 inches of sandstone and 3 feet of buff clay, the coals and flint clay being out.

A sample of Kittanning clay from a ravine across the river from Neale (Ewing) showed a steel-gray color, with a high percentage of sand. It contained black plant stems, and was stained with sulphur. In a cut on the Buffalo, Rochester and Pittsburg Railroad just west of West Mosgrove station there is 15 feet of Kittanning clay and shale under the coal. The upper 7 feet is drab and crumbly; the lower 8 feet is drab and shaly. The clay appeared to be of excellent quality. The clay was formerly worked in the vicinity of Allegheny Furnace, opposite the mouth of Cowanshannock Creek, and according to Platt yielded both

flint and plastic clay of good quality. In a cut in new railroad grade 1½ miles above the Buffalo, Rochester and Pittsburg Railroad bridge on the west side of the river occurs 8 feet of clay below 8 inches of coal. In the trolley cut 2 miles west of Stone House a coarse clay, apparently just above the Lower Kittanning coal, shows 9 feet thick, the upper 4 feet being a dark gray and the lower 5 feet a lighter gray color, but hard and sandy. One-fourth mile west of Pine Furnace this clay appears to be thin and sandy.

An analysis of this clay at Kittanning, furnished by Mr. George W. McNees, is given below:

Analysis of Kittanning fire clay.

	Per cent.
Silica (SiO_2)	60.40
Alumina (Al_2O_3)	26.23
Ferric oxide (Fe_2O_3)	1.34
Ferrous oxide (FeO)	.23
Lime (CaO)	.14
Magnesia (MgO)	.54
Potash (K_2O)	2.66
Soda (Na_2O)	.28
Loss on ignition (H_2O, etc.)	8.71

Distribution.—The Kittanning clay is above drainage on Buffalo Creek around West Winfield, lying about 60 feet above the Clarion, but with a crop line nearly or quite twice as long. It rises above Buffalo Creek about 2 miles below Buffalo Mills, and is above drainage to above the county line up Buffalo and to Fosters Mills, near Patterson Creek. It rises above the bottom lands of the Allegheny just south of Kittanning, extends up Limestone Run to above Morrows Corner, up Cowanshannock Creek for 2 miles from the mouth, then rises again a mile below Stone House to again pass under near the mouth of Huskins Run. The Fairmont syncline carries the clay below drainage for a short distance on both forks of Pine Creek just above their junction. On the south fork it is above the creek nearly to Echo, and on the north fork to about 1½ miles above Slabtown. The clay keeps above the bottoms of the Allegheny River above Pine Creek. Up Mahoning Creek it is above drainage to the eastern edge of the quadrangle.

In a ravine to the south about half a mile above Dee the following section of this clay is exposed:

Section in ravine near Dee, Pa.

	Feet.
1. Lower Kittanning coal	2–3
2. Concealed	5
3. Sandstone	3
4. Clay	6
5. Sandstone	3
6. Clay (partly flint)	10
7. Clay, with sandstone and iron ore (?) layers	10
8. Vanport limestone.	

The 6 feet of clay of No. 4 probably is Kittanning. In the neighborhood of Mahoning Furnace it is less than 150 feet above creek level, but it rises to the east and west, so that at the eastern edge of the Rural Valley quadrangle it is nearly 1,500 feet above tide, or about 450 feet above drainage. This brings it high in the hills over the northeast corner of the area. On account of the steepness of the banks on Redbank Creek the outcrop line of the Lower Kittanning clay nearly coincides on the economic map with that of the Clarion, already described, except that it is 60 feet higher and extends a little farther up the side branches. Between the mouths of Mahoning and Sugar creeks this clay is well up in the hills, but gets much lower toward East Brady. It extends up Sugar Creek to Kaylor.

FREEPORT FIRE CLAY.

Stratigraphic position.—The Freeport fire clay occurs beneath the Upper Freeport coal, and as this is at the top of the Allegheny formation, the position of the clay in the hills can be determined by noting on the geologic map the dividing line between this and the

Conemaugh formation. In the western part of the Kittanning quadrangle immediately south of Chicora this seam becomes a flint clay, 10 feet or more thick, which apparently has an extent of several square miles. Although nothing is known of its qualities, the thickness and extent of the bed and its proximity to the railroad would seem to warrant an investigation on the part of investors.

At Cowansville about 4 feet of plastic clay occurs in the top of the shale quarry. In the central part of the area covered by the two quadrangles the Freeport clay is partly flint, and along Allegheny River is reported to average about 6 feet in thickness. The plant at Manorville, which now makes silica brick exclusively, formerly used flint clay from this bed for making fire brick, but as the clay was found only in small pockets, the mine was abandoned. The quality and thickness of the seam in the vicinity of Yatesboro is indicated by the following general section given by the superintendent of the coal mines at that place:

Section of Freeport fire clay near Yatesboro.

	Feet.
Fire clay and sandstone	1
Hard and sandy fire clay	4-5
Hard flinty rock	2-4
Impure limestone	6-7

McCreath analyzed specimens of this clay from the vicinity of Allegheny Furnace and from Kittanning, which results are given below. No. 1 is from Allegheny Furnace opposite the mouth of Cowanshannock, No. 2 is from Kittanning (H5, pp. 240 and 246).

Analyses of Freeport fire clay from Allegheny Furnace and Kittanning.

Constituent.	1.	2.
Silica	50.370	58.750
Alumina	32.890	25.170
Protoxide of iron	1.641	2.195
Titanic acid	1.030	1.050
Lime	.310	.710
Magnesia	.353	.936
Alkalies	.290	3.535
Water	13.760	8.110

Distribution.—The Upper Freeport clay is above the main lines of drainage over practically all of the Kittanning quadrangle. In the northwest corner of the quadrangle it comes near the middle of the hill slopes. Going southeast toward the Kellersburg anticline this clay rises until all over the central and northern central part of the quadrangle it occurs well up on the upland, in some cases occupying small isolated areas on hilltops only. This is especially true going eastward toward the Allegheny at Mahoning. In the southern and southeastern part of this quadrangle the Boggsville and Fairmont synclines bring the Freeport clay down into the valleys, so that at the southern edge of the quadrangle the clay is not far above drainage on Buffalo Creek or Allegheny River.

In the northwest corner of the Rural Valley quadrangle this clay horizon comes above the hilltops and has been removed. East of Kellersburg it comes into the tops of the hills, and northeast of Mahoning Furnace it lies well under their summits, but east of Eddyville it again rises above the tops of the hills. Between Mahoning Creek and Pine Creek it lies well under the upland, or in the lower valleys at the west, but to the east it rises and is above most of the hilltops around Belknap. South of Pine Creek it is well down in the valleys at the west, rises well up on the hills in crossing the Greendale anticline about Greendale and Oscar, then descends and passes below drainage on Cowanshannock Creek at Yatesboro. It is below drainage over all of the southeast corner of the Rural Valley quadrangle.

SHALE.

This is utilized in these quadrangles only at Kittanning by the Kittanning Clay Manufacturing Company and by Daugherty Brothers. The following beds shown in the section on page 168 are used. From No. 1 is made a fine vitrified brick for building fronts; from No. 4 is made a vitrified brick and building brick; from No. 7 is made a building brick, and No. 8 is said to be suitable for buff fire brick and for sewer pipe. Mention has already been made of the shale associated with the Kittanning clay about Buffalo Mills, the two there being reported as averaging 30 feet thick. From exposures at several places it appeared possible that this shale would repay investigation.

At the Du Bois & Butler Brick Company's plant at Cowansville the shales between the Upper and Lower Freeport coals are worked. The section here shows as follows:

Section near Cowansville.

	Ft.	in.
1. Surface and sandstone fragments	4	
2. Clay, whitish	4	
3. Shale, greenish gray	5	
4. Shale, black	12	
5. Coal (Lower Freeport)	4	6
6. Fire clay (concealed)	4	?

The clay at the top runs gradually into the shale below, which from being stained red is called "red shale." The shale is not very hard and but slightly gritty. The black shale is somewhat harder and not at all gritty. The clay and gray shale are very plastic, and depend upon mixing with the black shale to give the resulting brick the necessary refractory qualities.

At the cut on the Buffalo, Rochester and Pittsburg Railroad below the second bridge east of Cowansville the shales below the lower Freeport coal are exposed, as shown in the following section:

Section in railroad cut east of Cowansville.

	Ft.	in.
1. Shale, red, fissile	6	
2. Coal (Lower Freeport)	4	
3. Clay, drab		11
4. Carbonaceous layer		8
5. Clay, drab	5	
6. Shale, drab	6	6
7. Sandstone, gray		6
8. Shale, gray	3	
9. Shale, black	5	

The shales at this point appear to be inferior to those at Cowansville.

A fine-grained, olive-green shale near the horizon of the Upper Freeport coal outcrops on the east slope of the hill east of Kittanning. At Yatesboro it is stated that the air shaft went through 60 feet of shale above the Upper Freeport coal. Tests are being made of shales on the Kroh farm, just east of Yatesboro, but have not yet reached the point of demonstrating the workability of the shales there. Similar shale to that at Yatesboro outcrops at several points around Rural Valley, in places suggesting a thickness of 90 feet

The following analysis of one of the shales worked at Kittanning is furnished by Mr. George W. McNees:

Analysis of shale at Kittanning.

Silica (SiO_2)	55.17
Alumina (Al_2O_3)	19.92
Iron oxide (Fe_2O_3)	12.01
Loss on ignition (H_2O, etc.)	6.81

EXPLOITATION OF CLAYS AND SHALES.

Mercer clay.—The Mercer clay is worked on Redbank Creek by the Climax Brick Works at Climax and by the Clarion Brick Company at St. Charles. At both places the clay is obtained by drifting. The Climax mine is 1¼ miles above the plant, and is connected with it by a tram road, over which the clay is hauled in cars by horses. The St. Charles flint clay mine is about three-quarters of a mile below the plant and over 200 feet above the creek. The clay is lowered from the mouth of the mine in cars on inclined tracks, by gravity, to a tram road similar to the one at Climax. The plastic clay mine is nearly opposite the plant. The clay from this mine is brought down to the yard in carts. At both these plants the flint clay is used for making fire brick, and at Climax tuyeres also are manufactured.

At Climax three grades of clay are used. Grade No. 1 is the flint clay from which brick is made that is used in furnaces where the heat runs to 4,000 degrees Fahrenheit; No. 2 is the plastic clay used with flint clay for making tile for various purposes, which is said to be of excellent quality; No. 3 is a mixture of Nos. 1 and 2 as gathered up in the mines after the two grades have been assorted rather closely, and from this stock the second quality of brick is made. The brick is used in iron and steel works, glass furnaces, malleable-iron plants, and in any place requiring a highly refractory brick.

At St. Charles two grades of brick are produced. Both are made by the hand-mold process and dried on gas-heated floors. Gas is also used for firing the kilns. Two types are in use, the square up draft and the round down draft. The bake lasts about eight days.

Clarion clay.—The Clarion clay, the most valuable in the quadrangles, is being worked on the east side of the Allegheny River at a number of points between Kittanning and the mouth of Mahoning Creek, and on Rough Run at West Winfield.

At West Winfield the Duquesne Fireproofing Company uses the clay for making front brick, fireproofing, and sewer pipe, the latter being the principal product. The opening of drift from which the clay is taken is about 200 feet from the clay pile in the yard, and is hauled up to the latter in cars, by cable. The clay is used just as it comes from the mine. After going through the dry pan the clay for brick is put through a pug mill and stiff-mud machine, and that for sewer pipe through a wet pan and pipe press. Round down-draft kilns are used for firing. The coal which overlies the clay is used for fuel. The sewer pipe is glazed at a temperature of 2,700 degrees, but according to the statement of the superintendent the clay will stand 3,000 degrees.

On the Allegheny at Neale and at Templeton Clarion clay is at present being mined by the Harbison-Walker Refractories Company, and shipped to their plant in Pittsburg for use as a bond in making fire brick. At the former place, however, this company now has under construction a plant for the manufacture of gray front brick. The same company also operates at Cowanshannock. The clay mined at this point is used in making a low-grade fire brick and also as a bond, with flint clay brought from Brookville, for a very refractory brick. The brick are made by the usual hand-mold process, and dried on a gas-heated floor. They are baked in square down-draft kilns fired by gas.

Just north of Neale the Kittanning Clay and Fire Brick Company use the Clarion clay in the manufacture of buff and gray building brick. For gray brick the clay is used as it comes from the mine, including sandy portions and the black upper layer; for buff brick loam is added. The bricks are made by the stiff-mud process, and cut in a wire side-cut machine. About 25 per cent of them are repressed. The drying is done in tunnels heated by waste heat from the kilns. The kilns are round down-draft and are heated by gas. The bake lasts about nine days, and for gray brick a No. 9 Seger cone is turned down in the center of the kiln and a No. 3 over the fire, while for buff brick cone 01 is turned down. Both the buff and gray brick are of excellent quality, and in much demand, especially the gray, which is extensively used for office buildings in large cities.

While no Clarion clay has as yet been used at Kittanning, the Kittanning Clay Manufacturing Company is planning to reopen an old test shaft to this clay, and ultimately, if further tests prove satisfactory, it is probable that the clay will be mined.

Lower Kittanning clay.—The Lower Kittanning clay is worked at Kittanning, where it is quarried by the Kittanning Clay Manufacturing Company and by Daugherty Brothers. At the former plant the clay is used in the manufacture of buff building brick, and is also mixed with the underlying shales for front and paving brick. The stiff-mud process is employed. The kilns are fired by gas fuel and are of the square and round down-draft types. The clay is burned at about 1,200 degrees centigrade. Daugherty Brothers manufacture red and buff building brick by processes similar to those used by the Kittanning Clay Manufacturing Company.

Shales.—The shales below the Lower Kittanning clay in the quarries at Kittanning, as already stated, are used with the clay for building and paving brick. Near Cowansville the shale above the Lower Freeport coal is being quarried by the Du Bois & Butler Brick Company. This shale mixed with the clay above in the proportions in which they occur in the quarry are used in the manufacture of paving and common brick, the former being this company's specialty. In making the latter the soil above the clay is also included. The bricks are made by the ordinary stiff-mud process and burned in round down-draft kilns at a temperature of from 1,200 degrees to 1,400 degrees for common brick and 1,500 degrees to 1,800 degrees for paving brick. The fuel used is the Lower Freeport coal, which is mined below the shale.

IRON ORE.

GENERAL STATEMENT.

The production of iron from the ores of the quadrangles was formerly an important industry. A number of furnaces were erected and operated for many years, but the general use of better ores from the Lake regions and the exhaustion of the local outcrop ores made the business unprofitable and it was abandoned. The last furnace went out of blast about 1880. A brief history of these furnaces will be found in Platt's Report, H5, on Armstrong County, and in Lesley's History of Iron Making in America.

There are three ore-bearing horizons in the quadrangles, that of the Buhrstone ore at the top of the Vanport limestone, the Lower Freeport ore below the Lower Freeport coal, and the Upper Freeport ore below the Upper Freeport coal. Of the three, the first is the most and the second the least important.

BUHRSTONE ORE.

This is a compact layer running generally 6 inches to 1 foot thick, and resting immediately upon the Vanport ("Ferriferous") limestone. To this circumstance the limestone owes its descriptive name "Ferriferous." The term "Buhrstone" is due to the chert nodules said to occur in the ore in some localities. The ore may be a carbonate, limonite, or impure hematite. Probably it was originally carbonate, the limonite and hematite being the result of subsequent oxidation along the outcrop. This ore was the chief source of the iron once made in the region. It is practically coextensive with the Vanport limestone and its extent of outcrop corresponds with that of the limestone, which is shown on the map. Judging from the old strippings which follow the outcrop of the limestone for hundreds of miles, most of the ore to be had from the outcrop has already been taken out, so that in the future drifting will be necessary. As will be seen further on, this will be facilitated by the fact that the ore is generally overlain by soft shales which can be removed with comparative ease. This is not universally true, and in some localities, as near Phillipston, the ore is overlain by a coarse massive sandstone which seemingly precludes mining.

McCreath analyzed samples of the Buhrstone ore selected by Platt from all parts of Armstrong County. As a whole these analyses show not only uniformity in the grade of the ore, but also that it consists of three varieties, according to the amount of decomposition that has taken place, namely, carbonate ore, brown hematite, and an impure variety of red hematite. The unroasted carbonates average 33 to 38 per cent of metallic iron; the brown and red ores contain as high as 50 per cent of iron, the average being perhaps about 45 per cent. All of the ores are comparatively low in phosphorus—two-tenths of 1 per cent being

the usual amount, both in carbonates and hematites. The sulphur is also low, amounting in many cases to scarcely more than a trace. The hematites contain none of the protoxide of iron. The analyses are given below:

Analyses of Buhrstone ore.

RED ORE.

	Per cent.
Sesquioxide of iron	70.714
Sesquioxide of manganese	2.421
Sesquioxide of cobalt	.010
Alumina	1.491
Lime	7.630
Magnesia	.547
Sulphuric acid	.010
Phosphoric acid	.765
Carbonic acid	5.230
Water	7.465
Insoluble residue	3.860
	100.143
Metallic iron	49.500
Metallic manganese	1.686
Sulphur	.004
Phosphorus	.334

BROWN ORE.

Sesquioxide of iron	73.928
Sesquioxide of manganese	1.344
Sesquioxide of cobalt	.020
Alumina	1.532
Lime	1.610
Magnesia	.501
Sulphuric acid	Trace.
Phosphoric acid	.740
Carbonic acid	None.
Water	12.615
Insoluble residue	8.060
	100.350
Metallic iron	51.750
Metallic manganese	.936
Sulphur	Trace.
Phosphorus	.323

BLUE CARBONATE ORE.

Protoxide of iron	42.428
Sesquioxide of iron	2.233
Bisulphide of iron	.187
Protoxide of manganese	.799
Protoxide of cobalt	.010
Alumina	.916
Lime	7.150
Magnesia	1.881
Sulphuric acid	.030
Phosphoric acid	.334
Carbonic acid	32.622
Water	1.950
Insoluble residue	9.460
	100.000
Metallic iron	34.650
Metallic manganese	.619
Sulphur	.112
Phosphorus	.146

ROASTED ORES.

	Per cent.
Protoxide of iron	None.
Sesquioxide of iron	65.928
Sesquioxide of manganese	1.563
Sesquioxide of cobalt	.020
Alumina	2.688
Lime	7.710
Magnesia	.901
Sulphuric acid	.580
Phosphoric acid	1.074
Carbonic acid absorbed, Water	5.365
Insoluble residue	14.520
	100.349
Metallic iron	46.150
Metallic manganese	1.088
Sulphur	.232
Phosphorus	.469

Full details concerning furnace practice, the character and cost of the iron produced from the Buhrstone ore, and the general conditions of manufacture are contained in Platt's report,[a] to which the reader is referred for additional information.

LOWER FREEPORT ORE

According to I. C. White,[b] this ore largely supplied the old Winfield furnace. It is a mixture of carbonate and limonite, probably yielding from 35 to 50 per cent of metallic iron. Mr. Denny, on whose land the ore was mined, states that it varies in thickness from 1½ to 6 feet. This same ore was mined on the hill one-half mile north of the Butler pike in western West Franklin Township for use in Buffalo furnace and is reported 2 feet thick. It is said to have yielded about 25 per cent of metallic iron. Little is known of the extent of these deposits, but it seems likely that they are limited to small areas.

UPPER FREEPORT ORE.

The following discussion of this ore by Lesley[c] fully covers the ground:

> The Freeport (or Summit) ore, 26 feet below the coal, and running about 2 feet thick, but occasionally 4 feet (as in Phillip's hill), solid, compact, very argillaceous, almost a clay, mined by stripping; and also in gangways and rooms; mined with the pick by bearing in on the clay above and lifting the ore in masses from 15 to 20 inches thick; yielding 1½ tons to the yard, and requiring 3 to 3¼ tons to the ton of metal; specked with delicate rose-colored specks throughout, from incipient decomposition; remarkably like the "Big Bottom" ore of the Connellsville and Uniontown region; disposed to make red short iron; requires mixture with siliceous ores; would be greatly improved by mixture of one-fourth magnetic or red hematite ores. * * * A vast amount of stripping and mining has been accomplished. In some spots the bed is too thin to strip; 20 feet of stripping is the maximum it will bear. Ball ore occurs under the regular bed.

The ore was mainly worked by the Bradys Bend Iron Company on the high plateau between Holder and Greenville runs. It extends also west of Holder Run apparently in workable thickness. Toward the south its horizon is under all the high land of Sugar Creek Township. North of Sugar Creek its run is obscure, probably by reason of its

[a] Second Geol. Survey Pennsylvania, Rept. H5.
[b] Second Geol. Survey Pennsylvania, Rept. Q, p. 94.
[c] Report to the Bradys Bend Company, 1865, quoted in Platt's Report H5, pp. 220-221.

diminished thickness there. A chemical analysis by McCreath of a specimen of the ore from Phillips Hill follows:

Analyses of iron ore from Phillips Hills.

	Per cent.
Protoxide of iron	38.378
Sesquioxide of iron	2.646
Bisulphide of iron	.090
Protoxide of manganese	1.153
Protoxide of cobalt	Trace.
Alumina	1.223
Lime	10.840
Magnesia	2.666
Sulphuric acid	Trace.
Phosphoric acid	.480
Carbonic acid	32.074
Water	1.910
Insoluble residue	8.540
	100.000
Metallic iron	31.750
Metallic manganese	.893
Sulphur	.042
Phosphorus	.224

COMPARISON WITH ORES FROM OTHER REGIONS.

The Lake ores average over 60 per cent of metallic iron.[a] The soft red ore and the brown ores of Alabama average over 50 per cent of metallic iron, while the hard, limy, self-fluxing red ore, the poorest ore mined in Alabama, yields on the average 37 per cent of metallic iron.[b]

As shown by the above analyses, the Upper Freeport ore of this region yields only about 30 per cent, and the carbonate, of which most of the remaining Buhrstone ore probably consists, yields only 34 per cent of metallic iron. Furthermore, on account of their thinness. mining the Allegheny Valley ores would be much more expensive than mining those with which they would have to compete. Under such conditions, therefore, the production of iron from native ores could not be profitable. Experience also shows this to be true, for within recent years unsuccessful efforts have been made in Hocking Valley, Ohio, to produce iron from the Bajrd ore, which is similar in character and occurrence to the Buhrstone ore, with which it is correlated.[c]

LIMESTONE.

The limestones of economic value in these quadrangles are two, the Vanport and Upper Freeport. Of these the Vanport is by far the more important.

VANPORT LIMESTONE.

As shown on the map, this has a great extent of outcrop in the region. In some comparatively small areas it is not known, and is probably absent. Where thus absent the fact is indicated on the map by continuing the line showing its outcrop as a dotted line along its probable horizon. Where present, the limestone rarely falls below 8 feet in thickness and may reach 22 feet, as at West Winfield. From an examination of the table of records of oil and gas wells (pp. 110–161) it will be seen that if the records are to be trusted the limestone runs 20 feet or more thick over an extensive area in the west and southwest parts of the Kittanning quadrangle. A thickness of 15 feet or more is recorded in many other wells in the other parts of the two quadrangles, but these records may exaggerate the thickness. This limestone is of a good degree of purity, as shown in the following analyses by McCreath:

[a] Bauerman, H., A Treatise on the Metallurgy of Iron, 1882.
[b] Phillips, W. B., Iron Making in Alabama.
[c] Orton, Edward, Geological Survey of Ohio, vol. 5.

Analyses of Vanport limestone.

	1.	2.	3.	4.	5.
Carbonate of lime	93.246	94.721	96.007	95.567	94.51
Carbonate of magnesia	1.740	1.044	1.498	1.422	.....
Iron	1.667	1.383	1.462	.930	1.05
Alumina					1.80
Phosphorus	.032	.047	.034	.035	.076
Sulphur	.....	.....	.....	.....	.028
Insoluble residue	3.420	2.300	.790	2.110	.....

1. From Rhea farm near Greendale, on Cowanshannock Creek (p. 97 *a*).
2. From Colwell property, Mahoning Furnace (p. 162 *a*).
3. Laughlin property, Stewardson furnace, Dee (p. 169 *a*).
4. Reynolds property, Kittanning (p. 247 *a*).
5. Sample from quarry north of Mahoning Creek, 1 mile above mouth, furnished by Henry Colwell, superintendent of Kittanning Iron Company; analyst unknown.

As a flux.—This limestone was used for flux in the old blast furnaces. At present it is so used by the Kittanning Iron Company and is pronounced by the superintendent to be very satisfactory. The supply is drawn from the quarry on Mahoning Creek mentioned above. The Vanport limestone carries too much phosphorus for making iron which is to be used in the manufacture of Bessemer steel, but not enough to injure it for mill iron and probably not enough to injure iron which is to be used for making steel by the basic process. There is nothing in its quality, therefore, to prevent it from being an excellent flux. The only obstacle to its more extensive use for that purpose is probably the fact that it would have to compete with still better and more easily obtained limestone from other localities.

For cement.—According to the above analyses, this limestone is well adapted to the manufacture of Portland cement. This is made by burning a mixture of limestone and clay or shale. About the only restriction on limestone to be used for this purpose is that the magnesia content shall not much exceed 5 per cent. The other essential ingredients of cement are silica and alumina. These are supplied by the clay or shale used in the mixture. Whatever material is used, however, the alumina should not exceed 25 per cent, as a greater proportion injures the cement. The fire clays of the quadrangles can not be used for cement making since they run over 30 per cent alumina, as shown by the analyses given in the description of the clays. At Wampum, in Lawrence County, one of the first places in this country where Portland cement was made, the materials used are the Vanport limestone and shale from an immediately overlying bed 6 feet thick. The composition of the shale is given below:

Analysis of shale near Wampum, Pa.

Silica	65.99
Alumina	21.57
Ferric oxide	6.07
Lime	.47
Magnesia	.82

It seems probable that there is in these quadrangles an abundance of shale of this character to be had in association with the limestone, and this, with the cheap supply of fuel near at hand in the Lower Kittanning coal, would seem to indicate that cement making could be made a profitable industry.

Development.—The Vanport limestone makes good lime, and is quarried at many points in the quadrangles and burned into lime by the farmers in the fields, where it is to be used as a fertilizer. This custom is facilitated by the abundant and cheap supply of coal for fuel.

At West Winfield the limestone is worked on a commercial scale by A. G. Morris. The workings consists of an open-cut quarry and two mines. The limestone at this place is 22 feet thick and in mining 18 feet are taken out and 4 feet are left for roof. It is used for railroad ballast, concrete work, artificial stone, and fluxing, and is burned into lime.

a These references are to Report H5 of the Second Geological Survey of Pennsylvania.

FREEPORT LIMESTONE.

This is a less persistent bed than the Vanport. It reaches its maximum thickness and greatest economic importance in the southeast corner of the Kittanning quadrangle, between Manorville and Ford City, where it is 28 feet thick.

The composition of this limestone is shown in the analyses by McCreath given below:

Analyses of Freeport limestone.

	1.	2.	3.	4.	5.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Carbonate of lime	88.839	94.928	84.857	89.303	82.589
Carbonate of magnesia	1.513	1.210	1.868	1.900	5.751
Oxide of iron and alumina	2.557	1.246	2.568	2.002	3.367
Phosphorus	.021	.018	.024	.021	.063
Insoluble residue	5.030	1.920	9.520	4.830	7.310

	6.	7.	8.	9.	10.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Carbonate of lime	89.857	96.453	93.214	93.571	94.642
Carbonate of magnesia	2.898	1.445	2.065	1.324	1.574
Oxide of iron and alumina	1.860	.964	1.340	1.207	1.182
Phosphorus	.017	.007	.004	.029	.012
Insoluble residue	4.520	.830	2.220	3.170	1.850

1. From John Reefer farm, North Star ravine (Huskins Run?) (p. 93 [a]).
2. From William Marshall property, Dayton (p. 141 [a]). This locality is east of the Rural Valley quadrangle.
3. From William Hamilton property near Putneyville (p. 154 [a]).
4. From property of A. J. Dull & Co., Manorville, layer No. 1 (p. 257 [a]).
5. From property of A. J. Dull & Co., Manorville; layer No. 9 (p. 257 [a]).
6. From property of A. J. Dull & Co., Manorville; layer No. 11 (p. 257 [a]).
7. From Mehaffey's quarry, Logansport, just south of quadrangles; bank No. 1 (p. 257 [a]).
8. From same quarry, bench No. ? (p. 257 [a])
9. From same quarry, bench No. 11 (p. 257 [a])
10. From Monroe property on Buffalo Creek south of quadrangles (p. 289 [a]).

These analyses show considerable variation in the composition of the limestone. It generally carries less phosphorus than the Vanport. On the other hand they show in some cases, as at Manorville, a smaller percentage of carbonate of lime and much more insoluble matter, the decrease in the former being made up by the latter, which probably is mostly silica. At Mehaffey's quarry at Logansport, however, the percentage of carbonate is about the same as in the Vanport, while the phosphorus is very low. It would seem from these facts that the limestone at Manorville would not be suitable for flux, but would answer very well for making cement. It might be found that the clay and shale interbedded with the limestone, as shown in the section just referred to, would be suitable for mixing with the limestone in cement making, so that the whole stratum could be mined out and utilized. The limestone from this locality was once extensively quarried and shipped to Pittsburg for use as flux. The discontinuance of this industry was doubtless due to the fact that the limestone could not compete in the market with that of a better grade from other regions. Both the Vanport and Freeport limestones would afford a supply of road metal, probably, of good quality.

GANISTER.

A hard sand rock is used by the Cowanshannock brick works to mix with lime for making silica bricks. The exact source of this material is not known to the writer, but it is possibly the Clarion sandstone, which is of a coarse quartzose character along Cowanshannock Creek from its mouth to the old mill 1 mile above.

[a] These references are to Report H5 of the Second Geological Survey of Pennsylvania.

BUILDING STONE.

On the hills southwest of West Winfield the Saltsburg sandstone is extensively quarried by the Conemaugh Stone Company of Cresson, Pa. This sandstone practically forms the surface of the flat hilltops and can be reached by a minimum amount of stripping. The quarry already extends over a large space, throughout which the rock varies in thickness from 10 to 15 feet. The rock is a coarse-grained, free-working sandstone, in layers of such thickness that it is easily quarried and made into dimension stone of convenient size. It is suitable for coarse masonry only and is used for railroad purposes. The quarried blocks are let down by an incline to the West Winfield Railroad for shipment. On the east bank of Allegheny River, about three-fourths mile south of the mouth of Cowanshannock Creek, what is probably the Clarion sandstone has been quarried to a considerable extent for the same purpose, as has also the Freeport sandstone in the west bluff of the river just south of Applewold. There is a great abundance of sandstone to be had for coarse masonry throughout both quadrangles and further discussion is not demanded here.

SAND.

At West Winfield the Saltsburg and Clarion sandstones are being ground into sand. In the vicinity of Kittanning large quantities of sand are dredged from the river and used for grinding plate glass at the Kittanning plate glass works. It is also used to a less extent for mortar. It is prepared for use by being passed through three screens and then thoroughly washed. On the west side of the river opposite Ford City the Mahoning sandstone is extensively quarried by the Pittsburg Plate Glass Company, and reduced to sand, which is used for grinding glass at Ford City.

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