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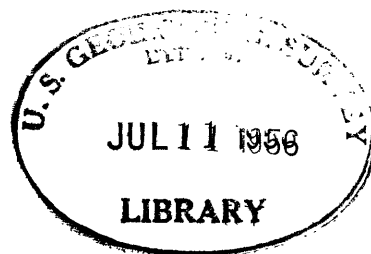
**RADIOACTIVITY OF SOME COALS AND  
SHALES IN SOUTHERN ILLINOIS**

By  
E. D. Patterson

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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## RADIOACTIVITY OF SOME COALS AND SHALES IN SOUTHERN ILLINOIS

By E. D. Patterson

## ABSTRACT

Channel samples of the commercially important coal beds in the Caseyville, Tradewater, Carbondale, and McLeansboro formations of Pennsylvanian age, and samples of the black, hard, sheety, roof shales of several coal beds were collected in southern and central Illinois. The content of the coal is generally less than 0.001 percent uranium, but at one locality a one foot thick layer of Herrin No. 6 coal contains 0.008 percent uranium, and the ash of the coal contains 0.125 percent uranium. The radioactivity of some black shale beds overlying coals ranges from 0.003 to 0.018 percent equivalent uranium. The most widespread uranium-bearing rock found by this reconnaissance is the hard, black, sheety shale above the No. 5 coal in Saline, Gallatin, and Williamson Counties. Based on available sample data, the more radioactive parts of this shale range from one to three feet in thickness.

## INTRODUCTION

As part of a systematic search for uranium-bearing coal and associated organic-rich deposits in eastern United States, a field reconnaissance examination of the coal and carbonaceous shales of Pennsylvanian age in the southern half of Illinois was undertaken by the writer in April 1954. The investigation was made by the U. S. Geological Survey on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

Coal and associated black shale beds were examined, field tested for radioactivity, and sampled at about 30 localities in 10 counties in Illinois (fig. 1) which include only a part of the areas underlain by coal-bearing rocks of Pennsylvanian age in the state. A portable scintillation meter and Geiger counter were used to make field determinations of radioactivity, and a portable radiation scaler was used to determine radioactivity of collected samples, after they were crushed to minus 1/4 inch at a laboratory in Lexington, Ky. Approximately 150 samples, each representing a one-foot thickness of coal or shale, were tested for radioactivity with the scaler. The samples were sent to the geochemical laboratory of the U. S. Geological Survey for verification of radioactivity and chemical analysis.

Coal reserves in Illinois and the geology of the coal-bearing rocks are extensively described in scientific literature and trade publications. Reports by Wanless (1939) and by Cady and others (1952), which summarize the stratigraphy and coal resources of the region, were used for general geologic background of the areas examined. Part of the area has been mapped by Cady (1919) and Butts (1925). A list of the active coal mines in the state, obtained from the Illinois State Bureau of Mines, provided valuable information on accessible fresh exposures of coal. Localities examined in the field were located on topographic quadrangle maps of the U. S. Geological Survey (scale 1:62,500).

## GEOLOGY

A large part of southern Illinois is underlain by sedimentary rocks of Pennsylvanian age (fig. 1), but in most places these rocks are concealed by a mantle of Pleistocene glacial drift and outwash. Fresh

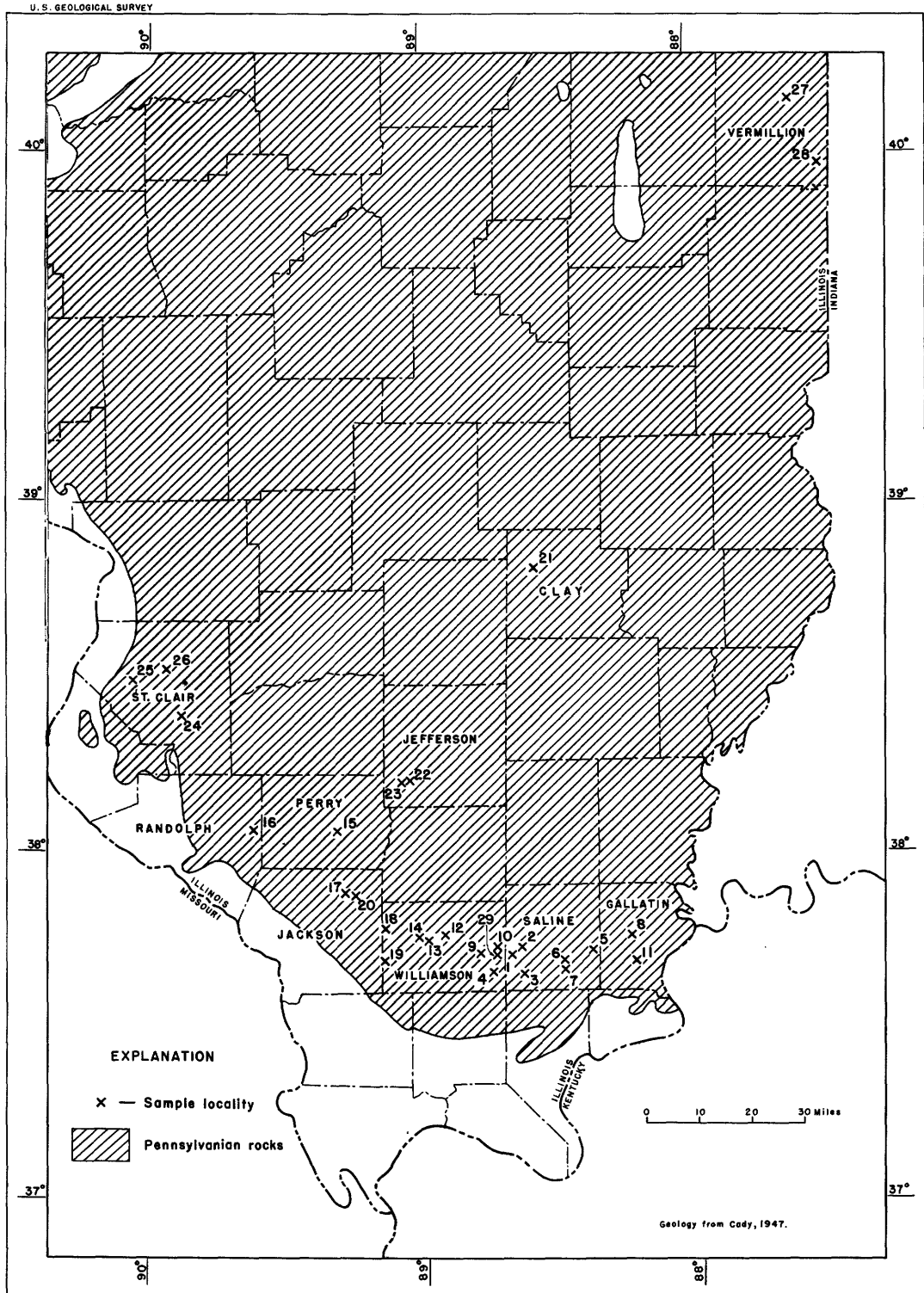


FIGURE 1.— SAMPLE LOCALITIES IN SOUTHERN ILLINOIS COAL FIELD

exposures of the Pennsylvanian strata including the coal beds, therefore, are found mainly in deep road cuts or in mine workings.

In most of the area covered by this report, the coal-bearing rocks are nearly horizontal but in general dip a few tens of feet per mile toward the center of the Illinois basin which is in Clay and adjacent counties (fig. 1). The basin is interrupted by a number of faults and gentle folds not shown on the map (Cady and others, 1952, p. 40, fig. 8).

Most of the commercially exploited coal in Illinois lies near the surface along the southern margin of the Illinois coal field (fig. 1), but these coals are more than 1,000 feet below surface in the deeper parts of the basin.

### Stratigraphy

Rocks of Pennsylvanian age in Illinois have been subdivided into four formations named in ascending order the Caseyville, Tradewater, Carbondale, and McLeansboro. The thickness, general character, and important coal beds and other thin rock units in these formations are shown in table 1.

### Coal examined

There are about 40 or 50 coal beds, 28 inches or more thick, in the Pennsylvanian rocks of Illinois, but the most important beds are in the upper part of the Tradewater, in the Carbondale, and in the lower part of the McLeansboro formations (Cady, 1952, p. 29).

The Caseyville formation consists mostly of sandstone and conglomerate, especially in the lower part. It also contains thin,

Table 1.--Generalized table of Pennsylvanian formations in southern Illinois showing the relative position of beds mentioned in this report.

	Important beds	General character and thickness
McLeansboro formation	Omega coal	:
		:
		:
	Shoal Creek limestone member	:
	Cutler coal*	:
	Danville (No. 7) coal*	:
	Jamestown limestone	:
	Jamestown coal	:
Carbondale formation		:
		:
	Herrin limestone	:
	Herrin (No. 6, Grape Creek coal) coal*	:
	Briar Hill (5a) coal	:
	Harrisburg (No. 5) coal*	:
	Sumnum (No. 4) coal*	:
	LaSalle (No. 2) coal*	:
		:
	Palzo sandstone	:
Tradewater formation		:
	Dekoven coal	:
	Davis coal*	:
	Stonefort limestone	:
	Bald Hill coal	:
	Curlew limestone	:
	Murphysboro (No. 1) coal	:
	Pounds sandstone	:
Caseyville formation		:
		:
	Makanda sandstone, shale, and coal beds	:
		:
	Battery Rock coal	:
	Battery Rock conglomerate	:

From Cady, 1952, p. 29-33 and Moore and others, 1944, vol. 55

\*Black, hard shale overlies the coal at many localities.



discontinuous coal beds. Three beds, believed to be Caseyville in age, were sampled from a strip mine south of Crab Orchard Lake near Carbondale.

The overlying Tradewater formation, composed mainly of sandstone and shale, contains several coal beds. Two of these coal beds, known as the Davis and DeKoven, were sampled but the Murphysboro, which is reported to be almost completely mined out, was not sampled.

The Carbondale formation contains the more important commercial coal beds in southern Illinois. The formation consists of sandstone, limestone, and shale and includes the LaSalle (No. 2), Sumnum (No. 4), Harrisburg (No. 5), Briar Hill (No. 5a), and Herrin (No. 6) coal beds. The Grape Creek coal, probably equivalent to the Herrin coal, outcrops in Vermillion and nearby counties. The base of the Carbondale in southern Illinois is marked by the Palzo sandstone, a coarse, reddish sandstone which overlies the DeKoven coal bed of the Tradewater formation.

The McLeansboro formation consists mainly of shales and sandstones with numerous thin beds of limestone, underclays, and coal beds. The lower 300 to 500 feet of the formation, below the Shoal Creek limestone member, contains the commercially important coal, especially the Danville (No. 7), which is mined in Vermillion County. The Danville (No. 7) coal is widely distributed in northern and western Illinois, outside the area sampled. In southern Illinois the Jamestown coal is thin and unworkable but is exposed in the high wall of many strip mines in the Herrin (No. 6) coal and is of minable thickness in Kentucky and Indiana. Coal in the McLeansboro formation above the Shoal Creek limestone generally occurs as thin and discontinuous lenses.

## Black shale examined

According to Wanless (1939, p. 15) black, sheety shale is widespread in the coal-bearing rocks of Pennsylvanian age in Illinois, occurring in parts of the basin in the roof rocks of the Cutler and Danville (No. 7) coal beds of the McLeansboro formation; the Herrin (No. 6), Harrisburg (No. 5), Summum (No. 4), and LaSalle (No. 2) coals of the Carbondale formation; and the Davis and Murphysboro (No. 1), locally called Rock Island, in the Tradewater formation. Black shale commonly includes concretions of pyrite and limestone; the concretions and enclosing shale contain marine fossils at many places. The unweathered black shale is massive and has a conchoidal fracture, but it weathers to form paper-thin sheets. The dark color is due to organic matter.

The shales above the Davis, Harrisburg (No. 5), and Herrin (No. 6) coals were sampled. The thickness of the black, hard, sheety shale at these localities ranges from one to ten feet, averaging two feet. These shales contain as much as 0.018 percent uranium in Saline County (Loc. 5, table 2).

## Basic igneous rocks examined

Basic igneous dikes intrude the coal beds of the Pennsylvanian at a number of places in southern Illinois (Cady, 1919, p. 34-35, 56-61 and Butts, 1925, p. 57). A dike cutting the Harrisburg (No. 5) coal at Locality 29 was examined and sampled. Neither the altered coal adjacent to the dike nor the dike is radioactive.

## RADIOACTIVITY OF COAL AND BLACK SHALE

Most of the 150 samples of coal and black shale collected in southern Illinois contain less than 0.001 percent equivalent uranium, but a few samples contain more.

One coal sample containing 0.008 percent equivalent uranium was collected in the upper part of the Herrin (No. 6) coal bed on the property of the Sahara Coal Company (Loc. 1, table 2). The coal immediately below this sample is not radioactive and the Herrin coal is not radioactive at nearby localities. It is unlikely that a large quantity of radioactive coal exists at this locality.

Radioactive black shale was found at a number of horizons and localities including: the black shale above the Davis coal, 2 to 25 feet thick, at Localities 3 and 6; a black, hard shale above the Harrisburg (No. 5) coal at Localities 11, 13, 18, and 23; and a black shale above the Herrin (No. 6) coal at Localities 5, 9, 15, 16, and 24. It is evident that these black shales are radioactive over a wide area. The radioactivity seems to be higher in black shales containing pyrite than in those without it. In some places the shale contains pyritized fossil shells and shell fragments, while in other places the pyrite is absent and thin layers of vitrain are present. A gray shale, which is not radioactive, replaces the black shale overlying the Harrisburg (No. 5) and the Herrin (No. 6) coal at some localities.

## CONCLUSIONS

The sample coverage was sufficiently dense to detect any large areas of radioactive coal, or shale overlying the Harrisburg (No. 5) and Herrin (No. 6) coals. Inasmuch as the most radioactive coals found in the investigation yielded only 0.003 to 0.008 percent uranium, there seems little possibility for discoveries of coal beds containing significantly higher percentages of uranium.

The black shales overlying the Harrisburg (No. 5), Herrin (No. 6), and Davis coal beds yield radioactivity in places ranging from 0.004 to 0.018 percent uranium, but the radioactivity varies from place to place and the more radioactive beds are thin, ranging from one to three feet thick. The apparent lack of large concentrations of uranium in such deposits makes them of little interest as a source of uranium at the present time.

Table 2.--Location, lithology, and radioactivity of samples.

<u>Loc. No.</u>	<u>Location</u>	<u>Thickness (feet)</u>	<u>Lithology</u>	<u>Equivalent Uranium <math>\frac{1}{2}</math> (percent)</u>
1	Sahara Coal Co., Harrisburg, Ill., Mine No. 6 - strip mine. Herrin (No. 6) coal. NE $\frac{1}{4}$ sec. 31, T. 9S., R. 5 E., Harrisburg quad- rangle, Saline County	1 4.12 .5	Coal, bright attrital Coal, bright to medium with thin pyritic partings Clay, gray	0.008 $\frac{2.3}{2}$ a $\frac{4}{4}$
2	Sahara Coal Co., Harrisburg, Ill., Mine No. 5 - slope mine. Harrisburg (No. 5) coal. SW $\frac{1}{4}$ sec. 22, T. 9 S., R. 5 E., Harrisburg quadrangle, Saline County	5.5	Coal, medium bright attrital Clay, gray	a
3	Saxton Coal Corp., Carrier Mills, Ill., - strip mine. Davis $\frac{1}{2}$ coal. NW $\frac{1}{4}$ sec. 16, T. 10 S., R 5 E., Harrisburg quadrangle, Saline County	1 1 1 .5 3.7 .5	Shale, black, hard Shale, black, hard Shale, black, hard Shale, black, pyritic Coal, bright Clay, gray	.006 $\frac{2}{2}$ .004 $\frac{2}{2}$ .002 a

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- 1/ Radioactivity measurements made in laboratory by author, unless otherwise noted. Chemical analyses by Barbara Guarco and Roosevelt Moore, U.S.G.S., Washington, D. C.
- 2/ Radioactivity measurements by Benjamin A. McCall, U. S. G. S., Washington, D. C.
- 3/ Percent ash 6.79, percent uranium in ash 0.125, percent uranium in sample 0.0085.
- 4/ a less than 0.001 percent eU.

Table 2.--Location, lithology, and radioactivity of samples--Continued.

<u>Loc. No.</u>	<u>Location</u>	<u>Thickness</u> <u>(feet)</u>	<u>Lithology</u>	<u>Equivalent</u> <u>Uranium</u> <u>(percent)</u>
4	Stonefort Coal Corp., Will Scarlet Mine - strip mine. Dekoven ? coal. NW $\frac{1}{4}$ sec. 24, T. 10 S., R. 4 E., Harrisburg quadrangle, Williamson County	3 1.35 .25 1 .5 2	Sandstone, pink, medium to coarse-grained, micaceous Coal, weathered, bright, banded Clay, gray Coal, bright, thin vitrain bands Siltstone, gray, stigmairian bands Siltstone, gray	a a
5	Recently abandoned strip mine - company unknown. Harrisburg (No. 5) coal. SE $\frac{1}{4}$ sec. 14, T. 9 S., R. 7 E., Equality quadrangle, Saline County	2 4	Shale, black, hard Fresh rock fracture chonchoidally, weathered rock fracture paper-thin sheets. Some pyrite. Grab sample from spoil pile. Coal, weathered, inaccessible	0.018 2.5/ 17
6	Beecher Williams' strip mine. Davis ? coal. NW $\frac{1}{4}$ sec. 8, T. 10 S., R 7 E., Equality quadrangle, Saline County	5 3 4 .57	Shale, gray Shale, black, hard Coal, medium to bright, no thick partings, slightly weathered Clay, gray	.005 2/ a

5/ Percent ash 61.4, percent uranium in ash 0.027, percent uranium in sample 0.017.

Table 2.--Location, lithology, and radioactivity of samples--Continued.

<u>Loc. No.</u>	<u>Location</u>	<u>Thickness (feet)</u>	<u>Lithology</u>	<u>Equivalent Uranium (percent)</u>
7	Beecher Williams' strip mine. Dekoven ? coal. NW $\frac{1}{4}$ sec 8, T. 10 S., R 7 E., Equality quad- rangle, Saline County	20 3.25 .5	Shale, gray Coal, medium to bright, no thick partings, slightly weathered Clay, gray, stigmurian	a
8	B. & W. Coal Co., Junction, Ill. - Shaft mine. Harrisburg (No. 5) coal. SW $\frac{1}{4}$ sec. 12, T. 9 S., R. 8 E., Equality quadrangle, Gallatin County	1 $\frac{1}{2}$ .45 4	Bone coal, pyritic Coal, medium attrital, pyrite and calcite on joint faces. Brighter in upper part of seam. No partings. Coal, medium attrital	0.002 $\frac{2}{2}$ a .002 a
9	Republic Coal & Coke Co., Delta Mine - strip mine. Herrin (No. 6) coal. SE $\frac{1}{4}$ sec. 21, T. 9 S., R. 4 E., Marion quadrangle, Williamson County	20 1 1 4	Shale, gray Shale, black, hard Coal, bright, very thin vitrain bands Coal, medium bright to dull, thin vitrain bands, thin clay and pyrite partings	.005 $\frac{2}{2}$ .001 a
10	Harrisburg Coal Co. - slope mine Harrisburg (No. 5) coal. NE $\frac{1}{4}$ sec. 27, T. 9 S., R. 4 E., Harrisburg quadrangle, Williamson County	12 4.31 .5	Siltstone, gray. Replaced in places by carbonaceous shale Coal, medium to bright Shale, gray	a

Table 2.--Location, lithology, and radioactivity of samples--Continued.

<u>Loc. No.</u>	<u>Location</u>	<u>Thickness (feet)</u>	<u>Lithology</u>	<u>Equivalent Uranium (percent)</u>
11	Shawneetown Coal Co., Shawneetown, Ill. - drift mine. Harrisburg (No. 5) coal. NW $\frac{1}{4}$ sec. 8, T. 10 S., R. 9 E., Shawneetown quadrangle, Gallatin County	1 $\frac{1}{2}$ 1.8 .1	Siltstone, carbonaceous Shale, black, hard Clay, gray, contains thin coal sheets, grooves, and root slicks(?)	0.003 $\frac{2}{2}$ .008 $\frac{2}{2}$
		.7	Coal, bright, large amount of pyrite, badly crushed in places	.001 $\frac{6}{4}$
		4	Coal, as above	a
		.5	Clay, gray	
12	Norris Coal Co., Dogwatch, Ill. - slope mine. Harrisburg (No. 5) coal. SE $\frac{1}{4}$ sec. 1, T. 9 S., R. 2 E., West Frankfort quadrangle, William- son County	4 $\frac{1}{2}$ 20 $\frac{1}{2}$ .1 3.7	Limestone Shale, gray, indurated Siltstone, gray Coal, medium bright, sparse, thin vitrain bands. Coal brighter in top half of seam	a
		.5	Shale, gray	

6/ Highest radioactivity, 0.1 to 0.15 mr/hr, is in thin siltstone sheet replacing clay lying between coal and overlying black shale, but not enough of it was obtained to test with scaler.



Table 2.--Location, lithology, and radioactivity of samples--Continued.

<u>Loc. No.</u>	<u>Location</u>	<u>Thickness (feet)</u>	<u>Lithology</u>	<u>Equivalent Uranium (percent)</u>
13	Morgan Mines, Inc.,--strip mine. Harrisburg (No. 5) coal. NW $\frac{1}{4}$ sec. 4, T. 9 S., R. 2 E., West Frankfort quadrangle, Williamson County	20 1.5 1 3.9	Shale, gray (lower foot sampled) Shale, black, hard Shale, black, hard Coal, medium to bright attrital, numerous thin pyritic partings, and calcite sheets along cleats Clay, gray	0.002 .003 2/ a a
14	Morgan Mines, Inc. - strip mine. Herrin (No. 6) coal. NW $\frac{1}{4}$ sec. 4, T. 9 S., R. 4 E., West Frankfort quadrangle, Williamson County	20 2 5 $\frac{1}{2}$ 2 9 1	Shale, gray Limestone Covered interval Shale, black, silty Coal, mainly bright, no thick partings. Some pyrite Clay, gray	a a a
15	Truax-Traer Coal Co., Mine No. 2 - strip mine. Herrin (No. 6) coal. SE $\frac{1}{4}$ sec. 26, T. 5 S., R. 2 W., Pinckneyville quadrangle, Perry County	3 $\frac{1}{2}$ 2 $\frac{1}{2}$ 4.8 .1 .1 .1 .3 .5 $\frac{1}{2}$	Limestone Shale, black Coal, medium to bright Shale, gray, with interbedded coal-clay sheets Coal, bright Clay, gray Coal, bright Clay, gray	.006 2/ a a a a

Table 2.--Location, lithology, and radioactivity of samples--Continued.

<u>Loc. No.</u>	<u>Location</u>	<u>Thickness (feet)</u>	<u>Lithology</u>	<u>Equivalent Uranium (percent)</u>
16	Southwestern Illinois Coal Co. - strip mine. Herrin (No. 6) coal. NE $\frac{1}{4}$ sec. 36, T. 5 S., R. 5 W., Coulterville quadrangle, Randolph County	1  5.75  .25 .05 .30 .10 1 .5	Shale, carbonaceous (grab sample from dump) Coal, medium to bright, with several thin clay partings Coal, medium bright attrital) Clay parting ) Coal, medium bright attrital) Clay, gray, parting ) Coal, medium Clay, gray	0.006 $\frac{2}{2}$  a  a $\frac{2}{2}$  a
17	Truax-Traer Coal Co., Burning Star #1 mine - strip mine. Harris- burg (No. 5) coal. SE $\frac{1}{4}$ sec. 35, T. 7 S., R. 2 W., Murphysboro quadrangle, Jackson County	3.3 .1 .3 .5	Clay, gray Shale, carbonaceous Coal, medium bright attrital Pyritic parting Coal, medium bright attrital Clay, gray	a a a a
18	Forsyth-Carterville Coal Co. - strip mine. Harrisburg (No. 5) coal. NW $\frac{1}{4}$ sec. 31, T. 8 S., R. 1 E., Herrin quadrangle, Williamson County	1 2-10 3.7  .5	Limestone Shale, carbonaceous Coal, medium. No thick partings. Some pyrite. Sheets of calcite in cleats. Clay, gray	.002 $\frac{2}{2}$  a

Table 2.--Location, lithology, and radioactivity of samples--Continued.

<u>Loc. No.</u>	<u>Location</u>	<u>Thickness (feet)</u>	<u>Lithology</u>	<u>Equivalent Uranium (percent)</u>
19a	Cooksie Coal Co. Coal in Makanda formation. NW 1/4 sec. 36, T. 9 S., R. 1 W., Carbondale quadrangle, Jackson County	.54 3.3 .1	Clay Coal, medium to bright Clay and coal; thin interbedded sheets Clay, gray	a a a
19b	Cooksie Coal Co. Same location, different pit. This coal stratigraphically higher than 19a	5 3.5 .5	Shale, black to dark gray Coal, weathered, pyritic Clay, gray	a a a
19c	Cooksie Coal Co. Same location, different pit. This coal stratigraphically higher than 19b	4 3.3	Shale, dark gray Coal, weathered. No thick partings except discontinuous parting 0.1 foot thick, 1 foot from base	a a
20	Truax-Traer Coal Co., Burning Star #1 mine - drift mine. Herrin (No. 6) coal. SW 1/4 sec. 31, T. 7 S., R. 1 W., Murphysboro quadrangle, Jackson County	20 5.6 .12 1.8 .5	Claystone, gray - grades to black, hard, shale in lower part Coal, medium to bright Clay parting (Blue Band) Coal, medium to bright Clay, gray	a a a a

Table 2.--Location, lithology, and radioactivity of samples---Continued.

<u>Loc. No.</u>	<u>Location</u>	<u>Thickness (feet)</u>	<u>Lithology</u>	<u>Equivalent Uranium (percent)</u>
21	Iola Stone Co., Iola, Ill. - strip mine in Omega coal, 3.7 miles SSE Iola, NW $\frac{1}{4}$ sec. 11, T. 4 N., R. 5 E., (No quadrangle for this area), Clay County <u>I</u>	2 1 $\frac{1}{4}$ 11 1.3 .2 .5 1.4 .1 .4 0.0	Clay, black Interbedded sandstone and black shale in very thin beds Limestone (Omega limestone) Shale, gray, pyritic, silty Limestone Shale, gray Coal, bright Clay parting Coal, medium bright to dull Clay, gray, with stigmata	a a    a a    a
22	Chicago-Wilmington and Farmington Coal Co. - shaft mine. Herrin (No. 6) coal. NW $\frac{1}{4}$ sec. 11, T. 4 S., R. 1 E., DuQuoin quadrangle, Jefferson County	4.6 .15 1.9	Coal "Blue Band" - gray shale parting Coal	a a a
23	Chicago-Wilmington and Farmington Coal Co. - diamond drill core. Harrisburg (No. 5) coal. SW $\frac{1}{4}$ sec. 9, T. 4 S., R. 1 E., DeQuoin quad- rangle, Jefferson County	1 1 4	Shale, black, hard Shale, black, hard Coal, medium to bright	0.005 .009 a

I This is the only known locality where this coal has a minable thickness (J. A. Simon, personal communication).

Table 2.--Location, lithology, and radioactivity of samples--Continued.

Loc. No.	Location	Thickness (feet)	Lithology	Equivalent Uranium (percent)
24	Reinheimer Slope Mine, Freeburg, Ill. Herrin (No. 6) coal. SE $\frac{1}{4}$ sec. 32, T. 1 S., R. 7 W., New Athens quadrangle, St. Clair County	1 $\frac{1}{2}$ .8 6 .5 $\frac{1}{2}$	Shale, carbonaceous, hard Coal, bright, thick vitrain bands Coal, bright, thick vitrain bands. Several thin clay partings Clay, gray	0.007 .001 a
25	Midwest Radiant Corp., Millstadt, Ill. Strip mine. Herrin (No. 6) coal. Near center sec. 31, T. 1 N., R. 8 W., Waterloo quadrangle, St. Clair County	6.2 .5 $\frac{1}{2}$	Coal, medium to bright, with thin discontinuous clay partings Clay, gray Limestone, black, from spoil pile	a .001
26	Belle Valley Coal Co. - slope mine. Herrin (No. 6) coal. SE $\frac{1}{4}$ sec. 26, T. 1 N., R. 8 W., O'Fallon quadrangle, St. Clair County	4 $\frac{1}{2}$ 6.25 .5 $\frac{1}{2}$	Shale, carbonaceous Coal, medium to bright. Several thin clay partings Clay, gray	.001 a
27	Fairview Collieries Corp., Harnatton Mine - strip pit. SE $\frac{1}{4}$ sec. 2, T. 19 N., R. 12 W., Danville quadrangle, Vermillion County	.3 5.9 .2	Shale, dark gray, abundant pyritized fossils Coal, bright attrital, with sparse, thick, vitrain Shale, medium dark gray, root allig- ensides	a

Table 2.--Location, lithology, and radioactivity of samples--Continued.

<u>Loc. No.</u>	<u>Location</u>	<u>Thickness (feet)</u>	<u>Lithology</u>	<u>Equivalent Uranium (percent)</u>
28	Grape Creek Coal Co. - strip mine. Grape Creek (No. 6?) coal. NW $\frac{1}{4}$ sec. 2, T. 17 N., R. 11 W., Ridge Farm quadrangle, Vermillion County	15 $\frac{1}{2}$ 2.73	Shale, gray Coal, medium to bright attrital. Contains thin fusain pyrite and shale partings	a
29	Delta Collieries Corp. - abandoned strip mine. Harrisburg (No. 5) coal. SW $\frac{1}{4}$ sec. 34, T. 9 S., R. 4 E., Harris- burg quadrangle, Williamson County. Coal samples collected 1 foot east of a basic igneous dike at margin of the strongly altered coal	0-2.5 2.5-3.75 3.75-4.7	Dike rock Coal Coal Coal - not exposed. Thickness reported.	0.001 a a

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