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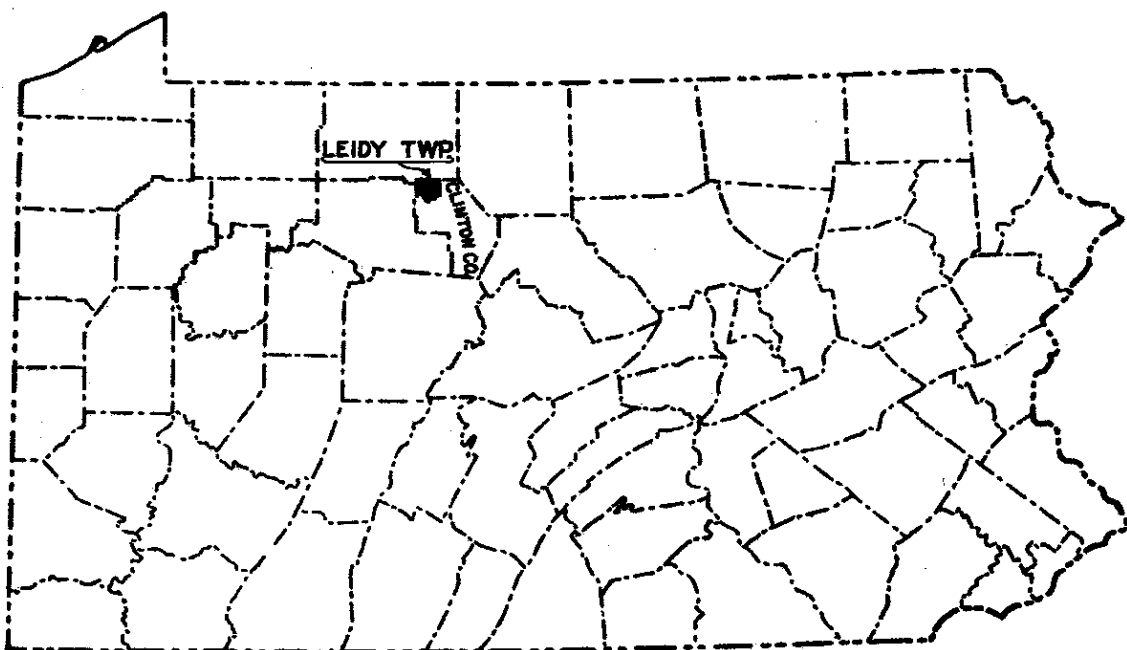
GAS IN LEIDY TOWNSHIP

CLINTON COUNTY

PENNSYLVANIA

By

S. H. CATHCART



COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF INTERNAL AFFAIRS
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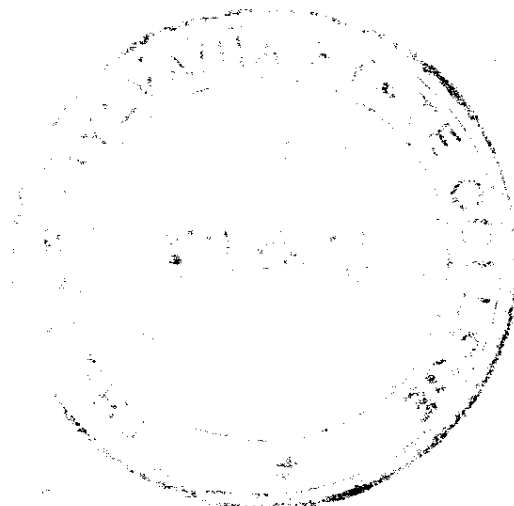
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GAS IN LEIDY TOWNSHIP, CLINTON COUNTY, PENNSYLVANIA

By S. H. Cathcart

INTRODUCTION

Gas was discovered in the Oriskany sand of Leidy Township, Clinton County, on January 8, 1950. Judging from early reports the deposit may prove to be of commercial value. The discovery is of particular interest because it extends the area of known Oriskany gas occurrence and suggests that additional discoveries may be expected.

Discovery was made by the Leidy Prospecting Company on the Dorsey Calhoun Farm. The discovery well, Dorsey Calhoun No. 1 (see pl. 1), encountered the Oriskany sand at 5,659 feet. Potential initial production is variously estimated to be 10 to 15 million cubic feet per day and the rock pressure to be 4,000 pounds. The well is located on a domed area on the Wellsboro anticline, the en échelon equivalent of the Chestnut Ridge anticline to the southwest.

It is the purpose of this paper to present information from the files of the Geological Survey which may prove useful in further exploration of this region. No new field work has been done; here we intend only to summarize certain available information which otherwise might not be readily accessible (see also Selected References, p.10).

SUMMARY OF GEOLOGIC INFORMATION

The geology of this area has not been studied in detail. Published geologic information by the State Survey is limited to:

- (1) H. M. Chance, 1879, Geology of Clinton County, Vol. G4, Pennsylvania Second Geological Survey. A report & geologic map which are out of print but available in some public libraries or from used-book dealers.

- (2) M. E. Johnson, 1923, Gas in Leidy Township, Mimeographed bulletin (prog. rept.) 78, Pennsylvania Geological Survey, 4th Series. Out of print.
- (3) S. H. Cathcart, 1934, Geologic Structure in the Plateau Region of Northern Pennsylvania, Bulletin (prog. rept.) 108, Pennsylvania Geological Survey, 4th Series. Available for free distribution, but is in short supply.

Notations from and concerning these reports follow:

Report G4 of the Second Geological Survey: This report contains the only published geologic map of the county; it is incorporated in the Geologic Map of Pennsylvania published in 1932. The county geologic map shows the distribution of surface formations but does not indicate the presence of the Wellsboro anticline crossing Leidy Township. The text includes considerable stratigraphic data but no geologic section for Leidy Township. A principal contribution of the report is the 13,636+ -foot "Lock Haven Long Section" (G4, pp. 124-129), measured on the Susquehanna River between Lock Haven and Farrandsville, which is here summarized:

		Feet
Carboniferous	Lower productive Coal Measures	86 +
	Conglomerate Measures (Pottsville)	129
Sub-Carbonif.	Mauch Chunk red shale (local)	100
	Pocono sandstone	1175
Devonian	Red Catskill	2106
	Chemung & Portage	3314
	Genesee	560
	Hamilton	1131
	Marcellus	759
		5764
Silurian	Oriskany sandstone - wanting	
	Lower Helderberg	895
	Clinton	1080
	Medina & Oneida sandstone	2301

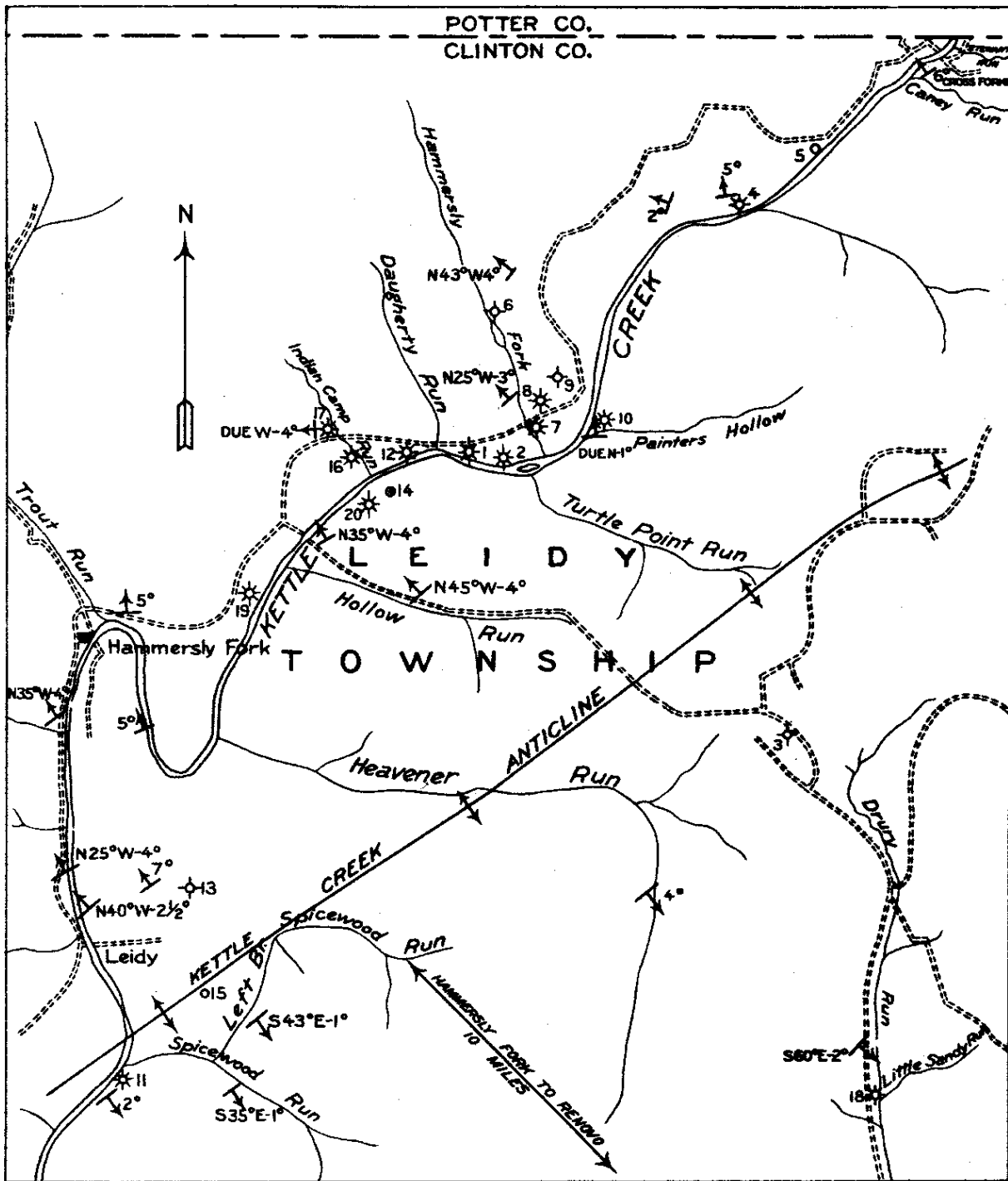
Since modern geologic reports are not available for most of the plateau region, the reports and maps of the Second Survey are of considerable interest but must be used with discretion. This applies to the Clinton County report, for example: The fact that Chance did not recognize the

existence of the Wellsboro anticline crossing Leidy Township suggests a lack of detailed information and indicates the reconnaissance nature of his report and map. His map shows the Pocono sandstone cropping out along Kettle Creek where that stream crosses the Leidy dome. The recent discovery well on the Leidy dome, located in Kettle Creek Valley, encountered the Oriskany sandstone at a depth of 5,659 feet. In the near-by East Fork-Wharton Field, wells which start at the approximate top of the Catskill red beds log about 700 feet of red beds and encounter the Oriskany sand at a depth of about 6,300 feet. It appears then that the Leidy dome well starts considerably below the Pocono sandstone, probably near the base of the Catskill or in the Chemung formation, and that Chance, not recognizing the anticlinal structure, incorrectly mapped the beds along Kettle Creek as Pocono.

Bulletin 78, 4th Series — Gas in Leidy Township: Leidy Township first attracted attention as a prospective gas-producing locality in the early 20's when an attempt was made by the Clinton Natural Gas and Oil Company of Renovo to develop shallow production in the area. Meredith Johnson, then of the Pennsylvania Geological Survey staff, now State Geologist of New Jersey, visited the area briefly in April 1923. His report (bull. 78) consists of six pages of text, a structural outline map showing well locations, and ten graphic sections compiled from drillers logs. His map and plate of sections are reproduced here as Figures 1 and 2.

It is recognized that there need be no significant relation between Oriskany sand and "shallow" sand production, but the fact that multiple targets may exist here should not be ignored. Both the "shallow" and the deep zones may contribute toward successful operation.

The following information has been abstracted from Bulletin 78:



LEGEND

- Location ● Drilling well * Gas well * Dry hole, showing of gas
- ◇ Dry hole * Abandoned gas well ↘ Showing direction of dip.

Figure 1. Sketch map of the shallow gas field, Leidy Township, Clinton County, from Pa. Geol. Survey Bulletin 78, by M. E. Johnson, 1923.

Leidy Township is a sparsely populated region of high flat-topped wooded hills and narrow, deep valleys (relief about 1,000 feet). Kettle Creek is the only stream of importance in the township and most of the population lives along this stream.

Massive Pottsville conglomerate caps most of the hills, and since the dip of the strata is low, the hilltops are essentially flat and have about the same elevation (2,000 - 2,200 feet).

A fairly complete section is exposed on a steep hill slope northeast of Renovo. The rocks exposed range from the top of the Pottsville to about the middle of the Pocono and measure as follows:

	Feet
*Pottsville conglomerate	200
Mauch Chunk red shale & concealed	77
Pocono sandstone & shale	550

The Pottsville conglomerate as exposed here is very hard and massive. It consists of gray to white quartz grains and small quartz pebbles. In the sunlight the quartz grains sparkle in such manner as to distinguish the formation even at a distance from other outcropping formations.

The Mauch Chunk formation is indicated only by a red clay soil, the rock not being exposed. It was impossible to tell how much of the 77-foot measured interval actually consists of red shale.

The Pocono formation consists chiefly of fine- to medium-grained yellowish sandstone often having a faint greenish tint. Some shale is interbedded with the sandstone, and, in the lower part of the section, two thin beds of red shale are exposed. These beds are lenticular and occur between beds of yellowish cross-bedded sandstones.

In April 1923, 18 wells had been drilled in the field. Numbers 20, 16, a 100-foot offset to 16, 18, and 19 were drilled in 1864, 1878, 1881, 1905, and 1912, respectively. Reported production ranged from a show to enough gas to fire a boiler.

In 1913 the Clinton Natural Gas and Oil Company and its predecessor, the Williamsport Oil and Gas Company, had completed 13 wells and were drilling a 14th. These wells are numbered on Figure 1 in the order of drilling. The first two wells were good

*It should be recognized that the exposed 827-foot section measured by Johnson near Renovo is not a complete section; the relief there being about 1,000 feet. Furthermore, since this section was measured near the axis of the Clearfield syncline, the beds exposed along Kettle Creek on the Leidy dome lie below stream level at Renovo.

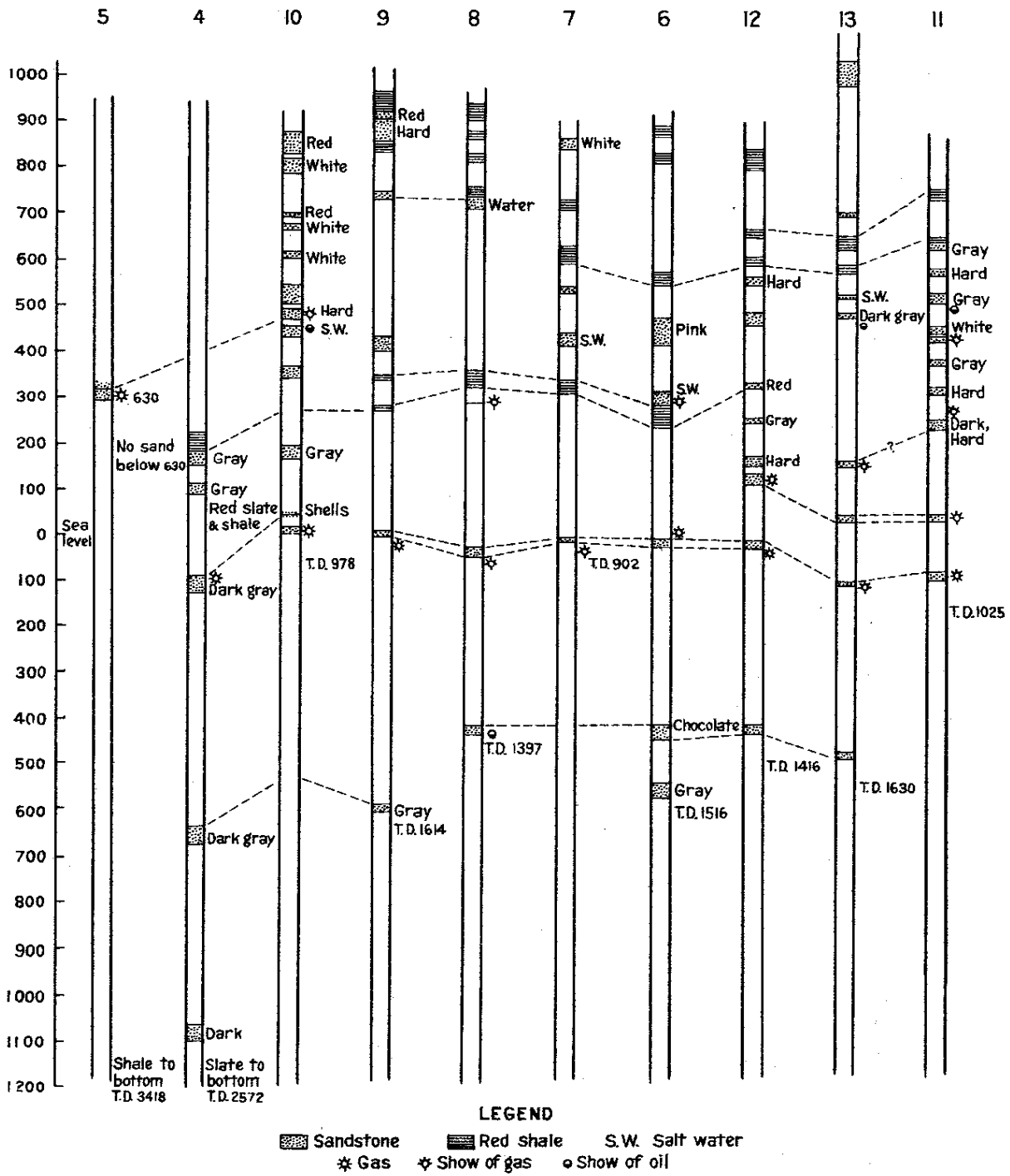


Figure 2. Graphic drillers' logs of shallow gas wells in Leidy Township, Clinton County, from Pa. Geol. Survey Bulletin 78, by M. E. Johnson, 1923.

producers, having a combined production of over 600,000 cubic feet per day, but by 1923 both had been "drowned out". In 1923 seven wells were producing, five of which, numbers 7, 8, 10, 11, and 12, were said to be capable of producing a total of 4 million cubic feet per day. Rock pressure ranged from 125 (No. 7) to 700 (No. 11) pounds.

The Pennsylvania Geological Survey has no further record of drilling and production in this field. The dome on which Oriskany production was discovered, and on which the earlier shallow production was developed, has been variously named the Kettle Creek, Leidy, and Hammersley Fork dome. Johnson, working locally, only partially defined the structure (fig. 1) and called it the Kettle Creek anticline. Cathcart, incident to a regional structural reconnaissance in 1932, identified the structure as the Leidy dome on the Wellsboro anticline. Because the dome, as now known, appears to be localized within Leidy Township and its axis appears to pass near the village of Leidy, this name serves well in identifying the structure.

Bulletin 108, 4th Series: Following discovery of gas in the Oriskany sand in Tioga County in 1930, the Pennsylvania Geological Survey made a special project of mapping the anticlines occurring north of the Allegheny Front, between McKean County on the west and the Delaware River. The mapping was done by the strike and dip method and is, therefore, reconnaissance in nature. Special effort was made, however, to indicate the presence of all domes occurring on the anticlines. The results were published in Bulletin 108 in March 1934.

A part of the structural outline map included in Bulletin 108 is reproduced here with slight modifications as Plate 1. The anticlines with domes and faults shown on this map represent an exact reproduction of the earlier map, except that the trace of the axis of the Marshlands anticline in southwestern Potter and adjacent Cameron County has been modified

to conform with a recent detailed survey in that area (Ebright, 1949). Pool and well data have been brought up-to-date, and lines indicating probable limits of the Oriskany sand have been added. The latter revision is after a detailed development record, which has been prepared by C. R. Fettke of the Survey staff and will soon go to press. The purpose here is to indicate the location of all domes recognized by the Survey and to point out those domes which have yielded commercial fields, those which have been tested unsuccessfully, and those which have not yet been tested.

SIGNIFICANCE OF THE DISCOVERY

From Plate 1 the significance of the Clinton County discovery is apparent. It may be summarized thus: Prior to 1947 all commercial discoveries in the Oriskany of this part of the Plateau Region were located on domal highs on the Sabinsville and other anticlines to the north -- the Harrison, Hebron, and Smethport anticlines. Certain domes on the Marshlands, Wellsboro, and Towanda anticlines, which roughly parallel the Sabinsville to the south, had been explored to some extent without commercial success. The initial discovery on the Marshlands anticline was actually made in East Fork District in the 30's, but the result was not commercially attractive. It was not until 1947 that further drilling on that structure, in Wharton Township, gave a satisfactory result. The East Fork-Wharton Oriskany Field still is in process of development. A report by the Pennsylvania Geological Survey, Bulletin M30, East Fork-Wharton Gas Field, Potter County, Pa., will be ready for distribution soon.

With success on the East Fork-Wharton dome commercial production progressed one anticline farther toward the south. Similarly, success on the Leidy dome, Clinton County, extends commercial production southward

still another anticline.

The fact that previous drilling on domes on the Wellsboro and Towanda anticlines in Tioga County had been unsuccessful and that the early results on the Marshlands anticline in Potter County (East Fork-Wharton dome) had not been encouraging, tended to discourage prospecting on all anticlines south of the Sabinville trend. The success of the East Fork-Wharton development may have inspired the discovery on Leidy dome, and the recent well at Leidy may stimulate exploration of other domes south of the present margin of Oriskany production. Further prospecting of these southerly structures may now appear less hazardous to exploration groups, and it is likely that Oriskany prospects throughout this entire southern belt will be reconsidered.

PROSPECTIVE DRILLING SITES

To date, accumulations of gas in the Oriskany sand of Pennsylvania appear to be closely related to structural highs, or domes, on anticlines. On Plate 1 are indicated localities at which Survey geologists have observed doming. Domes have been recognized northeast of Leidy dome on the Wellsboro anticline in Elk, Delmar, Charleston, and Richmond townships, Tioga County, and in Ridgebury Township, Bradford County, and on the Towanda anticline in Union Township, Tioga County. At least one unsuccessful test well has been drilled to the Oriskany on each of these domes, but it cannot be said that all of these structures have been adequately tested; certain of them may yet yield commercial production with further prospecting. In addition, untested domes are indicated to the south and east of Leidy dome on the Slate Run, Hyner, Ferney, Cogan House, and Rose Valley anticlines, and to the west and south of Leidy on the Wellsboro and Chestnut Ridge anticlines. All of these structures must be considered

potentially productive until they have been condemned by drilling.

It should not be inferred that favorable structure is the only requirement for the success of an Oriskany test; dry holes shown on certain domes confirm this. Favorable sand conditions, as well as favorable structure, are essential to gas accumulation. Locally, the Oriskany sand may be absent, and Plate 1 pictures a large area northwest of the East Fork-Wharton Field where test wells have found this to be true. Similarly, the sand outcrops near Lock Haven but is missing from the exposed section in the vicinity of Williamsport. Locally, also, wells find the Oriskany present but due to cementation, fineness of grain, or some other factor it is lacking in porosity and permeability and is not a suitable reservoir rock. Favorable structure sometimes can be detected at the surface, but favorable sand conditions can be ascertained only by drilling.

Depth of drilling on untested domes of the southern belt cannot be predicted with assurance. In general, however, the thickness of the stratigraphic section appears to increase southeastward, and most of the increase appears to reflect a variation in the thickness of the Catskill red beds. This generalization is based on the comparison of data provided by the Lock Haven Section of Chance, quoted above, and a sample log of State of Pennsylvania Well No. 1 in the East Fork-Wharton Field by Fettke (Ebright, 1949). No log of the Dorsey Calhoun Well is available. The interval from the top of the Catskill red beds to the top of the Oriskany is 7,870 feet in Chance's section, while in the State of Pennsylvania No. 1 Well, the same interval is reported by Fettke to measure 6,302 feet. These measurements indicate that the interval thickens 1,568 feet southeastward in about 40 miles, or at the rate of about 40 feet to the mile. Comparing the lesser interval, base of Catskill red beds to top of Oriskany, the two

sections record 5,764 and 5,617 feet, respectively, or a thickening of only 147 feet in about 40 miles.

These observations need to be evaluated. The Catskill red beds are transitional with Pocono above and Chemung below, and it is probable therefore that the interpretations by Chance and Fettke of the thickness of Catskill are not closely comparable. The sections do, however, suggest that, owing to notable thickening of the interval from the top of the Catskill red beds to the top of the Oriskany, an increase in depth of drilling should be expected in the belt south of the region now productive.

SELECTED REFERENCES

Maps

Geologic Maps: Geologic Map of Pennsylvania, 1932, scale 1:380,160 (1" = 6 miles). Available from Division of Documents, Dept. Property & Supplies, 10th and Market Sts., Harrisburg, Pa., at a cost of \$1.50.

Topographic Maps: See Figure 3 for index to topographic maps. Topographic maps may be obtained at a cost of 20 cents per copy from the Director, U. S. Geological Survey, Washington 25, D.C. Topographic maps are not distributed by the Pennsylvania Geological Survey, but may be purchased from certain local book and stationery stores.

Advanced prints of quadrangles indicated in press may be obtained from the Map Information Office, U. S. Geological Survey, Washington 25, D.C., at a cost of 50 cents per copy, minimum charge \$1.00.

County Highway Maps, Type 10 (1941 Series): Available for all counties in this area at a cost of \$1.00 per county from the Publicity Bureau, Pennsylvania Dept. of Highways, Harrisburg, Pa. Scale 1" = 1 mile.

Aerial Photographs

U. S. Department of Agriculture (1938-1939 Series): Index sheets and stereographic aerial photograph coverage (scale 1:20,000) are available for all counties in the area from the Production and Marketing Administration, Washington 25, D.C.

New aerial photographs resulting from a current program of photography will be available from this same source for much of the north-central Pennsylvania area by late 1950. Most counties in this area are being photographed with infra-red film.

U. S. Geological Survey: Recent aerial photographs (approx. scale 1:27,000) are available for the areas covered by U.S.G.S. 7½-minute quadrangle topographic maps. Index sheets and stereo-coverage are available through the Map Information Office, U. S. Geological Survey, Washington 25, D.C.

Reports

Reports of the Pennsylvania Geological Survey, 4th Series: These reports have been selected because they have direct or indirect bearing on the geology and gas possibilities of this area. Free reports, here indicated, as well as a complete list of publications, may be obtained upon request from the Topographic & Geologic Survey, Harrisburg, Pa. Other reports may be obtained from the Division of Documents, Dept. Property & Supplies, 10th and Market Sts., Harrisburg, Pa., at the indicated cost.

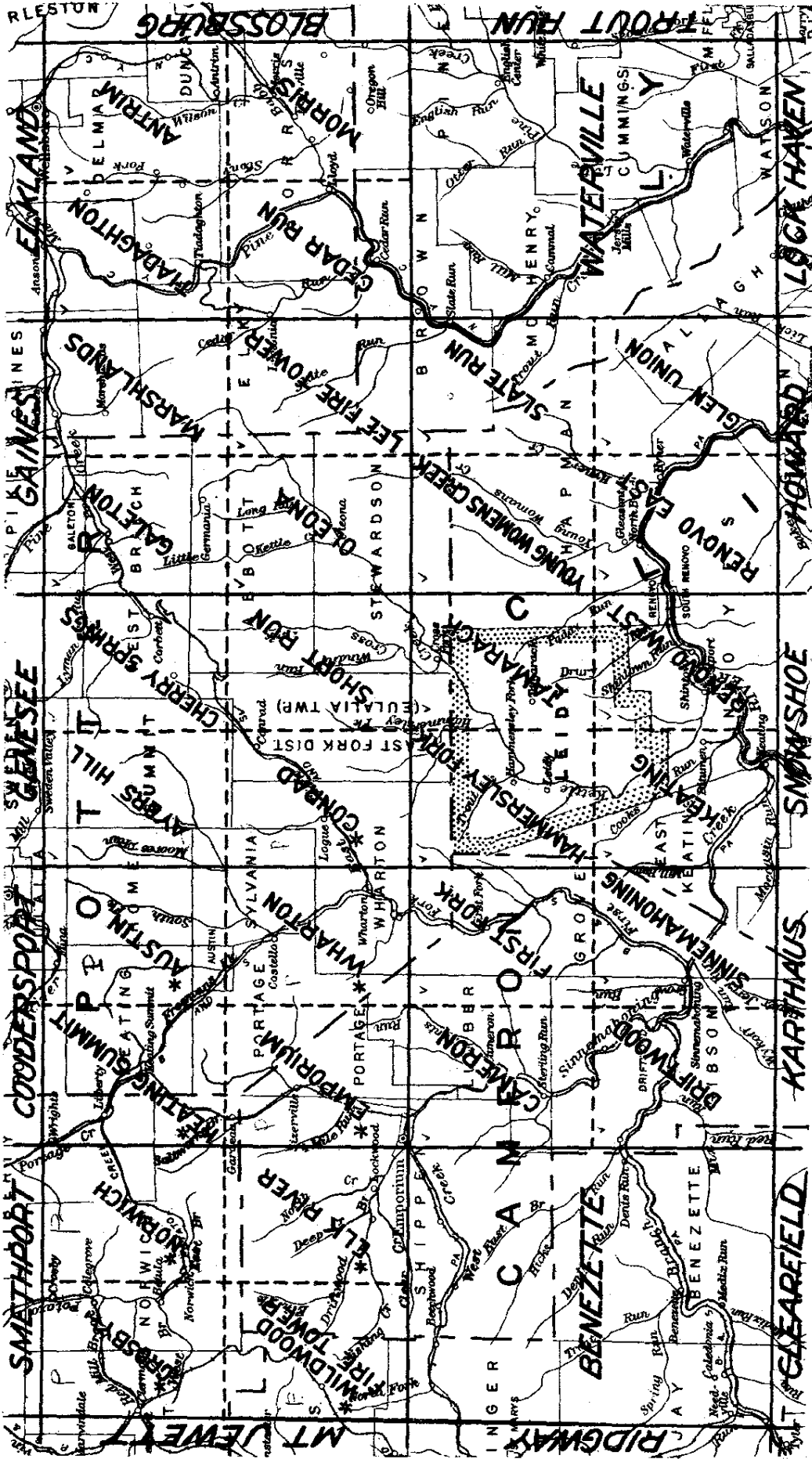


Figure 3. Index to U. S. Geological Survey topographic maps. Diagonal names refer to quadrangles of the 7½-minute series; those marked * are available as advanced sheets only. Names in *italic* refer to quadrangles of the 15-minute series. Under Selected References see instructions for ordering.

SELECTED REFERENCES — continued

Pa. Geol. Survey, 4th Ser.	Price
G19 The Devonian of Pennsylvania, by Bradford Willard, Frank M. Swartz, and Arthur B. Cleaves. 1939. (See Chapter III, the Oriskany Group)	\$3.00
M30 East Fork-Wharton Gas Field, by J. R. Ebright, C. R. Fettke, and A. I. Ingham. 1949.	in press
PR78 Gas in Leidy Township, Clinton County, Pa., by Meredith E. Johnson. 1923.	*
PR106 Gas and Oil in Potter County, Pa., by S. H. Cathcart. 1934.	*
PR107 Gas in Tioga County, Pa., by S. H. Cathcart, and T. H. Myers. 1934.	free
PR108 Geologic structure in the plateaus region of northern Pennsylvania and its relation to the occurrence of gas in the Oriskany sand, by S. H. Cathcart. 1934.	free
PR109 Possibility of finding gas in Cameron County, Pa., by S. H. Cathcart. 1934.	*
PR110 Possible occurrence of gas in the Oriskany sand of Elk County, Pa., by S. H. Cathcart. 1934.	*
PR114 Subsurface stratigraphy of northwestern Pennsylvania and a resume of gas and oil possibilities of deeper sands, by Chas. R. Fettke. 1935.	*
PR117 Supplementary record of "deep sand" wells in Pennsylvania, by S. H. Cathcart. 1937.	*
PR127 Subsurface sections across western Pennsylvania, by Chas. R. Fettke. 1941.	0.50
W5 Ground Water in south-central Pennsylvania, by Stanley W. Lohman. 1938.	1.50
W6 Ground Water in north-central Pennsylvania, by Stanley W. Lohman. 1939.	1.25
Pennsylvania's Mineral Heritage. 1944.	0.50

* Out of print, available in many public libraries

Information for early release by the Pa. Geol. Survey:

Well-Sample Records, by Chas. R. Fettke, for more than 20 deep wells in northwestern Pennsylvania are in press and will soon be released as separate pamphlets.

A Summarized Record of Deep Wells in Pennsylvania, by Chas. R. Fettke. A brief report containing a map (in 4 parts), 2 sections, and table of skeleton logs, to be sent to press in February 1950.

SELECTED REFERENCES — continued

Reports of the Pennsylvania Second Geological Survey:

The following reports are listed principally for their information on stratigraphy; all are out of print but may be consulted in some public libraries or purchased from used book dealers:

G Bradford County
RR Cameron County
H7 Clearfield County
G4 Clinton County
I4 Oil wells in
G2 Lycoming County
R McKean County
I4 Oil wells in
G3 Potter County
I4 Oil wells in
G2 Sullivan County
G Tioga County

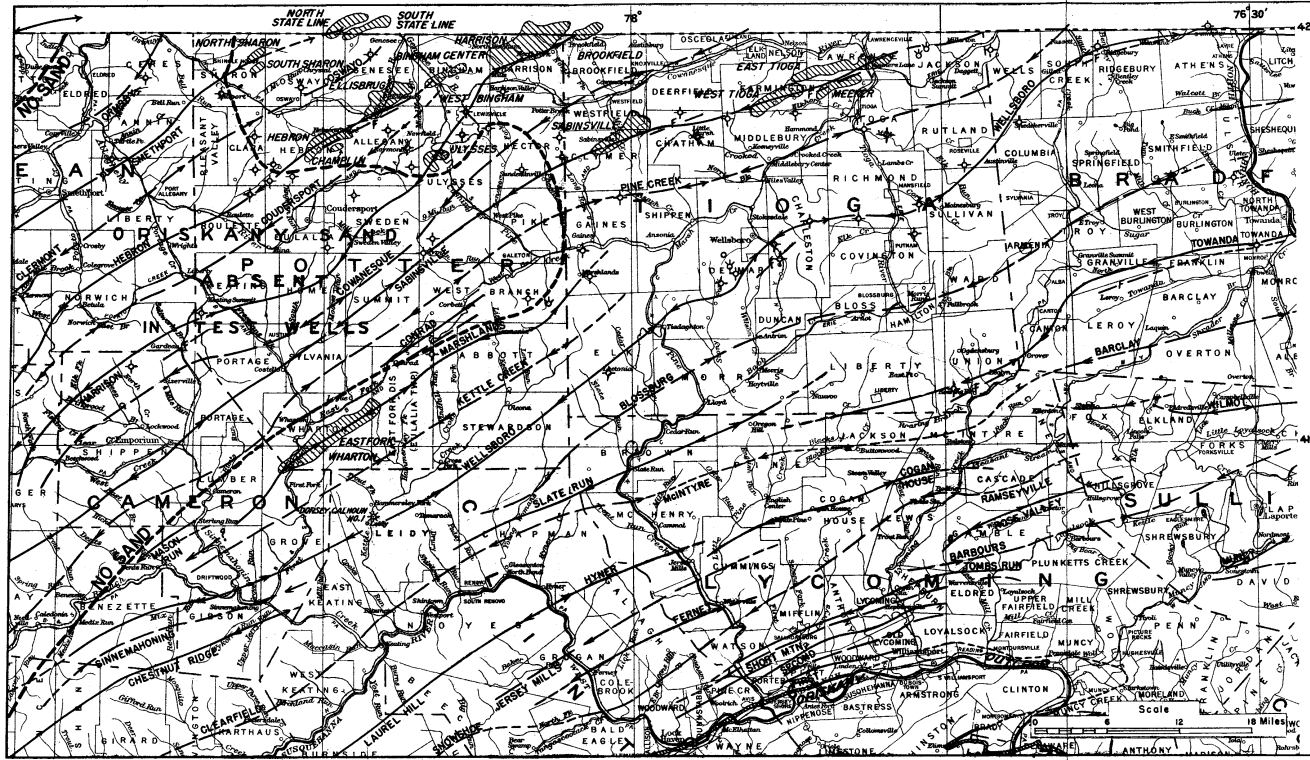
Other Publications:

Finn, Fenton H., 1949, Geology and Occurrence of Natural Gas in Oriskany Sandstone in Pennsylvania and New York, Bull. AAPG, vol. 33, pp. 303-335.

Grow, George C., et al., 1948, Guidebook: Geology of the Northern Portion of the Appalachian Basin, Pittsburgh Geol. Soc., pp. 121.

GEOLOGIC STRUCTURE IN NORTHCENTRAL PENNSYLVANIA

By
Pennsylvania Geological Survey
1934
Modified
1950



EXPLANATION

- ◇ Dry in Oriskany sand
- ⊕ Gas show in Oriskany sand
- ⊗ Gas well in Oriskany sand
- Drilling well
- ▨ Oriskany gas field
- ↔ Anticlinal axis and plunge
- ↔ Synclinal axis and plunge
- Fault
- Limits of Oriskany sand

Modified from Bull. 108 (1934), Fig. 2