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UPPER PENNSYLVANIAN AND LOWER PERMIAN ROCK SECTION AT BLAINE HILL, BELMONT COUNTY, OHIO[1]

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The relocation of the National Highway, Ohio–U. S. Route 40, in Belmont County has exposed many rock cuts in upper Pennsylvanian and lower Permian rocks from Morristown in the western part of the county to Blaine in the eastern part. These exposures have been studied as part of the investigation of the Monongahela formation by the Geological Survey of Ohio. The section exposed on the "Blaine Hill," (Fig. 1), 4 miles east of St. Clairsville, is of especial interest as it provides fresh outcrops of the upper part of the Conemaugh formation and of all of the Monongahela formation of the Pennsylvanian system and of most of the Washington formation and of the basal beds of the Greene formation of the Permian system. Its accessibility along a major highway makes a record and identification of the units of perhaps some general interest.

The section was measured by hand level in June, 1944, with the efficient aid of Mr. Richard E. Lee, field assistant during the 1944 field season. Dr. Aureal T. Cross, National Research Council Fellow, collected specimens from each of the coal units for study of micro-fossils, and his suggestions at certain points were helpful. Later in June Dr. Myron T. Sturgeon of the staff of the Geological Survey of Ohio reviewed the section with the writer, assisted in measuring a part of the Washington formation, and made extensive collections from the limestones and calcareous shales for paleontological study. Dr. Sturgeon's advice and assistance were much appreciated. Dr. Wilber Stout, Director of the Geological Survey of Ohio, has generously given counsel and suggestions based on his unrivalled knowledge of the Coal Measures in Ohio. The elevation of the Pittsburgh coal is from the records of the State Highway Testing Laboratory through the courtesy of Mr. Harry Marshall.

A section along the old National Pike west of Blaine was measured by Stauffer and Schroyer,[2] but this section was measured along the old road, where exposures were slumped and overgrown and many details and several members were concealed. The rocks did not outcrop so boldly as to excite the interest and notice of the casual traveler along the road as is now the case. The new location is much higher on the hillside as far as the horizon of the Washington coal and somewhat lower through the horizons above the Washington coal. Several hundred yards separate the outcrop of some horizons on the new location from their position along the old road, and certain differences in thickness and character of some units are to be expected in comparing the two sections. The names of the members in the section are those used by the Geological Survey of Ohio.[3]

[1]Published by permission of the Director, Geological Survey of Ohio.

[2]Stauffer, C. R., and Schroyer, C. R., "The Dunkard Series in Ohio," *Geol. Surv. Ohio Bull. 22*, pp. 48–49, 1920.

[3]Stout, W., "The Monongahela Series in Eastern Ohio," *Proc. W. Va. Acad. Science*, vol. 3, pp. 118–133, 1930.

Ibid., "Generalized Section of the Coal Bearing Rocks of Ohio," *Geol. Surv. Ohio Information Circular No. 2*, 1939.

Dr. M. T. Sturgeon, who collected samples for paleontological study in company with the writer and on other occasions, now has in preparation a report on his investigations of the approximately 70 limestone and calcareous shale units of the section. He informs the writer[4] that most of the strata so far studied are fossiliferous. He reports that ostracods, gastropods, and annelid worm tubes (*Spirorbus*) are the most abundant, but that fish remains and rare pelecypods are also present.

FIG. 1. Map of Ohio showing location of Belmont County and of Blaine Hill.

The rock section starts at road level at the bottom of the west side of the most westerly post on the south side of the viaduct at Blaine, in central-north Section 15, Pultney Township, Belmont County, and extends westward across the northwestern part of Section 15, and across the northeastern part of Section 21, Richland Township, to the sharp turn at the top of the ridge in southwestern Section 22 of the latter township. Comments on certain units are given after the section which follows by reference to the appropriate number.

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[4]Sturgeon, M. T., personal communication, June 11, 1945.

ROCK SECTION AT BLAINE HILL, BELMONT COUNTY

PERMIAN SYSTEM—DUNKARD SERIES		Thickness		Interval from base of Pittsburgh	
GREENE FORMATION		Ft.	In.	Ft.	In.
163. Shale, siliceous		1	0	470	3
162. Coal, weathered, fair to good, *Jollytown "A,"* elevation 1,290± ft		0	5	469	10
WASHINGTON FORMATION					
161. Shale, gray, calcareous		0	8	469	2
160. Limestone, gray; weathers to irregular fragments	*Upper Washington*	2	6	466	8
159. Limestone, weathered; or shale, very calcareous	*Upper Washington*	6	11	459	9
158. Shale, sandy, somewhat calcareous	*Upper Washington*	2	7	457	2
157. Limestone, shaly, impure	*Upper Washington*	3	0	454	2
156. Shale, calcareous		2	2	452	0
155. Sandstone, medium-grained, micaceous, massive, ripple marked; exposed as extensive surface north of pavement at curve at Pullman's restaurant, *Hundred*		6	0	446	0
154. Covered; along slope up National Road to crest of hill		27	3	418	9
153. Limestone, weathered, irregular	*Middle Washington*	10	0	408	9
152. Sandstone, buffish green, micaceous, calcareous, fine to medium-grained	*Middle Washington*	1	9	407	0
151. Limestone, gray, nodular	*Middle Washington*	0	5	406	7
150. Shale, calcareous	*Middle Washington*	1	10	404	9
149. Limestone, gray, nodular	*Middle Washington*	0	8	404	1
148. Sandstone, greenish gray, micaceous, calcareous, massive to irregular	*Middle Washington*	6	4	397	9
147. Sandstone, very irregular, shaly	*Middle Washington*	3	0	394	9
146. Shale, siliceous	*Middle Washington*	2	5	392	4
145. Shale, gray, calcareous	*Middle Washington*	1	0	391	4
144. Limestone, shaly to marly, ferruginous, weathers rose pink, *Creston* horizon	*Middle Washington*	2	1	389	3
143. Limestone, blue-gray, shaly; and shale, calcareous	*Middle Washington*	5	10	383	5
142. Limestone, gray, marly	*Middle Washington*	3	0	380	5
141. Limestone, weathered	*Middle Washington*	7	8	372	9
140. Covered (*Lower Washington* limestone horizon)		35	2	337	7
139. Sandstone, thin-bedded	*Lower Marietta*	5	0	332	7
138. Sandstone and covered	*Lower Marietta*	10	7	322	0
137. Coal blossom, *Washington*		3	6	318	6
136. Covered		4	6	314	0
135. Shale, calcareous; and limestone, nodular		5	6	308	6
134. Limestone, weathered tan		5	8	302	10
133. Shale, sandy, irregular		1	9	301	1
132. Sandstone, shaly to thin-bedded; part cross-bedded		7	2	293	11
131. Shale, sandy; with ore nodules		3	4	290	7
130. Sandstone, shaly		1	0	289	7
129. Shale, sandy; with ore nodules		1	3	288	4
128. Shale, clayey to siliceous; with ore nodules		2	4	286	0
127. Ore, irregular, weathered		0	3	285	9
126. Clay shale, gray, micaceous		1	3	284	6

			Ft.	In.	Ft.	In.
125.	Siderite, blue-gray, dense; single layer		0	3	284	3
124.	Clay shale, gray		2	4	281	11
123.	Clay shale, with carbonaceous streaks		0	2	281	9
122.	Clay shale, gray, irregular fracture		1	2	280	7
121.	Shale, coally below to carbonaceous above	*Waynesburg "A"*	0	10	279	9
120.	Limestone, dark; with carbonaceous streaks	*Waynesburg "A"*	0	2	279	7
119.	Clay shale, gray	*Waynesburg "A"*	0	3	279	4
118.	Shale, coally	*Waynesburg "A"*	0	4	279	0
117.	Limestone, blue-gray, dense, very hard; in several beds	*Mt. Morris*	2	10	276	2
116.	Shale, siliceous to sandy; with ore knots	*Mt. Morris*	5	10	270	4
115.	Limestone, gray, dense, hard	*Mt. Morris*	0	4	270	0
114.	Shale, with ore knots	*Mt. Morris*	1	7	268	5
113.	Sandstone, massive		2	5	266	0
112.	Shale, silty		1	2	264	10
111.	Sandstone, coarse; in two beds		1	9	263	1
110.	Shale, siliceous, fine-grained		7	4	255	9
109.	Clay shale, carbonaceous		0	3	255	6
108.	Limestone, thin-bedded to shaly		0	7	254	11
107.	Limestone, blue-gray, dense, hard		1	2	253	9
106.	Shale, siliceous to sandy		1	10	251	11
105.	Clay shale, gray		4	0	247	11
104.	Clay shale, carbonaceous		1	0	246	11
103.	Limestone, gray-blue, hard, shaly	*Elm Grove*	1	5	245	6
102.	Shale, gray-blue, calcareous	*Elm Grove*	0	9	244	9
101.	Limestone, gray, dense, microcrystalline, fossiliferous; lower ½" is bone bed with fish teeth	*Elm Grove*	1	10	242	11
100.	Clay shale, with thin carbonaceous streaks	*Cassville*	1	0	241	11
99.	Shale, carbonaceous	*Cassville*	0	5	241	6
98.	Clay shale, gray	*Cassville*	0	5	241	1
97.	Clay shale, carbonaceous	*Cassville*	0	2	240	11
96.	Clay shale, gray, irregular fracture	*Cassville*	0	5	240	6

PENNSYLVANIAN SYSTEM

MONONGAHELA FORMATION

			Ft.	In.	Ft.	In.
95.	Shale, bony to coally	*Waynesburg*	0	3	240	3
94.	Coal, blocky, banded	*Waynesburg*	1	7	238	8
93.	Shale, dark, carbonaceous	*Waynesburg*	0	¼	238	7¾
92.	Coal, blocky, banded	*Waynesburg*	1	6	237	1¾
91.	Shale, carbonaceous	*Waynesburg*	0	¼	237	1½
90.	Coal, bright	*Waynesburg*	0	2½	236	11
89.	Clay shale, somewhat carbonaceous		0	2	236	9
88.	Clay, very impure		2	0	234	9
87.	Shale, siliceous to sandy		4	5	230	4
86.	Sandstone, shaly; with shale streaks; contains a few ore knots	*Gilboy*	3	4	227	0
85.	Shale, sandy	*Gilboy*	13	5	213	7
84.	Sandstone, fine-grained, shaly	*Gilboy*	1	9	211	10
83.	Shale, blue-gray, silty to siliceous		11	6	200	4

		Ft.	In.	Ft.	In.
82. Coal, bony, grading upward to bone shale		1	2	199	2
81. Coal, blocky		0	3	198	11
80. Shale, carbonaceous		0	2	198	9
79. Limestone, tannish gray; with thin carbon shreds		0	4	198	5
78. Shale, black, very hard, carbonaceous, calcareous, (black-band?)	*Uniontown*	0	5	198	0
77. Coal, bony		0	1½	197	10½
76. Shale, black, carbonaceous		0	2½	197	8
75. Coal, bony		0	8	197	0
74. Shale, black, very hard, calcareous, ferruginous; contains ostracods		0	4	196	8
73. Shale, gray		4	3	192	5
72. Limestone, gray, shaly		2	2	190	3
71. Limestone, gray, marly		4	3	186	0
70. Limestone, "cemented breccia"		1	5	184	7
69. Limestone, shaly to marly	*Uniontown*	1	1	183	6
68. Limestone, composed of cemented nodules and fragments, fossiliferous		1	3	182	3
67. Shale, gray-green, calcareous and siliceous; lower part not well exposed		17	0	165	3
66. Limestone, gray, dense; upper part not well exposed		6	11	158	4
65. Shale, serpentine green	*Arnoldsburg*	3	5	154	11
64. Limestone, irregularly bedded		5	6	149	5
63. Limestone, nodular, weathered		2	10	146	7
62. Shale, green, siliceous	*Fulton*	1	10	144	9
61. Shale, gray-green, sandy		2	3	142	6
60. Limestone, shaly; with some beds to 6"		6	6	136	0
59. Limestone, shaly, marly		7	9	128	3
58 Limestone, gray, "flint clay" fracture		5	6	122	9
57. Limestone, gray, laminated, weathers platy	*Benwood*	3	9	119	0
56. Limestone, dark gray, argillaceous, "flint clay" fracture		21	0	98	0
55. Limestone, gray-blue, shaly and marly		5	6	92	6
54. Shale, gray, carbonaceous		1	6	91	0
53. Coal, shaly (or shale, coally)		1	3	89	9
52. Coal, blocky		2	½	87	8½
51. Shale, coally, fine banded; with macerated plant fragments and mica flakes	*Meigs Creek*	0	5½	87	3
50. Coal, bright, banded		0	10	86	5
49. Shale, bony and coally		0	3	86	2
48. Clay shale, carbonaceous		0	2	86	0
47. Clay shale, gray, calcareous		1	6	84	6
46. Sandstone, gray, micaceous, calcareous		1	1	83	5
45. Limestone, weathered buff; with irregular shale partings, *Sewickley*		9	6	73	11
44. Covered; indication of carbonaceous shale blossom, *Fishpot*		11	1	62	10

			Ft.	In.	Ft.	In.
43. Limestone, in 1″ to 2″ beds			5	7	57	3
42. Limestone, gray-blue, dense			10	9	46	6
41. Limestone, weathers tan, single bed.			1	3	45	3
40. Shale, gray, calcareous			2	2	43	1
39. Limestone, thin-bedded			0	3	42	10
38. Limestone, gray, dense			1	8	41	2
37. Shale, gray, calcareous			0	10	40	4
36. Limestone, dove gray, microbanded, cherty fracture, weathers white		*Fishpot*	1	6	38	10
35. Limestone, tan, shaly			0	3	38	7
34. Limestone, tan, dense; a few calcite crystals			1	7	37	0
33. Shale, dark gray, calcareous			0	2	36	10
32. Limestone, gray-blue, "cemented breccia"			1	1	35	9
31. Shale, gray, calcareous			0	10	34	11
30. Limestone, gray, irregular, dense, marly			3	7	31	4
29. Shale, gray, calcareous			2	11	28	5
28. Coal, bony and shaly, *Pomeroy* (*Redstone*)			0	4	28	1
27. Shale, gray; with carbonaceous streaks			1	10	26	3
26. Limestone, gray, dense, massive, conchoidal fracture		*Redstone*	2	4	23	11
25. Limestone, gray-blue, marly; with shale streaks			8	9	15	2
24. Shale, gray, calcareous			1	4	13	10
23. Limestone, gray-blue, dense, irregular			1	9	12	1
22. Shale, gray, calcareous			2	0	10	1
21. Shale, gray, calcareous, with carbonaceous streaks			2	2	7	11
20. Coal, bony; with shale interbedded	"roof"	*Pittsburgh*	1	5	6	6
19. Shale, black, bony	"roof"		0	5	6	1
18. Clay shale, gray; "draw slate"			0	4	5	9
17. Coal, bony, canneloid			0	2½	5	6½
16. Coal, very hard, blocky	"breast"		1	10	3	8½
15. Shale, carbonaceous	"breast"		0	½	3	8
14. Coal, blocky, hard	"breast"		0	3	3	5
13. Shale, carbonaceous			0	½	3	4½
12. Coal, with shaly streaks; "bearing in"			0	6	2	10½
11. Shale, carbonaceous			0	½	2	10
10. Coal, blocky	"brick"		0	5½	2	4½
9. Shale parting	"brick"		0	¼	2	4¼
8. Coal, blocky	"brick"		1	½	1	3¾
7. Shale, carbonaceous			0	¼	1	3½
6. Coal, blocky; "bottom"			1	½	0	3
5. Coal, shaly and bony			0	3	0	0

Elevation base of *Pittsburgh* coal, 819.5 ft.

CONEMAUGH FORMATION

4. Clay shale, carbonaceous	0	3
3. Shale, sandy, ferruginous	0	8
2. Clay shale, gray	5	2
1. Covered; and limestone, fossiliferous, *Upper Pittsburgh*	5	4

1. Approximately 100 feet of upper Conemaugh strata, mainly Bellaire sandstone, are exposed in the cliff beneath the viaduct but these strata are not included.

18. The "draw slate" is somewhat thinner than is usual in Belmont County.

28. The Pomeroy coal is better exposed just south of the main highway in a side road. It is thinner than is usual in Belmont County.

44. The only covered part of the Monongahela section occurs here where the road crosses a small ravine on a fill.

64–72. The distinction between the Arnoldsburg and Uniontown limestones is not always clear in the absence of the Arnoldsburg coal, which is not known to occur in Ohio;[5] unless well defined sandy beds intervene.[6]

74–82. The Uniontown coal is exposed at road level across the highway from the highway park, a few feet lower than the pump in the park. Of special interest is the limestone parting in the coal.

90–95. The Waynesburg coal is exposed at the top of the cut opposite the pump at the highway park. The section from the Uniontown coal to above the Waynesburg is exposed in the vertical cliff and well shown is the transition from the calcareous character of the Monongahela below the Uniontown to the clastic character above it. The Waynesburg coal is at road level opposite the upper part of the park. It has been mined in the hollow south of the road.

101–103. The Elm Grove limestone is exposed at road level opposite the upper part of the park. The contact between 102 and 103 appears to be an unconformity.

114–117. The limestone strata at this horizon constitute the Mt. Morris member. From St. Clairsville westward to Morristown dark, dirty, greenish gray, ferruginous, argillaceous limestone is well developed at this horizon. The member is present in Pultney, Richland, and Union townships of Belmont County, and probably extends beyond these. It is present in Jefferson County;[7] but in much reduced thickness. At Blaine Hill the Mt. Morris limestone is less ferruginous and does not have the dirty greenish gray color which characterizes the member further west, especially near Morristown in central Union Township.

120. The limestone parting in the Waynesburg "A" coal is noteworthy.

137. The Washington coal is better exposed 50 yards south of the National Road on a road at the east boundary of a cemetery. Its thickness in this section is less than in much of Belmont County.

141–153. The Middle Washington limestone is prominently exposed on the north side of the road in the cut west of the Bellaire Road fork. The Creston ferruginous member, 144, is much better developed as an iron ore 5 miles to the northeast, where it was formerly mined in southeast Section 1, Pease Township.

154–163. Because of the lateral extent of the covered interval 154, the correlation of the members above is less certain than could be desired.

156–163. The calcareous units here called Upper Washington are exposed in the cut at the top of the slope on the south side of the road, opposite Pullman's restaurant. The beds are more or less weathered. They are well and more freshly exposed in a cut one-fourth mile west along the road at a fruit stand on the south side of the road, in southeast Section 28, Richland Township. Here the Upper Washington limestone is fossiliferous; the Jollytown "A" coal 6 inches thick, overlain by 16 feet of sandy shale and thin-bedded Jollytown sandstone.

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[5]Stout, W., *op. cit.*, 1939.

[6]Lamborn, R. E., "Geology of Jefferson County," *Geol. Surv. Ohio Bull. 35*, pp. 244–246, 1930.

[7]Lamborn, *ibid.*, p. 259.