GEOLOGICAL SURVEY CIRCULAR 350

OCCURRENCES OF URANIUM IN CARBON COUNTY PENNSYLVANIA

This report concerns work done on behalf of the U. S. Atomic Energy Commission and is published with the permission of the Commission.

UNITED STATES DEPARTMENT OF THE INTERIOR
Douglas McKay, Secretary

GEOLOGICAL SURVEY
W. E. Wrather, Director

GEOLOGICAL SURVEY CIRCULAR 350

OCCURRENCES OF URANIUM IN CARBON COUNTY, PENNSYLVANIA

By Harry Klemic and R. C. Baker

This report concerns work done on behalf of the U. S. Atomic Energy Commission and is published with the permission of the Commission.

Washington, D. C., 1954

Free on application to the Geological Survey, Washington 25, D. C.

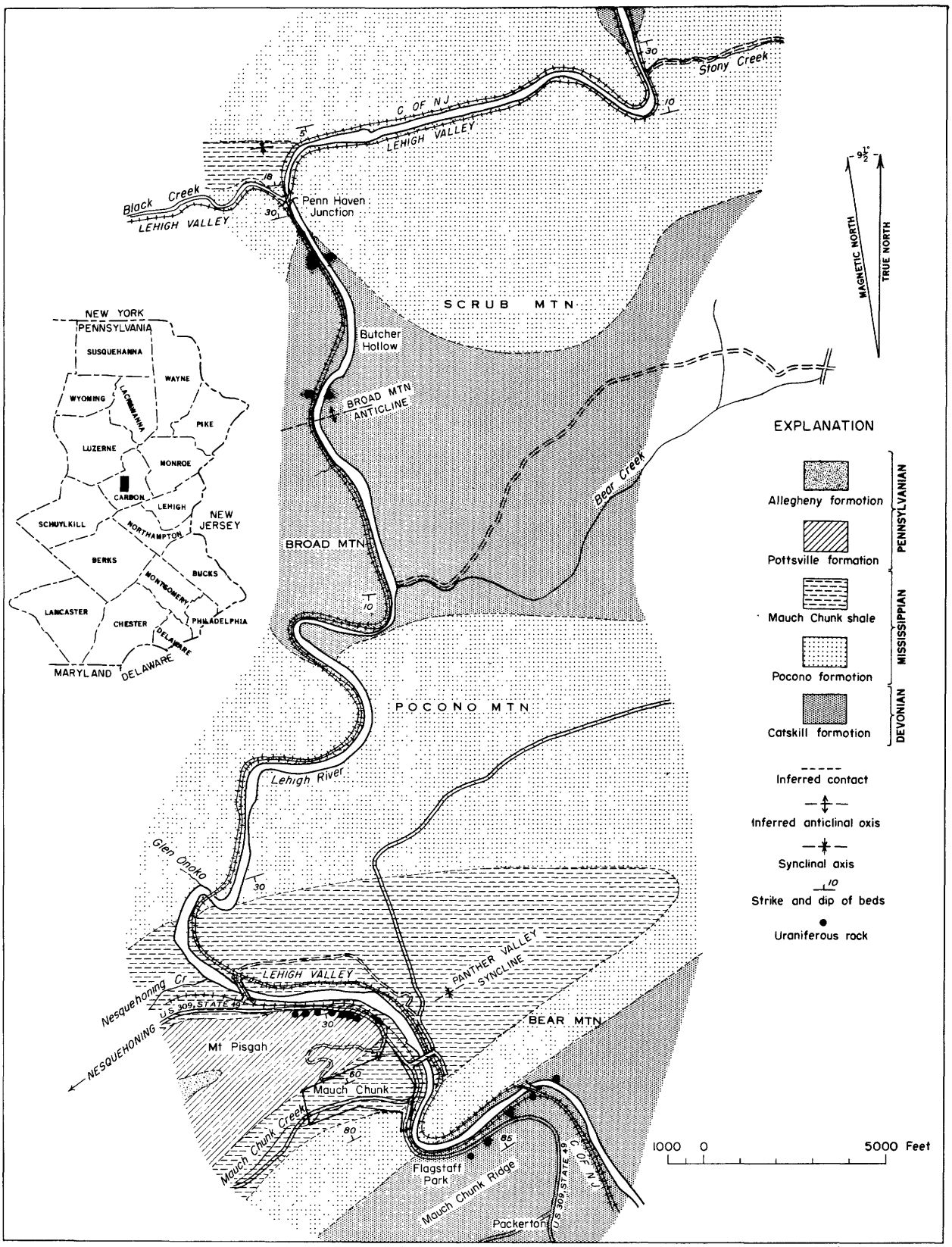

Figure 1.—Map of uranium occurrences in Carbon County, Pa.

OCCURRENCES OF URANIUM IN CARBON COUNTY, PENNSYLVANIA

By Harry Klemic and R. C. Baker

CONTENTS

ILLUSTRATIONS

TABLES

ABSTRACT

An occurrence of uranium in Carbon County, Pa., was known in 1874. Three other deposits were discovered in 1948 and 1953 by reconnaissance parties of the U. S. Geological Survey.

Uranium vanadates, carbonates, and silicates occur in coarse graywacke conglomerate near the base of the Pottsville formation, of Pennsylvanian age, on the north limb of the Panther Valley syncline; and on the south limb, autunite and uranium silicates occur in graywacke sandstones near the top of the Catskill formation of Devonian age. Uraniferous graywacke sandstone occurs in the upper part of the Catskill formation near Butcher Hollow and near Penn Haven Junction in minor anticlines of the Broad Mountain anticline. Small amounts of kasolite and galena occur in the vicinity of Penn Haven Junction. All three uranium deposits in the Catskill formation appear to be in the Cherry Ridge redbeds of Willard (1939).

The presence of 4 uranium deposits in rocks of 2 different types and ages, within a limited area, suggests that other deposits may be found by additional prospecting. Detailed study and geologic mapping of the area are planned.

INTRODUCTION

An occurrence of uranium in Carbon County, Pa., was known as early as 1874 when Genth (1875) reported autunite near Mauch Chunk but did not give the exact location of the deposit. Wherry (1912) described a deposit of carnotite northwest of Mauch Chunk, which he believed to be the one reported by Genth. More recently, McKeown (1949) found a uranium deposit southeast of Mauch Chunk. In July 1953 two occurrences of uranium north of Mauch Chunk were discovered by the writers during a reconnaissance for radioactive materials.

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

Location

All known occurrences of uranium in Carbon County are in the valley of the Lehigh River within 6 miles of Mauch Chunk (fig. 1). The deposits have been named Mount Pisgah, Mauch Chunk Ridge, Butcher Hollow, and Penn Haven Junction.

The Mount Pisgah deposit is located along a roadcut of U. S. 309 on Mount Pisgah, half a mile northwest of Mauch Chunk. The Mauch Chunk Ridge deposit is exposed along the right-of-way of the Central Railroad of New Jersey and also in a roadcut along U. S. 309 on Mauch Chunk Ridge about 0.4 mile southeast of Mauch Chunk, and on the northeast side of the Lehigh River about 1 mile southeast of Mauch Chunk. The Butcher Hollow deposit is exposed along the right-of-way of the Lehigh Valley Railroad on the west and east sides of the Lehigh River about 4 miles north of Mauch Chunk and about 1.5 miles south of Penn Haven Junction. The Penn Haven Junction deposit is exposed about 5 miles north of Mauch Chunk and about 0.4 mile south of Penn Haven Junction on both sides of the Lehigh River.

Development and ownership

The Mount Pisgah carnotite deposit has recently been prospected by the Lehigh Coal and Navigation Co., owners of the property. The Mauch Chunk Ridge deposit is owned partly by the Lehigh Coal and Navigation Co., and partly by Mr. Stuart Evans of Mauch Chunk. This deposit was prospected by core drilling during 1953. The Butcher Hollow and Penn Haven Junction deposits are on land owned by the Lehigh Valley Railroad Co. on the west side of the river and on land owned by the Commonwealth of Pennsylvania on the east side of the river. No development work has been done at either deposit.

GEOLOGY

Carbon County, in the central part of eastern Pennsylvania, has an area of 406 square miles. Maximum relief in the county is about 1,840 feet, from Lake Mountain in Kidder township (2,220 feet) to Lehigh Gap (380 feet), where the Lehigh River flows from the county. The Lehigh River and its tributaries drain the entire county except for a small area in the southwestern part which is drained by a tributary of the Schuylkill River.

During Pleistocene time the Wisconsin and Illinoian ice sheets covered the northern part of the county. In places on the Pocono Plateau the glacial drift is more than 100 feet thick. The Jerseyan ice sheet covered the entire county, but there are no extensive deposits of Jerseyan drift except in the southern part.

Uranium occurrences in Carbon County, Pa., are in Paleozoic sedimentary rocks near the southwestern corner of the Pocono Plateau and the eastern end of the Southern Anthracite field (fig. 1). The Pocono and Catskill formations crop out on the plateau and extend southwestward across the Lehigh River in the Broad Mountain anticline. On the southeast side of the anticline they dip below the surface as part of the Panther Valley syncline, emerging with almost vertical dips to form Mauch Chunk Ridge on the southeastern side of the syncline. On the north side of the Broad Mountain anticline the Pocono and Catskill rocks dip northward beneath the coal basins of the Eastern Middle Anthracite field. The Pottsville formation crops out to form a resistant rim around the coal basins. The less resistant Mississippian red beds of the Mauch Chunk shale have been deeply eroded and underlie the valleys between the ridges of Pottsville and Pocono rock.

Stratigraphy

The stratigraphic section of Carbon County includes Pennsylvanian, Mississippian, Devonian, and Silurian rocks. The geologic units in Carbon County and their thicknesses (Lesley, 1885) are listed below. Only the formations present in the vicinity of the uranium occurrences will be discussed in detail.

Stratigraphic section along the Lehigh River in Carbon County, Pa.

	Feet
Pennsylvanian:	
Productive coal measures	975
Pottsville conglomerate	880
Mississippian:	
Mauch Chunk shale	2170
Pocono gray sandstone	1255
Devonian:	
Catskill red sands and shales	7145
Chemung and Portage shales and flags	1290
Genesee shale	290
Hamilton shale	760
Marcellus shale	800
Oriskany sandstone	340
Helderberg limestone, lower part	295
Silurian:	
Onondaga and Clinton red and gray shale and marl	2000
Tuscarora sandstone	665
Oneida conglomerate	460
	19325

Catskill formation

The Catskill formation of Middle and Late Devonian age crops out over about 110 square miles of Carbon County on the Pocono Plateau and south of the Southern Anthracite field. Willard (1939) assigns a thickness of about 6,000 feet to the Catskill rocks, from the base of the Pocono formation to the top of the highest marine strata in the Lehigh Valley. The rocks are composed of continental sediments with red shales and sandstones, and gray, green, and brown sandstone and conglomerate members. Willard (1939) subdivides the Catskill formation, from top to bottom, as follows:

Member	Lithology
Mount Pleasant red shale	Red shale and sandstone.
Elk Mountain sandstone	Green to grayish-green flaggy crossbedded sandstone.
Cherry Ridge red beds	Red shale and sandstone and quartz conglomerate.
Honesdale sandstone	Greenish to gray flaggy sandstone with some red beds.
Damascus red shale	Red shale.

Pocono formation

The Pocono formation of Mississippian age crops out in areas totalling about 95 square miles in Carbon County. The formation consists of massive beds of gray and greenish-gray sandstone and conglomerate. On the south side of Mauch Chunk the top unit of the Pocono formation is massive gray sandstone. Below this is a series of sandstone and conglomerate beds. Near the bottom of the formation is a massive conglomeratic member which resembles some parts of the Pottsville formation. Underlying this member are gray and tan sandstones and some red beds. The Pocono-Catskill contact is difficult to define. For want of a more exact boundary, the top of the first red bed member below the massive conglomerate beds is called the Pocono-Catskill contact in this area.

The Pocono formation is well exposed in the Lehigh Valley near Mauch Chunk. Winslow (1887) gives the following thicknesses for the formation in Carbon County:

Location	Feet
Mauch Chunk	1253
Glen Onoko	1223
Penn Haven Junction	833
Stony Creek	548
Drakes Creek	798

Mauch Chunk shale

The Mauch Chunk shale of Mississippian age crops out in about 60 square miles of western Carbon County. Its type locality is at Mauch Chunk, where it is 2,168 feet thick. It consists of red shale, sandstone, mudstone, and siltstone, with thin beds of green, yellow, and tan shale. Calcareous concretions are present locally along some horizons but are not sufficiently developed or persistent to be useful for correlation over wide areas.

Pottsville formation

The Pottsville formation of Pennsylvanian age crops out in about 15 square miles of Carbon County in ridges around the eastern end of the Southern and Eastern Middle anthracite fields. It has a thickness of 1,155 feet in Nesquehoning Gap, 878 feet on Mount Pisgah east of the Panther Creek basin, and about 300 feet near the Beaver Meadow basin of the Eastern Middle coalfield. The most prominent features of the formation are its massive quartz conglomerate members, which crop out on the crests of ridges and weather into huge blocks and boulders. There are thin beds of coal and black shale in the upper half of the formation. Red shale and red and tan sandstone occur in the lower half of the formation in beds that are more than 100 feet thick in places. One red and tan shale and sandstone member, 30 to 40 feet thick, persists over wide areas. Coarse conglomerate members occur above and below this red bed horizon.

The basal member is a coarse graywacke conglomerate and sandstone. It differs from the coarse conglomerate beds at the top of the Pottsville in that it contains abundant dark rock fragments that form a dark matrix around the white quartz pebbles. The lithology of this member is not uniform. Sandstone and conglomerate lenses interfinger and thin and thicken. Small lenses of black siltstone and shale and porous brown sandstone are interbedded with the upper part of this conglomeratic member. Some of the conglomerate has graded bedding and crossbedding, particularly in the finer grained parts. Gray and tan coarse-grained sandstone at the base of the Pottsville formation grades into red and gray sandstone of the Mauch Chunk shale, so that an exact plane of demarcation cannot be drawn between the formations. Where the basal conglomerate member of the Pottsville formation and the upper part of the Mauch Chunk shale are obscured by talus, the lowest red bed member of the Pottsville formation closely resembles Mauch Chunk shale.

Allegheny formation

The Allegheny formation is a post-Pottsville formation of Pennsylvanian age. It consists of sandstone, conglomerate, shale, coal, and underclays. The Mammoth bed of the Allegheny formation is the most important coal bed in Carbon County. Lesley (1885) reports an average thickness of 29 feet for the Mammoth bed in the Panther Creek basin east of Nesquehoning. Because of its thickness and because it has been extensively mined, it is a key member for interpreting structure and for correlating coal beds within a coalfield and between adjacent fields. Most of the coal produced in Carbon County has been from the lower 300 to 500 feet of the Allegheny formation, from the top of the Mammoth bed to the bottom of the Buck Mountain or "B" bed, which is considered the lowest coal bed of the formation. An area of approximately 16 square miles in Carbon County is underlain by the Allegheny formation: about 7 square miles in the Panther Creek basin at the eastern end of the Southern Anthracite field and 9 square miles in the Eastern Middle Anthracite field.

MINERALOGY

Uranium occurs in unidentified black material disseminated in the Pottsville and Catskill formations. It also occurs in secondary minerals, some of which have been identified. They are listed in table 1.

The rocks containing uranium are composed chiefly of quartz, feldspar, muscovite and biotite, calcite, and rock fragments; with a chlorite and clay matrix in the Catskill formation; and a calcite cement in the Pottsville formation. Minor amounts of apatite, tourmaline, zircon, and pyrite are also present. Galena occurs in the uraniferous rock in the vicinity of Penn Haven Junction. Fragments of carbonaceous material are common in the Pottsville formation and unusual in the Catskill formation.

URANIUM OCCURRENCES

Mount Pisgah

The Mount Pisgah uranium deposit, exposed in cliffs along the highway between Mauch Chunk and Nesquehoning, is in the basal sandstone and conglomerate member of the Pottsville formation.

Table 1.—Uranium minerals found in Carbon County, Pa.

[Mineral identifications by A. D. Weeks, D. D. Riska, and B. R. Thompson. Chemical compositions from Frondel and Fleischer (1952)]

Mineral	Chemical composition	Locality
Phosphate:		
Autunite	$Ca(UO_2)_2(PO_4)_2 \cdot 10\text{-}12H_2O$	Mauch Chunk Ridge.
Vanadates:		
Carnotite	$K_2(UO_2)_2(VO_4)_2 \cdot 3H_2O$	Mount Pisgah.
Tyuyamunite	$Ca(UO_2)_2(VO_4)_2 \cdot nH_2O$	Do.
Carbonate:		
Liebigite	$Ca_2U(CO_3)_4 \cdot 10H_2O$	Do.
Silicates:		
Kasolite	$Pb(UO_2)SiO_4 \cdot H_2O$	Mauch Chunk Ridge. Penn Haven Junction.
Uranophane	$Ca(UO_2)_2Si_2O_7 \cdot 6H_2O$	Mount Pisgah. Mauch Chunk Ridge. Penn Haven Junction.
Beta-uranophane	$Ca(UO_2)_2Si_2O_7 \cdot 6H_2O$	Mount Pisgah.

The rocks have been folded into a tight syncline, the Panther Valley syncline, which strikes approximately S. 80° W. and plunges to the southwest at an angle of 5° as measured along the base of the Mammoth bed. The dip of the north limb of the syncline is about 45° to the south, whereas the dip of the south limb ranges from steep to the north, through vertical, to slightly overturned. Where the strata curve around the nose of the syncline, as on Mount Pisgah, the dip progressively decreases toward the axis.

The Lehigh River has cut its valley to the base of the Pottsville formation near the east end of the syncline so that no part of that formation is present on the east side of the river.

A discontinuous zone of uraniferous sandstone and conglomerate extends about 2,000 feet along the north limb of the syncline westward from the axis of the syncline. Near the western end of the zone, core drilling found discontinuous radioactive rock about 240 feet downdip from the outcrop. Near the center of the zone a drill hole ended in uraniferous rock about 100 feet downdip. A test adit driven horizontally into the rock about 25 feet started in uraniferous rock and ended in barren rock.

The mineralized rock varies in stratigraphic distance from an overlying sandstone and shale member. The easternmost exposure of uraniferous rock south of the highway is in a lens of conglomerate that wedges into the overlying sandstone. At the test adit near the western end of the uraniferous rock, more than 10 feet of massive conglomerate separates the uraniferous rock from the overlying sandstone and shale member.

The uranium content of the mineralized rock ranges from a few thousandths of a percent to a few tenths of a percent in a distance of a few feet along the strike.

The uranium occurs as yellow and yellowish-green minerals coating fracture surfaces and slickenside surfaces and as incrustations on loosely cemented quartz pebbles in coarse conglomerate. Fine cracks which penetrate both the pebbles and the calcite cement are filled with yellow minerals in many places. Uranium is also present in unidentified black material in the matrix of the rock and in very fine cracks in quartz pebbles.

Secondary uranium minerals were observed on surfaces of rock which had been broken only a few months previously, indicating that uranium is present in tightly cemented rock in a form that is unstable under present conditions of weathering. The absence of secondary uranium minerals in uraniferous rock in drill cores, except where they cut fractures and bedding-plane surfaces, indicates that the massive parts of the rock have not been deeply weathered.

Carnotite, tyuyamunite, liebigite, uranophane, and beta-uranophane have been identified in the Mount Pisgah deposit. An attempt is being made to isolate and identify the black radioactive material that occurs in the matrix of the rock.

Mauch Chunk Ridge

Uraniferous sandstone is exposed in a roadcut along U. S. 309 and along the tracks of the Central Railroad of New Jersey between Mauch Chunk and Packerton. The sandstone is in the Cherry Ridge red beds (Willard, 1939) of the Catskill formation on the south limb of the Panther Valley syncline. The bedding strikes N. 60° E. and dips from 80° NW. to vertical or slightly overturned.

From Mauch Chunk the Lehigh River flows southward for a quarter of a mile, then turns northeastward and follows the strike of the Catskill formation in a valley about 800 feet deep. About a mile east of Mauch Chunk the river turns sharply to the southeast and cuts across the upper units of the Catskill formation.

Uraniferous rock occurs discontinuously for about 1 mile along the strike and 700 feet along the dip of the Catskill formation between the top of Mauch Chunk Ridge near Flagstaff Park and the east side of the river where the Lehigh Valley Railroad tracks cross the river.

Most of the uraniferous rock exposed in the roadcut is in two beds of sandstone separated about 25 feet stratigraphically. The upper bed is 4 to 8 feet thick; the lower bed, 4 to 6 feet thick. Along the tracks of the Central Railroad of New Jersey at approximately the same stratigraphic position as the lower bed of the roadcut are four radioactive outcrops within a strike length of 2,700 feet. In addition, a few thin beds of radioactive shale and sandstone lie stratigraphically between the upper and lower beds of the roadcut. None is more than 1 foot thick and all are less radioactive than the main sandstones.

The sandstone is composed mainly of quartz, feldspar, muscovite, and phlogopite in a matrix of chlorite and clay. Chips of shale occur in some of the beds. Minor amounts of tourmaline, zircon, and apatite are accessory. Autunite, kasolite, and uranophane occur on joint surfaces and in cracks in the rock but are not conspicuous on the outcrops. Most of the radioactive material is in an unidentified black or gray material disseminated in the matrix.

Samples of radioactive rock (HK3-35, -36, -37, table 3) contain from 0.011 percent to 0.13 percent uranium.

Butcher Hollow

Near Butcher Hollow, about 4 miles north of Mauch Chunk, uraniferous rock is exposed in the gorge of the Lehigh River at an approximate elevation of 710 feet near the level of the tracks of the Lehigh Valley Railroad on the west side of the river. The uranium is in the upper part of the Catskill formation. It may be at about the same stratigraphic position as that in which the uranium occurs on Mauch Chunk Ridge, but no measurements have been made to confirm this possibility.

The uraniferous rock is on the south limb of a local anticline near the crest of the Broad Mountain anticline. On the east side of the river uraniferous rock occurs in talus at approximately the same elevation and the same stratigraphic position as the mineralized rock in outcrops on the west side of the river. The distance between these two points is about 500 feet. The uraniferous rock dips 15° S., and the north limb of the anticline dips 50° N. The sandstone of the south limb of the anticline is not uniformly radioactive. There is a mineralized zone about 20 feet long with a stratigraphic width of 6 feet. Within this zone, are some shaly and silty members and some poorly cemented, limonitic parts of the sandstone, with abundant shale chips. These rocks are penetrated by fractures and are more strongly radioactive than the rest of the rock. No uranium minerals from this deposit have been identified.

The average uranium content of 4 samples (HK3-39, -40, -41, -42, table 3), representing about 2 feet of the 6-foot interval of sandstone, is 0.016 percent. A selected sample (HK3-49, table 3) of radioactive rock from the talus on the east side of the river has a uranium content of 0.055 percent.

Penn Haven Junction

Uraniferous rock is exposed on both sides of the Lehigh River at an elevation of about 720 feet about 0.4 mile south of the railroad station at Penn Haven Junction. The uranium is in the upper part of the Catskill formation at about the same stratigraphic position as that on Mauch Chunk Ridge. It occurs in a local anticline on the north limb of the Broad Mountain anticline. On the east side of the river the uraniferous rock crops out along an abandoned railroad bed. No detailed sampling of the rock or measurement of the radioactivity at this outcrop has been done. In general, the extent of the radioactive rock and the intensity of the radioactivity on the east side of the river is less than that at the outcrop on the west side of the river about 500 feet away.

On the west side of the river the uraniferous rock crops out along the tracks of the Lehigh Valley Railroad for about 300 feet between the track level and about 10 feet above the track level. A small spring flows from the ground near the southern end of the zone of uraniferous rock. The uranium appears to be concentrated on the limbs of the anticline, particularly on the north limb (fig. 2). In general, the uraniferous zone cuts obliquely across the dip in a fairly horizontal band. Within this zone the uranium minerals follow the bedding, but in places the amount of uranium varies abruptly with no apparent change in lithology and no extensive fracture in the rock.

The mineralized rock is gray to greenish-gray medium-grained graywacke that weathers tan and, in places, is stained black. Although some of the black stain is probably due to manganese oxides, much of it is soot from locomotives. Galena and pyrite occur in some of the more strongly radioactive parts of the rock. Some of the galena is granular. The grains are angular to rounded, equant, range from about 0.05 millimeter to 1.0 millimeter in diameter, and are disseminated in layers a few millimeters thick. Because the grains are partly rounded and because some of them occur in layers parallel to the bedding, they resemble detrital grains or pseudomorphs of detrital grains. Galena and pyrite also occur as irregular-shaped masses, either as open-space fillings or as a replacement of material in the matrix, and conform in shape to spaces

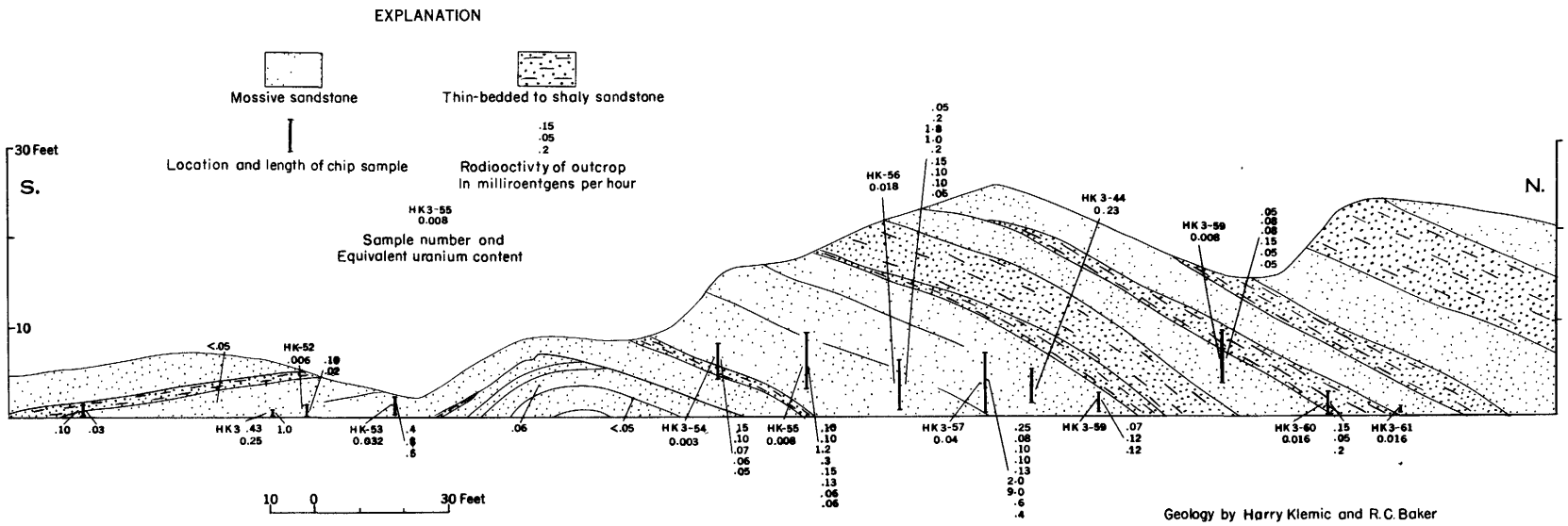

Figure 2.—Sketch of outcrop of uraniferous rock near Penn Haven Junction, Carbon County, Pa.

between the clastic grains. This galena appears to have crystallized in place and at least in its present form is not detrital. In places pyrite is crystallized around the edges of and between the irregular masses of galena. In one hand specimen a mass of pyrite about 4 millimeters by 6 millimeters in cross section and about 11 millimeters long appears to have replaced fibrous plant material. The pyrite has a columnar appearance, and many of the columns are partly or wholly surrounded by black opaque material. The general appearance is that of pyrite filling cells and partly replacing cell walls in a piece of carbonized plant stem.

The rock that contains the sulfide is slightly darker than the remainder. In and near the dark zones some fine-grained yellowish-brown and pale translucent green materials in the matrix of the rock form elongate streaks parallel to the bedding.

Kasolite and an unidentified yellow fluorescent mineral, probably uranophane, occur sparingly as flakes and incrustations on bedding-plane and fracture surfaces. Uranium in an unidentified form also is disseminated in the rock. The weathered surface of one specimen of sandstone is less radioactive than the freshly broken surface. This suggests that the intensity of radioactivity at the outcrop is related to disseminated uraniferous material in the rock and not to an accumulation of secondary uranium minerals on the weathered surfaces. Assays of 13 samples (HK3-43 to -45 and -52 to -61, table 3) weighted against the lengths of the samples, average 0.053 percent uranium. A selected sample (HK3-50, table 3) from a highly radioactive zone on the east side of the river contains 0.30 percent uranium. The uranium content of samples from the Penn Haven Junction deposit ranges from 0.001 to 0.56 percent.

RESULTS OF ANALYSES

The results of semiquantitative spectrographic analyses and determinations of equivalent uranium and uranium in samples taken from the occurrences in the Catskill formation are given in tables 2 and 3.

CONCLUSIONS AND PLANS

Uranium minerals have been found in Carbon County, Pa., in the Catskill formation at 3 different localities, and in the Pottsville formation at 1 locality. Additional prospecting may locate other occurrences where the Pottsville, Catskill, and adjacent formations crop out. Prospecting may further be guided by rock type. The known occurrences of uranium in Carbon County are all in gray or greenish-gray sandstone or

Table 2.—Results of semiquantitative spectrographic analyses of radioactive sandstone from Carbon County, Pa.

[Analyses by Charles Annell]

Percentage	Mauch Chunk Ridge		Butcher Hollow		Penn Haven Junction		
	HK3-36	HK3-37	HK3-41	HK3-43	HK3-45	HK3-50	HK3-61
XO.	Al Si	Si	Al Si	Si	Si	Si	Al Si
X.	K Fe Mg	Al Fe	K Fe	Al Fe	Al Fe	Al Fe	Fe K
.X	Ti Ba Ca Na	K Mg Ca Ti	Mg Ca Na Ti	Mg Ca U Ti	K Mg Ca Ti U	Mg Ca Ti Pb U	Mg Ti Ca Na
.OX	Pb Sr B Cu Mn Co Cr V	Pb Na V Ba B Mn Cu	Ba Pb B Mn V Co	Pb Mn Ba Na B V	Pb Na Ba B Mn V	Ba Mn V Na B Co	Ba Mn B Co Pb Ni V
.OOX	Ni Ga Zr Y Sc	Ni Cr Sr Ga Y Zr	Ga Cr Ni Sr Cu Y Sc	Co Cu Ni Cr Y Sr Ga	Co Ni Ga Cr Cu Sr Y	Zr Ni Cu Y Cr Ga Sr	Ga Cr Sr Zr Cu Y Sc
.0000X	Be Yb	Be Yb	Be Yb	Yb	Yb	Yb	Yb Be

Table 3.—Equivalent uranium and uranium content, in percent, of radioactive sandstone from Carbon County, Pa.

[Radioactivity measurements (eU) by B. A. McCall; chemical analyses (U) by Esma Campbell]

Location and sample no.	Type of sample	Length of sample (feet)	eU	U
Mauch Chunk Ridge:				
HK3-35	Grab	---------	0.034	0.030, 0.031
36	do	---------	.017	.012, .011
37	do	---------	.10	.13, .13
Butcher Hollow:				
HK3-39	Chip	0.5	.004	.002, .003
40	do	.5	.048, 0.047	.040, .038
41	do	.5	.026, .027	.022, .022
42[1]	do	.5	.004	.002, .001
49	Grab	---------	.063	.060, .055
Penn Haven Junction:				
HK3-43	Chip	1.0	.25	.22, .24
44	Grab	1.0	.60	.56, .56
45	Chip	5.0	.23	.22, .22
50[1]	Grab	---------	.32	.30, .30
52	Chip	1.5	.006	.003, .003
53	do	2.0	.032	.031, .030
54	do	4.0	.003	.001, .001
55	do	7.0	.008	.005, .005
56	do	6.0	.018	.015, .015
57	do	7.0	.040	.038, .038
58	do	2.5	.002	.001, .001
59	do	6.0	.008	.005, .005
60	do	2.5	.019, .016	.008, .009
61	do	.5	.017, .016	.026, .025

[1] Sample from east side of Lehigh River.

conglomerate; none is in red sandstone or shale. One of the constituents that causes the gray color in the rocks is finely disseminated carbonaceous matter. As carbonaceous matter is associated with many uranium deposits in sandstone and is used as a criterion for "favorable ground" for carnotite deposits on the Colorado Plateaus (Weir, 1952, p. 22), it also may indicate "favorable ground" in Pennsylvania.

Geologic mapping on aerial photographs and detailed reconnaissance of about 100 square miles in the vicinity of the known uranium occurrences in Carbon County are planned. The purpose of this study will be to determine the relationships of the uranium occurrences to the structure and stratigraphy of the region, to search for additional occurrences, and, if possible, to determine the source of the uranium and the time of its deposition.

LITERATURE CITED

Frondel, J. W., and Fleischer, Michael, 1952, A glossary of uranium- and thorium-bearing minerals, 2d ed.: U. S. Geol. Survey Circ. 194.

Genth, F. A., 1875, Preliminary report on the mineralogy of Pennsylvania: Pa. Geol. Survey, 2d, B., p. 144.

Lesley, J. P., 1885, A geological hand atlas of the sixty-seven counties of Pennsylvania: Pa. Geol. Survey, p. 33-34.

Weir, D. B., 1952, Geological guides to prospecting for carnotite deposits on the Colorado Plateau: U. S. Geol. Survey Bull. 988-B.

Wherry, E. T., 1912, A new occurrence of carnotite: Am. Jour. Sci., 4th ser., v. 33, no. 198, p. 574-580.

Willard, Bradford, 1939, The Devonian of Pennsylvania: Pa. Geol. Survey, 4th Ser., Bull. 19G, 481 p.

Winslow, Arthur, 1887, The Lehigh River section: Pa. Geol. Survey Ann. Rept., pt. 4, p. 1347-1385.

UNPUBLISHED REPORT

McKeown, F. A., 1949, Preliminary report of uranium deposits near Mauch Chunk, Pennsylvania: U. S. Geol. Survey Trace Elements Memo. Rept. 19.

INT.-DUP. SEC., WASH., D.C.69429