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RADIOACTIVITY OF COAL AND ASSOCIATED ROCKS IN THE ANTHRACITE FIELDS OF EASTERN PENNSYLVANIA

By
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This report is preliminary and has not been edited or reviewed for conformity with U. S. Geological Survey standards and nomenclature.

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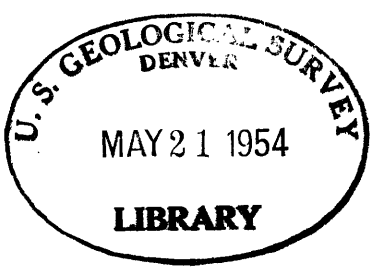

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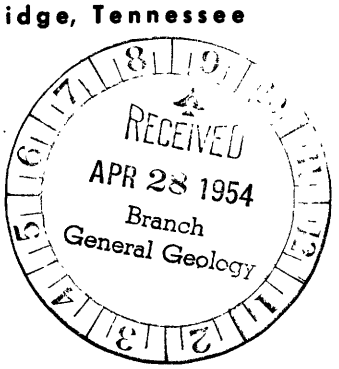

Subject Category, GEOLOGY AND MINERALOGY.

This report concerns work done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

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RADIOACTIVITY OF COAL AND ASSOCIATED ROCKS IN THE ANTHRACITE FIELDS OF EASTERN PENNSYLVANIA

By Stewart W. Welch

ABSTRACT

A reconnaissance of coal and associated rock was made in the anthracite fields of eastern Pennsylvania. Forty-six localities were visited and 153 samples, 150 of coal and 3 of shale, were collected. The radioactivity of rocks exposed at each locality was measured with a portable survey meter of the scintillation type and the equivalent uranium content of the samples was determined in the field with portable assay equipment. The radioactive content of the rocks, ranging from background to 0.001 percent equivalent uranium in the coal and from 0.001 to 0.003 percent equivalent uranium in the shale, is too low to be of economic interest at the present time.

INTRODUCTION

A study of the radioactivity of anthracite and associated rocks in eastern Pennsylvania was made in January and February, 1953, by the U. S. Geological Survey on behalf of the Division of Raw Materials of the Atomic Energy Commission. Stewart W. Welch was in charge of the field work of the investigations and was assisted by J. L. Snider.

The Pennsylvania anthracite fields were visited in 1948 by Nelson and Brill, who measured the radioactivity of coals and associated rocks with portable survey meters of the Geiger counter type. Their measurement of the Buck Mountain coal north of Williamstown and of the Mammoth and Skidmore coals west of Goodspring indicated equivalent uranium contents of

0.003 to 0.004 percent. The exact places at which these readings were taken could not be recovered because of the progress of mining in the intervening years, but the same coals were sampled as near as possible to the original localities. Results of the present study do not confirm the 1948 readings.

The localities visited during the present investigation were strip pits, underground mines, and road cuts - care being taken to visit as many coal beds and as many structural situations as possible. Field measurements of radioactivity were made with a portable survey meter of the scintillation type. Channel samples of coal were taken at each locality, and samples of rock associated with coal were collected when field readings were significantly greater than background. Samples were later crushed and their equivalent uranium content measured with portable assay equipment (Stead, 1951).

Localities visited are shown on the map (fig. 1) and the pertinent data on these locations, including radioactivity measurements, are summarized in table 1.

GEOLOGY

Coal fields

The anthracite region of eastern Pennsylvania is divided into four major fields: the Southern field, occupying parts of Dauphin, Lebanon, Schuylkill, and Carbon Counties; the Western Middle field, in Northumberland, Columbia, and Schuylkill Counties; the Eastern Middle field, in Columbia, Luzerne, Carbon, and Schuylkill Counties, and the Northern

field in Luzerne, Lackawanna, Susquehanna, and Wayne Counties. The Southern, Eastern Middle, and Western Middle fields adjoin each other; the Northern field is separated from the others by about 10 miles of non-coal-bearing rocks. The location and extent of the fields is shown in figure 1. In all, they occupy a northeast-trending area about 115 miles long and have a maximum width of 15 miles.

Coal-bearing formations

The coal-bearing rocks in the anthracite fields are the Pottsville, Allegheny, and Conemaugh formations of Pennsylvanian age.

Pottsville formation

The Pottsville formation overlies the Mauch Chunk formation of Mississippian age, and extends upward to the base of the Buck Mountain coal bed. It is composed principally of massive conglomerates and conglomeratic sandstones separated by carbonaceous shales and coals. The coal beds are thin at most places and are mined only in the western half of the Southern field and in the Western Middle field. The formation is thickest in the western part of the Southern field and thins to the northeast. The coal beds in the formation are listed below:

Southern and Western Middle Fields	Eastern Middle and Northern Fields
Lykens Valley No. 1	Coal beds are generally thin or absent
Lykens Valley No. 2	
Lykens Valley No. 3	
Lykens Valley No. 4	
Lykens Valley No. 5	
Lykens Valley No. 6	

Radioactivity measurements were made of the Lykens Valley No. 2, Lykens Valley No. 4, and Lykens Valley No. 5 beds of the Pottsville formation.

Allegheny formation

The Allegheny formation overlies the Pottsville conformably and consists of massive sandstones, shales, and coal. Lithologically, it is distinguished from the Pottsville principally by the relative lack of conglomerate. It contains the thickest and most extensively mined coal beds in the anthracite fields. The major coal beds recognized in these fields are listed below; the base of the Holmes coal in the Conemaugh formation is taken as the top of the formation.

Southern, Western Middle, and Eastern Middle Fields	Northern Field
Four-foot (No. 9½)	
Top split of Mammoth (No. 9)	
Bottom split of Mammoth (No. 8)	Baltimore
	Ross or New County Line
Skidmore (No. 7)	Clark
Seven-foot (No. 6)	Dunmore III
	Dunmore II or Red Ash
Buck Mountain (No. 5)	Dunmore I

Radioactivity measurements were taken of all beds in the Allegheny except the Seven-foot and the Dunmore I.

Conemaugh formation

The Conemaugh formation, like the Allegheny, is composed of massive sandstones, carbonaceous shales, and coal. In general the percentage of shale is higher, and the percentage of sandstone lower, in the Conemaugh than in the Allegheny. The named coal beds in the Conemaugh, most of

them locally of commercial importance, are listed below:

Southern, Western Middle, and Eastern Middle Fields	Northern Field
Peach Mountain (No. 18)	Auble
Little Tracy (No. 17)	Snake
Tracy (No. 16)	Abbott
	Kidney
	Olyphant I
Little Diamond (No. 15)	Olyphant II
Diamond (No. 14)	Diamond
Little Orchard (No. 13)	
Orchard (No. 12)	"C"
Primrose (No. 11)	Five-foot or "F"
Holmes (No. 10)	

Radioactivity measurements were made of the Holmes, Primrose, Orchard, Little Diamond, and Tracy coals in the Conemaugh formation.

Structure

Each of the four fields is a large northeast-trending syncline that contains many smaller synclines and anticlines, some of which are broken by thrust faults. The deformation of the rocks is most intense in the Southern field, but the entire anthracite-bearing area is remarkable for its complicated structure which is largely responsible for the rank of the coal and for the mining problems peculiar to the region. Lohman (1937) described the geology and structure by counties; detailed descriptions of parts of the Western Middle field are given by Rothrock and others (1950, 1951, 1952, 1953).

RADIOACTIVITY MEASUREMENTS

Radioactivity measurements at the outcrops were made with a portable survey meter of the scintillation type, the response of which was

calibrated in milliroentgens (mr/hr). The radioactivity of samples was measured with portable assay equipment, the response of which was calibrated in percent equivalent uranium by comparison with a standard sample. Based on the correlation between the radioactivity of outcrops measured in mr/hr and the assay results for corresponding samples expressed in percent equivalent uranium, the outcrop measurements of radioactivity can be interpreted qualitatively in terms of the equivalent uranium content of the outcrop.

The locations, thickness, and lithology of sample intervals, and radioactivity in percent equivalent uranium for all samples tested are given in table 1. Radioactivity of rocks in the Pottsville formation along U. S. Highway 122 at Pottsville, Pennsylvania, where the strata are well exposed in a new road cut, are given in table 2.

Table 1.--Localities and lithologies examined

Loc. No.	Location	Thickness Ft.	Thickness In.	Lithology	Equivalent Uranium (percent) [1]
	Southern Field				
1	Lebanon Co., Pa. Abandoned mine in unnamed coal about 4 miles south of Tower City on west side of Mine Run Gap. Tower City quadrangle: 11,550' N. 40°30' [2] 15,400' W. 76°30'		5	Shale, dark-gray, carbonaceous	.002
		2	1	Coal, bright, sheared	a
		2	2	Coal, bright, sheared	a
			6	Shale, unevenly-bedded	.002*
2	Lebanon Co., Pa. Small opening in abandoned strip pit in unnamed coal about 4 miles south of Tower City and 0.3 mile north of Mine Run Gap. Tower City quadrangle: 12,900' N. 40°30' 14,200' W. 76°30'		2	Shale, medium light-gray	.001*
		2	7	Coal, bright, sheared	a
		2	7	Coal, bright, sheared	a
		2		Shale, dark-gray	a*
3	Daupin Co., Pa. Abandoned strip pit in Primrose (?) coal 1.2 miles north of Lykens town limit. Lykens quadrangle: 13,900' S. 40°37½' 13,800' E. 76°45'	4		Shale, dark-gray, poorly-bedded	
			4	Bone coal	
		2		Coal, bright	a
		2		Coal, bright	a
		1	4	Coal, medium bright	a
		3		Coal, bright	a
			1	Bone coal	

1/ - Equivalent uranium of samples measured with portable assay equipment.
2/ - Distances from coordinates on published topographic maps are given to permit sample relocation in case land marks are destroyed.
* - eU estimated from outcrop measurements based on correlation between radioactivity of outcrops measured in mr/hr and equivalent uranium content of corresponding samples measured with portable assay equipment.
a - Less than 0.001 percent equivalent uranium.

Table 1.--Localities and lithologies examined-Continued

4	Dauphin Co., Pa. abandoned strip pit in the Mammoth coal about 1.5 miles northwest of Williamstown and on north side of Big Lick Mountain. Lykens quadrangle: 11,200' S. 40°37½' 6,200' W. 76°37½'	4		Shale, dark-gray, carbonaceous	
		1	11	Coal, bright, lower 4" dull	a
		2	6	Shale, dark-gray, carbonaceous	
		1	8	Coal, bright	a
			3	Coal, dull	
		2		Coal, bright	a
			6	Bone coal	
5	Schuylkill Co., Pa. Small mine in the Buck Mountain coal 1.4 miles northwest of center of Tower City and 0.2 mile south of crest of Big Lick Mountain. Tower City quadrangle: 9,800' S. 40°37½' 13,200' E. 76°37½'		6	Shale, thin-bedded, carbonaceous	.002*
		2		Coal, bright, fusain stringers	a
		1	2	Coal, bright)	
			2	Bone coal)	a
			7	Coal, moderately dull)	
6	Schuylkill Co., Pa. Abandoned mine opening in the Lykens Valley No. 5 coal 0.6 mile north of Tower City. Tower City quadrangle: 10,300' S. 40°37½' 17,000' E. 76°37½'	4		Sandstone, conglomeratic	
		1	5	Coal, bright	a
		2	3	Coal, sheared	a
		2	4	Coal, sheared	a
7	Schuylkill Co., Pa. Small mine in Lykens Valley No. 4 coal 0.7 mile north of Tower City. Tower City quadrangle: 10,100' S. 40°37½' 17,900' E. 76°37½'		6	Siltstone, medium dark-gray	
			8	Bone coal	
		1	6	Coal, bright, sheared	a
		1	6	Coal, bright, sheared	a
			1	Claystone, stigmarian	

Table 1.--Localities and lithologies examined-Continued

8	Schuylkill Co., Pa. Abandoned strip pit in the Skidmore coal about 2 miles north of Tower City and 0.3 mile southwest of Rausch Cr. gap of Bear Mtn. Tower City quadrangle: 2,600' S. 40°37½' 15,800' W. 76°30'	8		Flint fireclay, massive	.001*
		6		Shale, dark-gray, carbonaceous	.001*
		1	1	Coal, bright, has thin bony partings	a
		1	10	Underclay, stigmarian	.001*
		2	6	Coal, bright	a
9	Schuylkill Co., Pa. Small entry in No. 9½ (?) coal about 2 miles north of Tower City and 0.3 mile southwest of Rausch Cr. gap of Bear Mountain. Tower City quad: 2,750' S. 40°37½' 15,450' W. 76°30'	3		Sandstone, medium-grained, massive	
		1	5	Coal, weathered	a
			8	Shale, dark-gray, very carbonaceous	.002*
			11	Coal, bright	a
		2		Shale, medium light-gray, carbonaceous	.003
10	Schuylkill Co., Pa. Abandoned entry in unnamed coal 2.9 miles northwest of Pine Grove town limit and on west side of Lorberry Cr. gap in Sharp Mtn. Pine Grove quadrangle: 13,500' S. 40°37½' 17,050' E. 76°30'	2		Shale, mottled light and dark	.001*
		2	10	Coal, bright	a
		2	10	Coal, bright	a
		2		Siltstone, medium dark-brown	.001*

Table 1.--Localities and lithologies examined-Continued

11	Schuylkill Co., Pa. Abandoned strip pit in the Orchard coal 0.9 mile southeast of Joliett and 0.1 mile east of all-weather road. Pine Grove quadrangle: 7,700' S. 40°37½' 15,900' E. 76°30'	3		Shale, grayish-black, thin-bedded	.002*
		1	6	Coal, moderately bright, sheared	a
		1	6	Bone and bony coal	a
		3	4	Coal, bright, sheared	a
			2	Bone coal	.001*
		18		Concealed	
		2		Underclay, stigmarian	.001*
			2	Laminated coal and shale	
		2	1	Coal, bright, sheared	a
		2	2	Coal, bright, sheared	a
		2	2	Coal, bright, sheared	a
		1		Siltstone, stigmarian	.001*
12	Schuylkill Co., Pa. Abandoned strip pit in the Mammoth coal 3.6 miles north of Pine Grove town limit and 0.1 mile east of State Highway 125. Pine Grove quadrangle: 4,550' S. 40°37½' 4,750' W. 76°22½'	2		Shale, medium light-gray	.001*
		2		Coal, bright, weathered	a
		3		Coal, bright	a
		3		Coal, bright	a
		3		Coal, bright	a
		3		Coal, bright	a
		3		Coal, bright	a
		1	6	Bone coal, weathered	a*
			6	Shale, medium dark-gray	.001*

Table 1.--Localities and lithologies examined-Continued

13	Schuylkill Co., Pa. Road cut exposing the Skidmore and Buck Mountain coals on southeast town limit of Pottsville. Pottsville quadrangle: 19,900' N. 40°37½' 16,900' E. 76°15'	4		Shale, dark-gray, carbonaceous	.001*
		2	4	Coal, bright, sheared	a
		2	4	Coal, bright, sheared	a
		40		Claystone, sandstone, and siltstone	
			9	Coal	
		10	4	Claystone, thin-bedded, black	
		1	3	Coal	
		3		Claystone, carbonaceous	
		35	11	Sandstone, conglomeratic, massive	
			6	Claystone, carbonaceous	
		2		Coal	
		15		Sandstone, conglomeratic in lower half	a*
		3		Coal, weathered	a
		3		Coal, weathered	a
		3		Coal, weathered	a
		3		Coal, weathered	a
			6	Shale, carbonaceous	.001*
			10	Coal, weathered	a*
		1		Shale, dark-gray, carbonaceous	.001*
14	Schuylkill Co., Pa. Road cut exposing unidentified coal 0.4 mile north of center of Pottsville and on east side of U. S. Highway 122. Pottsville quadrangle: 21,150' S. 40°45' 14,750' E. 76°15'	3		Shale, dark-gray	.001*
		2	6	Claystone, non-bedded	.001*
		2	6	Coal, bright	a
		2	6	Coal, bright	a
		2	6	Coal, bright	a
			3	Siltstone, stigmarian	a*

Table 1.--Localities and lithologies examined-Continued

15	Schuylkill Co., Pa. Road cut exposing unidentified coal 0.3 mile north of Pottsville town limit on U. S. Highway 122. Pottsville quadrangle: 17,300' S. 40°45' 17,200' E. 76°15'	4		Shale, poorly-bedded	.001*
		1		Shale, thin-bedded, carbonaceous	.002*
		3		Underclay, non-bedded	.001*
		3	4	Coal, moderately dull, impure	a*
		2	6	Coal, mainly bright, impure	a*
		2	8	Coal, bright	a
		2	8	Coal, bright	a
		4		Siltstone, massive	.001*
16	Schuylkill Co., Pa. Road cut exposing unidentified coal 0.5 mile north of Pottsville town limit on U. S. Highway 122. Pottsville quadrangle: 16,200' S. 40°45' 16,900' E. 76°15'	2		Shale, dark-gray, carbonaceous	.001*
		2	5	Coal, bright	a
			1	Shale, carbonaceous	
			8	Coal, bright	a
		3		Claystone, poorly-bedded	.001*
17	Schuylkill Co., Pa. Road cut exposing unidentified coal 0.8 mile north of Pottsville town limit on U. S. Highway 122. Pottsville quadrangle: 14,850' S. 40°45' 16,700' E. 76°15'	3		Shale, dark-gray, thin-bedded	.001*
			9	Coal, bright)	
			6	Shale, dark-gray, not sampled)	a
			10	Coal, bright)	
			3	Bone coal	a*
		2	9	Coal, bright	a
		2		Shale, dark-gray	.001*

Table 1.--Localities and lithologies examined-Continued

18	Schuylkill Co., Pa. Abandoned mine opening in strip pit in unidentified coal 0.3 mile northeast of center of Tuscarora and 0.1 mile west of U. S. Highway 209. Delano quadrangle: 7,800' N. 40°45' 9,250' W. 76°00'	3			Sandstone, fine-grained	.001*
		1			Shale, grayish-black	.001*
				3	Coal, bright	
				6	Shale, very dark-gray	
		2		8	Coal, bright	a
				4	Bone coal	
		3			Coal, bright, sheared	a
		3			Coal, bright, sheared	a
				1	Bone coal	.001*
19	Schuylkill Co., Pa. Strip mine in the Primrose coal 1.2 miles northeast of center of Tuscarora and 0.3 mile northwest of U. S. Highway 209. Delano quadrangle: 12,050' N. 40°45' 6,050' W. 76°00'	2			Shale, dark-gray, thin-bedded	.001*
		1			Bone coal and carbonaceous shale	.001*
		1		6	Coal, medium bright	a
				11	Bone coal and carbonaceous shale	a*
		3		10	Coal, mainly bright	a
				4	Bone coal	
		1		8	Coal, bright)	
				5	Bone coal, not sampled)	a
		1		2	Coal, bright, sheared)	
				2	Bone coal	.001*
20	Carbon Co., Pa. Road cut exposing Primrose (?) coal 0.8 mile south of Nesquehoning on west side of U. S. Highway 209. Nesquehoning quadrangle: 8,400' S. 40°52½' 14,800' E. 75°52½'	2			Shale, dark-gray, thin-bedded	.001*
		2		4	Bone and bony coal	.001*
		1		8	Coal, very bright	a
				8	Bone coal	a*
		3			Coal, very bright	a
				8	Bone coal	.001*
		2			Claystone, stigmarian	.002*

Table 1.--Localities and lithologies examined-Continued

21	Carbon Co., Pa. Abandoned strip pit in unidentified coal 0.9 mile southeast of center of Nesquehoning and on south side of unimproved road. Nesquehoning quadrangle: 7,000' S. 40°52½' 13,500' W. 75°45'	4		Claystone, stigmarian	.001*
		3	4	Coal, bright, sheared	a
		7		Shale, has pyrite lenses	.002*
		1	3	Coal, bright	a
			8	Bone coal	a*
		2		Coal, bright	a
		2		Coal, bright	a
			11	Bony coal	.001*
			6	Shale, dark-gray, carbonaceous	.002*
22	Carbon Co., Pa. Abandoned strip pit in the Buck Mtn. coal 1.5 miles southeast of center of Nesquehoning and on south side of unimproved road. Nesquehoning quadrangle: 6,050' S. 40°52½' 9,900' W. 75°45'	2		Claystone, very carbonaceous	.001*
		1		Bone coal	.001*
			5	Coal, moderately bright	
			2	Bone coal	
			4	Coal, bright	
		1		Bone coal	.001*
		2	4	Coal, very bright	a
		2	6	Coal, very bright	a
		2	6	Coal, very bright	a
		2	6	Coal, very bright	a
		1	2	Bone coal	.001*
		1	9	Coal, bright)	
			4	Bone coal, not sampled)	a
			6	Coal, bright)	
			6	Bone coal	a*

Table 1.--Localities and lithologies examined-Continued

	Western Middle Field				
23	Northumberland Co., Pa.	2		Shale, grayish-black	.001*
	Abandoned strip pit in Mammoth	2	3	Coal, bright	a
	coal 3.0 miles northeast of	2	4	Coal, bright	a
	center of Shamokin and 0.2 mile	6		Shale, dark-gray, carbonaceous	.001*
	north of Pennsylvania Railroad.		6	Coal, bright	a
	Shamokin quadrangle:		4	Shale, very dark-gray	
	9,700' S. 40°50'		10	Coal, moderately bright	a
	500' W. 76°30'		5	Shale, dark-gray, poorly-bedded	
			2	Bone coal	
		2	6	Coal, moderately bright	a
		2	6	Coal, moderately bright	a
24	Northumberland Co., Pa. Strip	1		Shale, medium dark-gray, silty	.001*
	mine in Mammoth coal 0.2 mile	1	8	Coal, bright	a
	north of Kulpmont town limit and	1	8	Coal, bright	a
	0.3 mile west of Marion Heights		2	Shale, very carbonaceous	
	town limit. Mount Carmel quad:				
	18,600' N. 40°45'				
	7,250' E. 76°30'				
25	Northumberland Co., Pa.	4		Shale, dark-gray, thin-bedded	.001*
	Abandoned strip mine in the Lykens	1		Sandstone, fine- to medium-grained	a*
	Valley No. 2 coal 2.5 miles north-	2	3	Coal, bright, sheared	a
	west of Mount Carmel town limit	2		Coal, bright, sheared	a
	and 0.4 mile northeast of State	2		Coal, bright, sheared	.001
	Highway 54. Mount Carmel quad:		1	Shale, dark-gray	.002*
	19,500' S. 40°52½'				
	11,600' E. 76°30'				

Table 1.--Localities and lithologies examined-Continued

26	Columbia Co., Pa. Abandoned strip pit in Buck Mountain coal 1.1 miles west of Centralia town limit and 0.3 mile north of U. S. Highway 122. Ashland quadrangle: 19,700' N. 40°45' 1,100' E. 76°22½'	3		Shale, black, carbonaceous	
			8	Coal, bright	
			5	Shale, carbonaceous	
			9	Coal, moderately dull	
		6		Shale, medium dark-gray, carbonaceous	.002
		1	4	Coal, bright	a
		1	4	Coal, bright	a
			7	Shale, very carbonaceous	.002*
		1	4	Coal, moderately bright	a
27	Schuylkill Co., Pa. Small opening in the Primrose, Holmes, and No. 9½ coals 0.8 mile west of Shenandoah town limit and 0.2 mile south of State Highway 45. Shenandoah quadrangle: 20,600' N. 40°45' 6,300' E. 76°15'	1		Shale, very dark-gray	.001*
		5		Coal and partings, weathered	a*
		2	4	Shale, grayish-black	.002
		1	4	Coal, bright	a
		1	5	Coal, bright	a
			3	Underclay, stigmarian	.001*
		2		Sandstone, fine-grained	.001*
		2		Coal, bright	a
		2		Coal, bright	a
		2		Coal, bright	a
			3	Shale, grayish-black	.001*
		1		Shale, dark-gray	.001*
		1	8	Coal, bright	a
		1	8	Coal, bright	a
			2	Siltstone, poorly-bedded	a*

Table 1.--Localities and lithologies examined-Continued

28	Schuylkill Co., Pa. Strip pit in Mammoth coal 0.6 mile west of Shenandoah town limit and 0.3 mile south of State Highway 45. Shenandoah quadrangle: 20,800' N. 40°45' 7,500' E. 76°15'	2		Siltstone, dark-gray	.001*
			2	Shale and coal, laminated	
		1	10	Coal, bright	a
		1	11	Coal, bright	a
		1	2	Bone and bony coal	a*
		2	4	Coal, bright	a
			5	Bone and pyrite	
			11	Bone coal	.001*
		1	3	Coal, bright	a
			2	Bone coal	
		1	11	Coal, bright	a
		2	5	Bone and bony coal	.001*
		2	4	Coal, bright	a
			4	Bone coal	.001*
29	Schuylkill Co., Pa. Road cut exposing No. 6 coal 1.0 mile northeast of Frackville town limit and 0.1 mile southeast of State Highway 924. Shenandoah quadrangle: 18,500' N. 40°45' 9,000' E. 76°15'	6		Sandstone, medium- to coarse-grained	a*
		1	11	Coal, bright	.001
		1	11	Coal, bright	.001
			1	Siltstone, very carbonaceous	
		1		Coal, medium bright	a
			10	Bone coal	.001*
			1	Shale, dark-gray	.002*
30	Schuylkill Co., Pa. Small mine openings in the Tracy and Little Diamond coals 1.4 miles northeast of Frackville town limit and 0.3 mile southeast of State Highway 345. Shenandoah quadrangle: 17,000' N. 40°45' 12,200' E. 76°15'	3		Shale, thin-bedded, carbonaceous	.001*
		1	6	Coal, bright	a
		1	5	Coal, bright	a
		1		Shale, carbonaceous	.001*
		?		Concealed	
		1		Shale, silty, pyritic	.001*
		3	8	Coal, bright, sheared	a
			2	Shale, very carbonaceous	.001*

Table 1.--Localities and lithologies examined-Continued

31	Schuylkill Co., Pa. Mine entry in the Orchard coal 1.7 miles northeast of Frackville town limit and 0.4 mile south of State Highway 345. Shenandoah quadrangle: 17,200' N. 40°45' 13,850' E. 76°15'	1		Sandstone	a*
			8	Coal, bright	a*
		1	2	Bone and bony coal	.001*
		2	4	Coal, bright	a
		2	4	Coal, bright	a
			2	Bone coal	
		2	2	Coal, bright	a
			3	Siltstone, stigmarian	
32	Schuylkill Co., Pa. Abandoned mine opening in the Buck Mountain coal 0.2 mile south of center of Delano. Delano quadrangle: 14,250' S. 40°52½' 14,600' E. 76°07½'		2	Shale, grayish-black	
		5		Coal, mainly bright	a
		1		Coal, mainly bright	.001

Table 1.--Localities and lithologies examined-Continued

Eastern Middle Field

33	Schuylkill Co., Pa. Abandoned strip pit in the Buck Mountain coal 1.1 miles north of Sheppton and 0.1 mile north of State Highway 924. Conyngham quad: 13,450' N. 40°52½' 2,350' E. 76°07½'	4		Shale, dark-gray	.002*
		3		Shale and bony coal	.002*
			6	Coal, bright)	
			7	Bone coal, not sampled)	a
			7	Coal, moderately bright)	
			4	Bone coal	
		1	8	Coal, very bright)	
			5	Bone coal and shale, not sampled)	a
			5	Coal, bright)	
			2	Bone coal	
		2	6	Coal, bright	a
34	Luzerne Co., Pa. Abandoned mine opening in unidentified coal 0.4 mile south of State Highway 294 at Harwood. Conyngham quadrangle: 23,200' N. 40°52½' 5,050' W. 76°00'	3		Sandstone, conglomeratic	a*
		1	2	Shale, very carbonaceous	a*
		1	7	Coal, bright	a
		1	8	Coal, bright	a
			2	Bone coal	
			11	Coal, bright	a
35	Carbon Co., Pa. Strip mine in the Buck Mountain coal 0.4 mile east of road junction at Tresckow and 0.1 mile south of all-weather road. Hazelton quadrangle: 14,750' N. 40°52½' 11,200' E. 76°00'	1		Shale, dark-gray	.001*
		1	10	Coal, bright	a
			1	Shale, dark-gray	
		2	4	Coal, bright	.001
			5	Bone coal	
			9	Coal, medium bright	
			1	Shale, carbonaceous	

Table 1.--Localities and lithologies examined-Continued

36	Luzerne Co., Pa. Strip pit in Mammoth coal 3.2 miles northeast of Hazelton City Hall and 0.1 mile south of State Highway 940. Hazelton quadrangle: 4,750' S. 41°00' 15,750' W. 75°52½'	1		Shale, thin-bedded	.001*
		4		Coal, bright	a
		4		Coal, bright	a
		4		Coal, bright	a
			1	Bone coal	.001*
37	Luzerne Co., Pa. Strip pit in Mammoth coal 1.6 miles southwest of center of Freeland and 0.7 mile west of State Highway 940. Freeland quadrangle: 400' N. 41°00' 12,550' W. 75°52½'	10		Shale, dark-gray	.001*
			2	Bone coal	
			4	Coal, bright	
			5	Bone coal	
			7	Coal, bone, and pyrite)	
		1		Coal, bright)	a
			4	Bone coal, not sampled)	
			6	Coal, bright)	
		2		Shale, carbonaceous	.001*
		3		Coal, very bright	a
		3		Coal, very bright	a
		4		Concealed	
		3		Coal	a
		1	3	Bone coal	.001*
		1	6	Coal	a
		2		Concealed	
		7	6	Shale, carbonaceous, contains a lense of fusain and pyrite	.001*
		1	2	Coal, bright)	
			2	Bone coal, not sampled)	a
			8	Coal, bright)	
		1	8	Shale, very carbonaceous	.001*
		1		Coal, bright	a
		3	4	Coal, mined out	

Table 1.--Localities and lithologies examined-Continued

Northern Field

38	Luzerne Co., Pa. Strip pit in unidentified coal 1.9 miles southwest of Nanticoke town limit and 0.1 mile south of all-weather road. Nanticoke quad: 16,500' N. 41°07½' 11,050' W. 76°00'	3		Shale, carbonaceous	
		2	8	Coal, bright	a
		2	8	Coal, bright	a
			1	Shale, very carbonaceous	
		1	10	Coal, bright	a
			5	Bone coal	
			2	Coal, bright	
		2	2	Coal, dull, bony	.001*
39	Luzerne Co., Pa. Strip pit in Red Ash coal 0.7 mile west of Plymouth town limit and 0.5 mile northwest of U. S. Highway 11. Wilkes-Barre West quad: 5,900' S. 41°15' 5,800' E. 76°00'	1		Siltstone, dark-gray	.001*
		4	6	Coal, bright	a
			2	Shale, carbonaceous	
		1	4	Coal, bright	a
			2	Bone coal	
		2	6	Coal, bright	a
			4	Bone coal	
		2	3	Coal, bright	a
			2	Bone coal and pyrite	
		1	11	Coal, bright	a
			6	Bone coal and pyrite	
			9	Coal, bright	a*
			9	Bone coal	.001*
		3		Coal, moderately bright	a
		1		Coal, dull	a*

Table 1.--Localities and lithologies examined-Continued

40	Luzerne Co., Pa. Strip mine in the Baltimore coal 2.1 miles south of Wilkes-Barre City Hall and 0.2 mile southeast of U. S. Highway 309. Wilkes-Barre West quadrangle: 12,900' S. 41°15' 2,550' W. 75°52½'	2		Shale, carbonaceous, thin-bedded	.001*
			11	Coal, bright	
			2	Shale, not sampled	a
			4	Coal, bright	
		1	2	Shale, carbonaceous	.001*
		1	9	Coal, bright	a
			8	Siltstone, dark-gray	.001*
			8	Coal, very bright	
			1	Bone coal, not sampled	
		1	4	Coal, bright	a
			5	Coal, bony, not sampled	
		1		Coal, bright	
			4	Coal, bony	
41	Luzerne Co., Pa. Road cut exposing Ross and Top Ross coals 0.6 mile east of Wilkes-Barre city limit on State Highway 115. Pittston quadrangle: 450' N. 41°15' 14,350' E. 75°52½'	3		Shale, grayish-black, thin-bedded	.001*
			11	Coal, bright	a
			3	Bone coal	
			6	Coal, bright	
			2	Shale, carbonaceous	
			4	Coal, bright	
			5	Shale, dark-gray	
			3	Coal, bright	
		5		Shale, thin-bedded, silty	.002*
			6	Coal, dull	
		1	10	Coal, bright	a
			1	Bone coal	
		1	3	Coal, bright	a
			5	Bone coal	
		4		Shale, dark-gray	.001*

Table 1.--Localities and lithologies examined-Continued

42	Lackawana Co., Pa. Strip mine in New County Line coal 2.8 miles west of Scranton Court House and on north side of all-weather road 0.5 mile northwest of South Keyser Ave. Scranton quadrangle: 14,350' N. 41°22½' 9,650' E. 75°45'		6	Shale, dark-gray, thin-bedded	.001*
		2	9	Coal, bright	a
			7	Coal, moderately dull)	
		1	4	Coal, bright)	a
			3	Coal, bone, and shale	
			8	Coal, moderately bright	a
			1	Bone coal	.001*
43	Lackawanna Co., Pa. Mine entry in the Dunmore III coal about 3.0 miles east of Throop on north side of all-weather road and 0.2 mile north of Marshwood Reservoir Dam. Olyphant quad: 22,050' S. 41°30' 16,100' W. 75°30'	2		Shale, dark-gray, carbonaceous	
		1		Coal, bright	a
			1	Shale	
		1		Coal, moderately bright	a
			4	Shale	
		1	4	Coal, moderately bright	a
			1	Clay	
			2	Coal, bright	
			1	Shale, stigmarian	
44	Lackawanna Co., Pa. Strip mine in unidentified coal 0.6 mile west of center of Jermyn and 0.2 mile southwest of State Highway 107. Carbondale quad: 12,850' N. 41°30' 15,500' W. 75°30'		6	Shale, medium dark-gray	.001*
			4	Coal, moderately bright)	
			4	Bone coal)	a
		2		Coal, bright)	
			1	Shale, dark-gray	.001*

Table 1.--Localities and lithologies examined-Continued

45	Lackawanna Co., Pa. Abandoned mine in unidentified coal 0.5 mile east of center of Jermyn and 0.7 mile north of Aylesworth Creek. Carbondale quad: 11,250' N. 41°30' 9,900' W. 75°30'	3		Sandstone, fine- to medium-grained	a*
			6	Coal, bright)	
			1	Bone coal, not sampled)	a
		1	7	Coal, bright)	
46	Lackawanna Co., Pa. Strip mine in the Clark coal 0.7 mile north of Carbondale town limit on west side of all-weather road. Carbondale quadrangle: 10,950' S. 41°37½' 1,150' W. 75°30'		6	Shale, thin-bedded, carbonaceous	a*
		1	2	Coal, bright	a
			4	Bone coal	
		2	6	Coal, bright	a
			1	Bone coal	
		2		Coal, bright	a

Table 2.--Radioactivity of rocks along U. S. Highway 122 at Pottsville, Pennsylvania

Outcrop measurements of radioactivity taken in road cuts at southern edge of Pottsville. Section modified from field notes by H. H. Arndt and B. R. Haley.

Formation	Thickness Ft.	In.	Description of rocks	Equivalent Uranium (Percent) [1/]
Allegheny	20		Shale	.001
	8		Coal bloom (Mammoth)	a
	65		Shale and siltstone	a-.001
	6		Coal	a
	110		Sandstone, shale, and thin coals	a-.001
	13		Coal, sheared (Buck Mountain)	a
	1	8	Shale, carbonaceous	.001
		5	Coal	
Pottsville	6		Shale, black	.001-.002
	33		Sandstone, conglomeratic	a
	20		Shale, carbonaceous	.002
		9	Coal, sheared	.001
	16		Shale, dark-gray	.001
	300		Sandstone, conglomeratic, few carbonaceous shale lenses	a
	7		Shale, carbonaceous	.001
	18		Sandstone	a
	9	6	Shale, carbonaceous	.001
	86		Sandstone, conglomeratic, few carbonaceous shale lenses	a
	2	2	Shale, carbonaceous	
	1		Coal, bony	a
	2	4	Shale, carbonaceous	.001
	1		Coal	a
	2	4	Shale, carbonaceous	
		7	Coal, bony	
	23		Sandstone, coarse-grained	.001
	3		Coal, bony	a
	126		Sandstone, few carbonaceous shale lenses	a

1/-Equivalent uranium content of rock as estimated from outcrop measurements of radioactivity with a portable survey meter of the scintillation type, the response of which was calibrated in mr/hr.

a - Less than 0.001 percent equivalent uranium.

Table 2.--Radioactivity of rocks along U. S. Highway 122 at Pottsville, Pennsylvania-Continued

Pottsville		8	Coal, bony	
	10		Sandstone, medium-grained	a
		4	Coal	
		9	Shale, carbonaceous	
	1	8	Coal	
	1	10	Shale, carbonaceous	
	110		Sandstone, conglomeratic	a
	11	6	Shale and siltstone, carbonaceous	.001-.002
	273		Sandstone, conglomeratic	a
	16	7	Shale and siltstone, carbonaceous	.001-.002
	30		Sandstone, conglomeratic	a
	2	3	Shale, carbonaceous	.001-.002
	29		Sandstone, conglomeratic	a
	434		Siltstone and shale, green and red; interbedded with conglomeratic sandstone	a-.001
Mauch Chunk	790		Siltstone, shale, and sandstone; interbedded, mainly red with few green beds	a-.001

CONCLUSIONS

Coals in the anthracite fields of eastern Pennsylvania examined during this investigation contain 0.001 percent equivalent uranium or less. Some of the carbonaceous shale contain 0.002 to 0.003 percent equivalent uranium. Further investigation of the anthracites as potential sources of uranium does not appear warranted at this time.

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