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OIL AND GAS FIELDS OF GREENE COUNTY, PA.

BY

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AND

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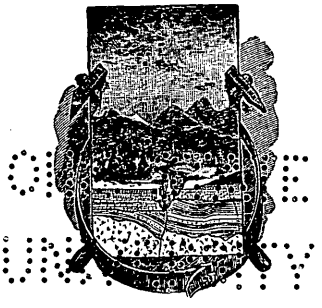

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OIL AND GAS FIELDS OF GREENE COUNTY, PA.

By RALPH W. STONE and FREDERICK G. CLAPP.

INTRODUCTION.

Greene County occupies the southwest corner of the State of Pennsylvania, extending eastward as far as Monongahela River. It is bounded on the north by Washington County, on the east by Fayette County, and on the south and west by West Virginia. It is approximately 32 miles long and 18 miles wide, having a total area of 588 square miles. The county is included almost entirely in the Rogersville, Waynesburg, and Masontown quadrangles of the United States Geological Survey.

Greene County has produced oil continuously since 1886, and since 1890 it has also yielded a large amount of natural gas. Over 1,300 wells have been drilled for gas or oil within its boundaries. So far as known these are shown on the accompanying map of the county (Pl. I, in pocket). Gas and oil wells and dry holes are represented by appropriate symbols. The map is complete to December, 1905, when the field was last visited. Other wells have been drilled since then, and it is probable that a few dry holes have been mist. While the derrick or "rig" remains standing or after the rig is blown down and only the bull wheels remain a well can hardly fail to be found, but when not even the conductor box is left the former existence of a well may escape notice.

The object of this report is to assemble the present knowledge of the occurrence of gas and oil in this county, including a large amount of unpublished data, and to present it in a convenient form for the use of those who are interested or engaged in the oil and gas business. The report describes (1) the rocks from the surface to the bottom of the deepest well; (2) the geologic structure, with a contour map of the Pittsburg coal; (3) the oil and gas sands; (4) the oil and gas fields, with suggestions for their further development. In addition many well records are given, and triangulation stations and bench marks are described.

The feature of greatest importance is the determination and representation of the geologic structure. The depth of the Pittsburg coal below the surface has been determined and a contour map

(Pl. I) constructed to show how it lies. By this map the depth of the coal below any point in the county can be told at a glance, and the shape and location of the anticlines and synclines, a knowledge of which is of great importance in the development of gas and oil pools, is clearly shown.

PREVIOUS ACCOUNTS OF THE AREA.

The principal published reports which discuss the oil and gas of Greene County are Report K, Second Geological Survey of Pennsylvania, 1876, by J. J. Stevenson; the Masontown-Uniontown folio (No. 82, 1902, by M. R. Campbell), Waynesburg folio (No. 121, 1905, by R. W. Stone), and Rogersville folio (No. —, in preparation, by F. G. Clapp), of the Geologic Atlas of the United States; a brief paper entitled "Oil and gas fields of eastern Greene County, Pa.," by R. W. Stone, in Bulletin No. 225, United States Geological Survey, 1904, pages 396–412; a paper entitled "The Nineveh and Gordon oil sands in western Greene County, Pa.," by F. G. Clapp, in Bulletin No. 285, United States Geological Survey, 1906, pages 362–366, and West Virginia Geological Survey, vol. 1 (a), 1904, pages 121–123, by I. C. White. In addition there are occasional brief statements and references in newspapers and technical journals.

ACKNOWLEDGMENTS.

The authors wish to acknowledge their indebtedness for many courtesies received from residents of the county during the prosecution of field work and to the various oil and gas companies and their field superintendents, as well as to individual drillers, for assistance and information. Special acknowledgment is made to Messrs. Reese & Heasley and P. A. Troutman, of Waynesburg, for much helpful information; to Mr. Robert Shear, of Mount Morris, for many records, suggestions, and courtesies; and to Messrs. Ira Ross, of Dunkard, and Charles Longanecker, of Sigsbee, for information concerning wells drilled and abandoned years ago. The oil and gas companies kindly furnished records of their wells, and without their assistance the most valuable part of this work could not have been accomplished. In the field work in western Greene County the authors were aided by Mr. F. W. De Wolf, to whom credit is due.

COMMERCIAL GEOGRAPHY.

RELATION TO MARKET.

Greene County is a monotonously hilly region lying a little aside from any of the great natural transcontinental routes of travel and the transportation facilities are limited. Monongahela River, a navigable waterway, forms its eastern boundary. A narrow-gage railroad, which connects with a broad-gage road at Washington, enters the county from the north and terminates at Waynesburg.

Greene County is 30 miles south of Pittsburg, which has been made one of the greatest manufacturing centers of the world by cheap fuel. An abundance of coal, and especially of excellent coking coal, in the immediate vicinity early determined this point as the center of iron and steel making in this country, but the later development of natural gas as a cheaper and more convenient fuel has increased very markedly the amount of manufacturing at Pittsburg. All the iron and steel mills there use natural gas in their puddling furnaces and under their boilers. Practically all manufacturing establishments, including extensive glass factories and breweries, use gas for developing power, heat, and light, and on account of its cheapness, cleanliness, and convenience of application it is also in common household use. Much of this cheaper fuel comes from Greene County. Owing to the constantly increasing demand and the gradual failure of old wells, continuous drilling is necessary to keep up the supply. Manufacturing plants do not locate in the gas fields because it is much more economical to establish factories on a transportation line and bring the gas to them.

PIPE LINES.

All the oil and gas produced in Greene County is transported by pipe lines. The oil wells in the eastern part of the county do not flow, but have to be pumped, and yield but a few barrels per day per well. A common practice in pumping small groups of wells is to make steam at a central boiler house, pipe it to the engines at the wells, and pump with the walking beam. At Willow Tree some of the wells are pumped with a small mechanical device known as an air head or pump head, which is operated by compressed air. The oil from the Mount Morris, Garrison, and Whiteley Creek fields is pumped to a central station on Monongahela River, 2 miles above Morgantown, W. Va., and thence to the seaboard. It is estimated that the production of that portion of the Mount Morris field which lies in Greene County amounts to about 1,000 barrels daily. The Whiteley Creek oil field produces about 80 barrels daily and the Garrison field about 30 barrels. The production of the Fonner field, which is about 50 barrels of oil a day, is carried by pipe lines to storage tanks at Meadowlands, Washington County, Pa.

The oil wells in western Greene County are mostly pumping wells, although a few of them flow. The production recorded during the first twenty-four hours is not known to have exceeded 200 barrels in any well outside the Nineveh and Fonner fields, and the general averages for good wells in the Nineveh district are 10 to 60 barrels the first day. Throughout western Greene County there have been no such enormous yields as occurred in the Washington field in the early days. Owing to this general lightness of production the South Penn Oil Company has recently abandoned drilling in that part of the county.

Three main pipe lines carry the oil from the western half of the county to tanks at Meadowlands—a 5-inch line about 40½ miles long, extending in a direct course from Littleton, W. Va., a 6-inch pipe running from Downs station, West Virginia, northward 36 miles, and a third line following a nearly direct course from Dolls Run, West Virginia. At present there are at Meadowlands about 50 tanks, having a total capacity of about 1,467,000 barrels. The tanks are not all the same size, their capacities ranging from 12,850 to 37,300 barrels, with an average capacity of about 29,350 barrels each. The entire capacity of the tanks in the southwestern Pennsylvania field amounts to not more than 1,700,000 barrels. The yield from the various oil fields can not be readily ascertained.

Most of the gas from this area is carried by pipe lines to Pittsburg, where it is used largely by manufactories for steaming and heating purposes and by the city in general for heating and lighting. Some goes to Wheeling and other points in West Virginia, and some is used locally for heating, lighting, and cooking, as at Waynesburg and on many farms which are near producing wells.

The Carnegie Natural Gas Company has a pump station 2 miles east of Waynesburg that draws from wells in the Waynesburg field and from two 10-inch lines, one of which extends to Mount Morris and the other enters West Virginia 3 miles west of Blacksville. The gas is sent to Pittsburg from this station thru two pipe lines, 12 inches and 16 inches in diameter. This company has also smaller lines in the western part of the county. The Philadelphia Company has a 16-inch line to Pittsburg which extends across the county from northeast to southwest, a 10-inch line from Blacksville to Waynesburg, two or three lines to the Waynesburg field, and a second 16-inch line from Waynesburg northeastward to Pittsburg. The Peoples Natural Gas Company has lately completed a 20-inch line which enters Greene County at Dent, 3½ miles west of Blacksville, passes 4 miles east of Waynesburg, and crosses the county line again near Zollarsville. The Manufacturers Light and Heat Company takes gas from the field south of Waynesburg through a 16-inch line, and the Fort Pitt Gas Company has a 12-inch line which crosses the county from a point 4½ miles east of Blacksville to Zollarsville and carries gas to Pittsburg. The Natural Gas Company of West Virginia and the Wheeling Gas Company have several 8-inch and 10-inch lines in the western part of the county which carry gas to Wheeling and other points on the Ohio River.

STRATIGRAPHY.

GENERAL STATEMENT.

The rocks exposed at the surface of Greene County are about 1,400 feet thick. The section includes the upper part of the Conemaugh formation, which outcrops in a narrow belt on Monongahela River,

the Monongahela formation, and the Dunkard group. It happens that the Pittsburg coal, which is at the base of the Monongahela formation, is the lowest easily recognized bed outcropping in the county and is also the stratum used by drillers throughout the county for calculating distances to productive sands. It is encountered at the surface and at varying depths down to more than 1,300 feet. Being confident of finding and recognizing it, drillers often neglect to keep detailed records of the overlying rocks. For this reason, and because this bulletin is designed primarily for the use of oil and gas men who think of the rocks in the order in which they find them, it seems advisable to divide the discussion of the stratigraphy of the county into two parts, considering first the rocks exposed, or all above the Pittsburg coal, and then the rocks below the surface, or lower than the Pittsburg coal, and thus to treat the rocks from the driller's point of view, as they are discovered by the descending drill. A description of the surface rocks is pertinent to this report because, though the Pittsburg coal outcrops along Monongahela River, throughout much of the county it is several hundred feet below the surface. If the driller can recognize the horizon which his hole has reached by the character and sequence of the higher beds, he can tell approximately at what depth the coal should be found. Since the Pittsburg coal is used as a reference stratum from which the position of the oil and gas sands is calculated, it is particularly necessary to note its horizon.

ROCKS SHOWING AT THE SURFACE.

The surface rocks in this county belong entirely to the Carboniferous system. Four formations are represented, the Greene, Washington, and Monongahela being present entire and the upper 100 feet of the Conemaugh showing along the eastern edge of the county, where the Pittsburg coal rises above the level of Monongahela River. The Greene and Washington formations comprise the Dunkard group.[a]

GREENE FORMATION.

The section from the highest rocks exposed in the State down to the top of the Upper Washington limestone is included in the Greene formation, which is about 700 feet in maximum thickness and is composed largely of shale and shaly sandstone. These rocks are so deeply weathered on the hills that little can be determined of the details. The formation contains also some locally developed massive sandstone, red shales, small limestone beds, and two or three very thin coal seams.

[a] For more complete descriptions of the surface rocks the Masontown-Uniontown folio (No. 82), Waynesburg folio (No. 121), Amity folio (in preparation), and Rogersville folio (in preparation), Geologic Atlas United States, should be consulted.

WASHINGTON FORMATION.

A series of comparatively soft rocks extending from the top of the Upper Washington limestone down to the roof of the Waynesburg coal comprise the Washington formation. The Upper Washington limestone is a conspicuous and rather persistent member of the Dunkard group, although it is absent in portions of the southern and western parts of the county. Its distance above the Waynesburg coal varies considerably on account of the variable thickness of the formation, but is between 300 and 400 feet.[a] Throughout much of the county this limestone weathers to a grayish white, a color so much lighter than that of other limestones that it is a distinct characteristic. The Upper Washington, where seen, is from 4 to 15 feet thick and is broken into two or more beds by thin layers of shale. On fresh fracture the rock is generally blue or black and mottled. The Lower Washington limestone is a bed in places 10 feet thick, which occurs a short distance above the Washington coal and 100 to 150 feet above the base of the formation.

Other beds of limestone up to 10 feet or more in thickness appear locally in the section. One of these, the Jollytown limestone, 30 feet above the coal of the same name and 20 feet below the top of the formation, is a persistent little bed, coarsely brecciated, weathering to a dull gray, in many exposures tinged with yellow.

A number of coal beds occur in the formation, but only one of them is of any importance. This is the Washington coal, which is opened below the Lower Washington limestone at a few points along the valleys of Dunkard Fork and Crabapple Creek, in Richhill Township. The other coals are too thin and too much broken up by partings to be worked until the thicker and more valuable beds in the Monongahela formation below are exhausted. The names Waynesburg A, Waynesburg B, and Jollytown are applied to them. Overlying the Waynesburg coal is the Waynesburg sandstone, which when massive is 40 to 70 feet thick.

MONONGAHELA FORMATION.

This formation extends from the top of the Waynesburg coal to the base of the Pittsburg coal and in Greene County is from 273 to 405 feet thick. The whole thickness is exposed in the county only at the mouth of Tenmile Creek and on Monongahela River above Grays Landing.

The Monongahela formation contains over 100 feet of limestone, some heavy beds of sandstone, shales, and five coal seams which are more or less persistent. The Waynesburg coal is from 4 to 6 feet thick. It outcrops extensively in the eastern part of the county

[a] Intervals given thruout this paper are from top to top of the respective beds.

and is also exposed on two branches of Wheeling Creek, on the western border. It is reported in a large number of wells.

A stratum of coal a foot thick, known as the Uniontown, lies about 90 feet below the top of the formation, being separated from the Waynesburg coal by a sandy shale and the Waynesburg limestone.

Below the Uniontown coal is the Benwood limestone, occupying about two-thirds of the 150-foot interval to the Sewickley coal. Shale and sandstone beds break up the Benwood into two or more divisions, each of which is made up of layers of white, gray, and drab limestone a foot or more thick. The Benwood limestone outcrops on Meadow Run below Davistown and in the valley of Tenmile Creek below Jefferson. Particularly good exposures occur on Castile Run and at the iron bridge across Tenmile Creek, 2 miles below Jefferson.

Another persistent coal bed in the Monongahela formation is known as the Sewickley. It is 100 to 120 feet above the Pittsburg coal and varies in thickness from 20 inches to 4 feet or more. It outcrops only in the main stream valleys on the eastern side of the county, and it has been mined extensively for local use at Mapletown. To most well drillers it is known as the Mapletown coal.

The Redstone coal, from 40 to 70 feet above the Pittsburg bed, is seen in occasional outcrops below Clarksville, where it shows about 6 inches of coal and bituminous shale. This bed probably thickens in the southeastern part of the county, because 3 miles south of Dunkard, on Robinson Run, in West Virginia, it is 4 to 5 feet thick and 40 feet above the Pittsburg seam.

The Pittsburg coal, at the base of the formation, outcrops for a short distance in the northeast corner of the county. Near the mouth of Tenmile Creek it dips below water level, but it reappears near the mouth of Whiteley Creek and continues above water level to the West Virginia line. It is from 6 to 10 feet thick and is a high-grade bituminous coal. Little is known regarding the character of the coal or the detailed section of its bed in the deeply buried parts of the basin in Greene County. Drill records, with few exceptions, attest its presence in all parts of the county, with about the same aggregate thickness as it maintains in the outcrop on the edges of the field at the surface and at depths ranging to more than 1,300 feet. A heavy bed of sandstone generally lies above the coal.

ROCKS BELOW THE SURFACE.

SOURCE OF DATA.

The present discussion of the rocks which lie below the Pittsburg coal is based entirely on the records of wells scattered throughout the county. In comparing the records of wells in any given township

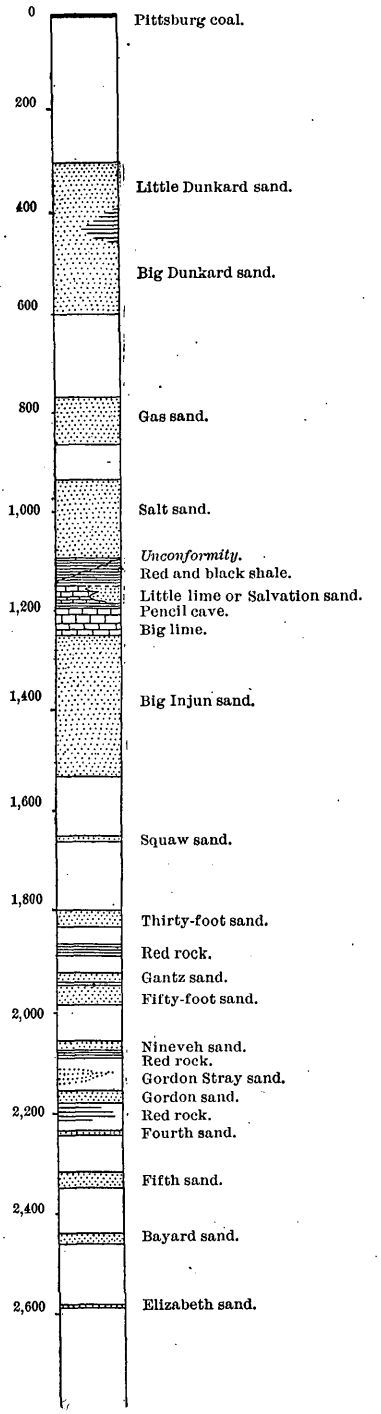

FIG. 1.—Generalized section of rocks below the Pittsburg coal.

considerable variations are found in the stratigraphy as observed by different drillers. This must necessarily be the case, for it is well known that most beds have a limited geographic development; some thicken in one direction and entirely disappear in another, and some of the most massive sandstones change to sandy shale or become calcareous in short distances. Some apparent variations in the stratigraphy shown by comparing the records of wells in close proximity to each other may be accounted for by the supposition that the drillers did not measure to the same bed, or by inaccuracies of measurement due to the stretching of the manila cable. Furthermore, although the depth to producing sands is measured by steel line, the other depths are generally obtained by counting the turns of the cable on the bull-wheel shaft, and errors in this sort of measurement are easily made. The difficulty of identifying rocks by sand pumpings or by the relative ease of drilling is also a source of variation or error. These facts must all be considered in comparing the records of deep wells.

Details regarding position, thickness, and productiveness of the sands will be found on pages 30–44. The reader is referred to the generalized section (fig. 1) for a graphic representation of the sequence of the beds described below. This section shows only the approximate position and relation of the sands and omits details of character and distribution.

CONEMAUGH FORMATION.

Many of the records of wells drilled in Greene County give no details between the Pittsburg coal and the Dunkard or first productive sand.

It is known, however, that limestone is encountered about 50 feet below the coal and that this is underlain by a massive sandstone the Connellsville, which in some places is 50 feet thick. Another heavy sandstone, the Morgantown, is found at a distance of 150 to 200 feet below the coal. The interval between these two sandstones is occupied by shaly sandstone or red shale. These beds of red shale in the upper part of the Conemaugh are probably continuous throughout the county, but in some sections the records are so incomplete that this can not be positively asserted. In the western part of the county most of the complete records note from 50 to 200 feet of red rock, and in Richhill Township it is reported even in the fragmentary records. In the eastern half of the county, however, red rock is not reported so uniformly. Several well records from Franklin Township indicate the presence of a considerable thickness of red beds. In the Waynesburg gas well (201),[a] which was drilled at the mouth of Purman Run in 1885,[b] red rock is reported as occupying 298 feet in an interval of 343 feet at this horizon. It is noted in the Fonner field and in the vicinity of Nineveh, in Morris Township, 100 to 250 feet below the Pittsburg coal. It is also found in eastern Washington County and is noted in many of the wells in Monongalia and Marion counties, W. Va. In the log of the Brice Wallace well, in Marion County,[c] red rock is recorded as extending through a space of nearly 300 feet.

The Morgantown sandstone, which lies beneath these red beds, is frequently reported in records of wells drilled in the western part of the county and is known there as the Murphy sand. In many places the shale underlying the Morgantown sandstone is red.

The Conemaugh formation in Greene County is from 570 to 670 feet thick. The lower half is composed largely of massive sandstone and sandy shale. This part of the formation is variable, being recorded in some logs as a continuous mass of sandstone and in others as two or more beds separated by shale. No two records are exactly alike in this respect. Where these rocks come to the surface there are generally two sandstones in this portion of the formation. They are known as the Saltsburg and Mahoning sandstones. Both of them are in some places almost continuous masses of heavy sand rock as much as 150 feet thick, with few or no breaks, while in other places either one or both become shaly. The upper portion of this sandy mass, lying 300 to 420 feet below the Pittsburg coal, is called the Little Dunkard sand and is considered equivalent to the Saltsburg sandstone, and the lower portion, known as the Big Dunkard sand, lying generally from 420 to 600 feet below the Pittsburg coal, is considered

[a] Numbers in parentheses refer to the same number at a well location on the county map (Pl. I). Logs of wells Nos. 1–170 are given in the table on pages 36–91.

[b] Carll, J. F., Ann. Rept. Geol. Survey Pennsylvania, 1886, Pl. II, p. 772.

[c] West Virginia Geol. Survey, vol. 1 (a), 1904, p. 238.

equivalent to the Mahoning sandstone. In several instances in various parts of the county sandstones which occur more than 600 feet below the Pittsburg coal have been called Dunkard by the drillers. Where these are thin and where their bases do not extend more than 650 to 670 feet below the Pittsburg, they may have been correctly named, but when their bases are lower than this it is probable that they are more nearly identical with the Upper Freeport sandstone, which lies below the Upper Freeport coal at the top of the Allegheny formation.

ALLEGHENY FORMATION.

In this region drillers rarely record any coal beds below the Pittsburg. Having reached this well-known stratum, they look only for productive sands and often record nothing else, or hundreds of feet of rocks are lumped together as "shale" or "shaly sandstone." In the record of the Sayers well (202), which was drilled on the site of the pump station 2 miles east of Waynesburg, the one item "black shale, 370 feet," covers the entire Allegheny and Pottsville formations. The Johnstown and Vanport ("Ferriferous") limestones are noted in one or two records, but as a whole the data in this formation are meager and unreliable.

The Allegheny formation, extending downward from the top of the Upper Freeport ("Connellsville") coal to the top of the Pottsville formation, varies in thickness from 270 to 370 feet, though in the southwestern part of the county its thickness may be placed as low as 240 feet. Nine records in the western part of the county, which give the Upper Freeport coal and Salt sand, make the greatest interval 367 feet, the least interval 241 feet, and the average 282 feet. Although the Upper Freeport coal is not reported in many wells, it is believed to be fairly continuous. In the Allegheny Valley at least five workable coal beds occur in this formation, but the number of these extending underneath this corner of the State is unknown. In several wells, of which the William Milliken No. 2 (27), in Center Township, is an example, a coal bed is recorded 150 feet below the Upper Freeport. This is probably the representative of one of the Kittanning beds. In the J. B. Fordyce record (66), Gilmore Township, the name Connellsville is applied to a bed of coal 5 feet thick which is found 725 feet below the Pittsburg. At an interval of 44 feet above this, directly underneath the Big Dunkard sand, lies a 3-foot bed of coal. It seems probable that this upper seam may be the true Upper Freeport, or "Connellsville," bed, in which case the lower seam would be the Lower Freeport coal. The lower coal lies only 197 feet above the Salt sand. There may be other reported occurrences of the "Connellsville" coal which are in reality the Lower Freeport instead of the Upper Freeport bed, in which case the Allegheny formation is locally thinner than estimated above.

The sandstones of the Allegheny are variable and may be found almost anywhere in the formation. On the surface they are known variously as the Upper Freeport, Freeport, Kittanning, and Clarion sandstones, according to their stratigraphic positions. Only one of the beds is recognized by the drillers in this region and that is called the Gas sand. Its top lies from 650 to 850 feet below the Pittsburg coal, and its recorded thickness varies from 15 to 140 feet. This sand is not supposed by the writers to be a definite bed, but the name seems to be applied to any sandstone occurring between the Big Dunkard and Salt sands. In general, the Gas sand lies about the horizon of the Kittanning or Clarion sandstone, near the middle or base of the formation, though in some records it seems to be placed still lower, in the subjacent Pottsville.

POTTSVILLE FORMATION.

The thickness of the Pottsville formation varies between 70 and 200 feet, being as a rule greatest in the eastern part of the county. In general, the formation consists of two beds of heavy sandstone, separated by shale. The upper is the Homewood and the lower the Connoquenessing sandstone of the Beaver Valley region. Many well records show these sandstones merged into one continuous bed.

In eastern Greene County a sand rock reported at an average depth of 765 feet below the Pittsburg coal and commonly known as the Gas sand, seems in some cases to be equivalent to the Homewood sandstone. The recorded thickness ranges from 15 to 140 feet. In western Greene County, as noted above, the term Gas sand is applied to a bed of sandstone in the Allegheny formation.

The top of the Salt sand occurs at an average distance of 930 feet below the Pittsburg coal. Its thickness varies from 15 to 200 feet. Where the Gas sand is equivalent to the Homewood sandstone, the Salt sand corresponds with the Conoquenessing sandstone. Where the Gas sand is absent or not noted, or in the Allegheny, and the Salt sand is only moderately thick, the latter may be equivalent to either the Homewood or Conoquenessing sandstone. When the Salt sand is recorded as being extremely thick, however, it usually coincides with the whole Pottsville formation and may include the upper part of the Mauch Chunk.

In general, the Pottsville formation is supposed to correspond in its limits with the Salt sand, but it is probable that locally in eastern Greene County the upper portion of the formation includes the Gas sand. In places a bed of dark shale occurs below the Salt sand and above the red shale of the Mauch Chunk formation. It can not be stated positively whether this belongs to the Mauch Chunk or Pottsville.

MAUCH CHUNK FORMATION.

The Mauch Chunk formation consists generally of a mass of red shale and underlying limestone, with here and there a sandstone bed between them. In some places the upper part of the formation consists of shale which is not red. This is especially true in the western part of the county, where red rock is rarely reported in this formation. To the east, however, it is more abundant, and in the vicinity of Waynesburg attains a thickness of over 100 feet. The Mauch Chunk formation increases in thickness, from 100 feet in the northwest corner of the county to over 250 feet in Monongalia and Marion counties, W. Va. The lessened thickness toward the north and west is due to an unconformity, caused by a period of elevation and erosion after the deposition of the Mauch Chunk and before the overlying Pottsville beds were laid down.

Throughout the greater portion of the county a bed of limestone 20 to 70 feet thick, known to drillers as the Little lime, occurs below the shaly portion of the Mauch Chunk. Toward the southwest, especially in Springhill and portions of adjacent townships, sandstone is reported at this horizon, to which the term Salvation sand is commonly applied in Pennsylvania and Maxton sand in West Virginia. Below the Little lime lies a few feet of soft shale that breaks up into small splinters in which the drill sinks rapidly. Owing to the peculiar way in which it breaks and its tendency to cave, this bed is known as the "Pencil cave."

The portion of the formation below the Pencil cave consists entirely of limestone, and is known as the Big lime. Sometimes the Little lime is not reported and the Pencil cave may be absent, in which case the entire thickness of limestone is reported as Big lime. These limestones are known over considerable areas as the Mountain limestone and correspond to the Greenbrier limestone which outcrops on Chestnut Ridge and Laurel Hill. In Greene County limestone seems to be everywhere present in the Mauch Chunk formation and is a good datum for the drillers.

POCONO FORMATION.

The top of the Pocono formation is coincident with the top of the Big Injun sand of the well drillers, which corresponds with the Burgoon sandstone of the Allegheny Front. The thickness of the formation varies from 300 to 900 feet, according to the position of its base as interpreted by different authorities. Considerable doubt exists regarding this point, as there is a strong resemblance between the Pocono rocks and those of the Chemung formation at the top of the Devonian, and even where they outcrop it is difficult in many places to draw any definite line of separation between them.

In his report on the geology of West Virginia,[a] I. C. White gives the Pocono a thickness of 560 to 600 feet, and includes in it the Big Injun and Squaw sands, with 380 feet of underlying shales and sandy beds. The Big Injun in White's section is 150 feet thick. He classes as Catskill a series of sands and shales 571 feet thick, extending from the bottom of the Pocono, which he places just above the Gantz sand, to the bottom of the Elizabeth sand, and places in the Chemung the gray and dark shales, with an occasional shell, which lie below the Elizabeth sand. On the other hand, J. J. Stevenson[b] states that he found along the National pike in Fayette County, within 18 inches of the base of the Pocono sandstone, a number of species, which, according to James Hall, are typical Chemung forms. The position of these fossils clearly shows that from a paleontologic standpoint no formation can be present in that region between the Pocono sandstone and the Chemung shale. The Pocono in this locality is approximately 300 feet thick and composed almost entirely of sandstone which varies from thin-bedded flaggy rock to massive conglomerate. Following Stevenson, M. R. Campbell[c] describes the Pocono as being about 400 feet thick and equivalent to the Big Injun sand of the drillers. He classes the sands and shales below the Big Injun as Devonian. The presence of so-called Chemung fossils, however, does not preclude the possibility that the rocks containing them are Pocono in age, as the fauna may represent a merging of Devonian into Carboniferous forms. That there may be such a zone of merging with no distinct boundary is shown by Charles Butts in a paper on the Olean quadrangle in southern New York.[d] He finds that a few distinctively Devonian forms persist and are associated with forms which belong in the Mississippian and with other forms which have Carboniferous aspects. Carboniferous fossils have not been found below the Burgoon sandstone in the Chestnut Ridge region, and, although thorough search has not been made, it seems probable that they are not there.

In the Latrobe and other quadrangles in that vicinity a bed of red shale has been recognized from 350 to 500 feet below the top of the Big Injun sand and has been correlated with a bed of red shale which outcrops at Patton, Jefferson County. This shale, known as the Patton shale, carries fossil plants which have been identified by David White as Pocono forms. The Pocono formation in that region, therefore, is considered to be at least 400 to 500 feet thick.

With the exception of the exposure on the National pike, the Pocono outcrop nearest to Greene County of which a measurement has been

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[a] West Virginia Geol. Survey, vol. 1, 1899, p. 205.

[b] The upper Devonian rocks of southwest Pennsylvania: Am. Jour. Sci., 3d ser., vol. 15, 1878, pp. 423-430.

[c] Masontown-Uniontown folio (No. 82), Brownsville-Connellsville folio (No. 94), and Latrobe folio (No. 110), Geologic Atlas U. S.

[d] Fossil faunas of the Olean quadrangle: Rept. New York State Paleont., 1902 (Bull. N. Y. State Mus. No. 69), pp. 990-995.

made is along the Pennsylvania Railroad east of Bennington, Blair County, on the Allegheny Front. This was measured by Charles Butts,[a] who collected fossils from this locality and came to the conclusion that although its base is rather indefinite the Pocono formation there is about 1,000 feet thick. In the Kittanning folio (No. 115) Butts describes this section in considerable detail and correlates it with well sections at Johnstown and in Indiana and Armstrong counties. A mass of red shales which he finds 1,000 feet below the top of the Burgoon sandstone is recognized as probably the Catskill formation at top of the Devonian, and these shales and the beds between them and the top of the Burgoon have been traced by means of various well sections into the Kittanning quadrangle; but the wells are at such a distance from each other that the identification can not be regarded as positive. The red beds of the Kittanning region lie not far below the Hundred-foot (Gantz and Fifty-foot) sand. From this Butts concludes that the Hundred-foot, Big Injun, and intervening sands are included in the Pocono and that the boundary between the Carboniferous and Devonian systems in Armstrong County should be considered as the top of the first red rock below the Hundred-foot sand. L. H. Woolsey has compared a large number of well sections and from them traced the horizon of the Hundred-foot sand and underlying red shale (Catskill) across Butler County to the Beaver quadrangle. A similar study was made by F. G. Clapp in work on the Amity quadrangle, in eastern Washington County. A great number of well records in western Pennsylvania were compared, and the beds between the Beaver and Amity quadrangles were correlated. There seems to be little question that the Hundred-foot sand of the northern counties is equivalent to the Gantz and Fifty-foot at Washington, and the tracing from Washington into Greene County is equally certain. In the same way the Berea sandstone of Ohio has been traced into this region, by means of well records, through Jefferson County, Ohio, Brooke County, W. Va., and Washington County, Pa., and it has been found to occur near the same horizon as the Thirty-foot sand. Throughout Greene County this sand lies from 20 to 80 feet above a certain bed of red shale, which is useful in correlating and which is supposed to be equivalent to the Bedford red shale of Ohio. Another group of red shale beds, similar to those called Catskill or sub-Blairsville in the Latrobe quadrangle, occurs in Greene County in all the wells which have penetrated that horizon.

Thus in tracing the formations into Greene County from the east and from the north and west two dissimilar conclusions have been reached. When traced from the east there seems to be little question that the Pocono formation is equivalent to the Big Injun sand only. When traced from the north and west, it is concluded that

[a] Ebensburg folio (No. 133), Geologic Atlas U. S.

the formation must be about three times as thick, including the Thirty-foot, Gantz, and Fifty-foot sands. For this reason it is necessary to leave the base of the Pocono in doubt, although in this report it is provisionally placed at the top of the Nineveh sand, which is supposed to be the uppermost bed of the Catskill formation.

The Big Injun or Mountain sand lies immediately below the Greenbrier limestone, or Big lime, of the Mauch Chunk formation, and its top is therefore everywhere definite, making a good reference plane in drilling. The sandstone constitutes the upper part of the Pocono formation and on the surface is known as the Burgoon sandstone. In Greene County it attains a thickness of 200 to 300 feet. In places it contains a break of shale up to 50 feet thick. The interval from the Pittsburg coal to this sand varies from 1,073 feet in the David Stickler well, near Simpson Store, to 1,345 feet in the Mary McClure well, in Perry Township.

Generally there is an interval of 250 to 350 feet below the Big Injun sand occupied by "slate and shells." In a few records, however, the Squaw sand is reported 50 to 150 feet below the base of the Big Injun. This sand locally amounts to 100 feet in thickness, although it is generally less than 50 feet. In Washington County it is a rather prominent bed.

The lower portion of the Pocono formation is composed of sandstone beds separated by shales. These sandstones in one place or another carry gas or oil. They occur in the following order, from the top down: Thirty-foot sand, Gantz sand, and Fifty-foot sand.

DEVONIAN SYSTEM.

About 2,000 feet below the Pittsburg coal occur the uppermost rocks supposed to be of Devonian age. They underlie the Pocono formation and consist of sandstones and shales of varying thickness and composition. The best-known members are the Nineveh, Gordon, Fourth, Fifth, Bayard, and Elizabeth sands. In many places red beds occur in the upper part of this series. The red color is found in both sandstone and shale, and these beds are believed to be the feather-edge of the Catskill formation of eastern New York and Pennsylvania.

In Greene County the Catskill may be placed either at the top of the Devonian or a few hundred feet below, its position in the stratigraphic column depending on the definition of the base of the Pocono. In the eastern part of the county the beds are several in number, attaining a total thickness of 100 feet or more, but in the western part they consist only of one or two thin beds which in few places exceed 30 feet in thickness. The uppermost of these is either the Nineveh sand or a bed directly underneath it. This red stratum is an excellent horizon marker. The other principal bed

of this series in western Greene County is less persistent, but where present it lies 75 to 100 feet below the bed just described, between the Gordon and Fourth sands. In wells where these beds are present, therefore, the Nineveh and Gordon sands can be almost certainly identified.

The Catskill formation should not be confused with the Bedford red shale, which occurs considerably higher, between the Thirty-foot and Fifty-foot sands. The Catskill formation increases in thickness toward the east, while the Bedford disappears in that direction and becomes more prominent toward the northwest. The Catskill is without doubt Devonian, and the Bedford, where it outcrops in Ohio, is of Carboniferous age.

The thickness of the Devonian rocks is not known. A well in Aleppo Township penetrated to a depth of 4,722 feet below the Pittsburg coal, or about 2,700 feet into the Devonian. Two thousand feet of strata below the Bayard sand are reported in the record of this well as "shells and slate," meaning thin beds of shaly sandstone and shale.

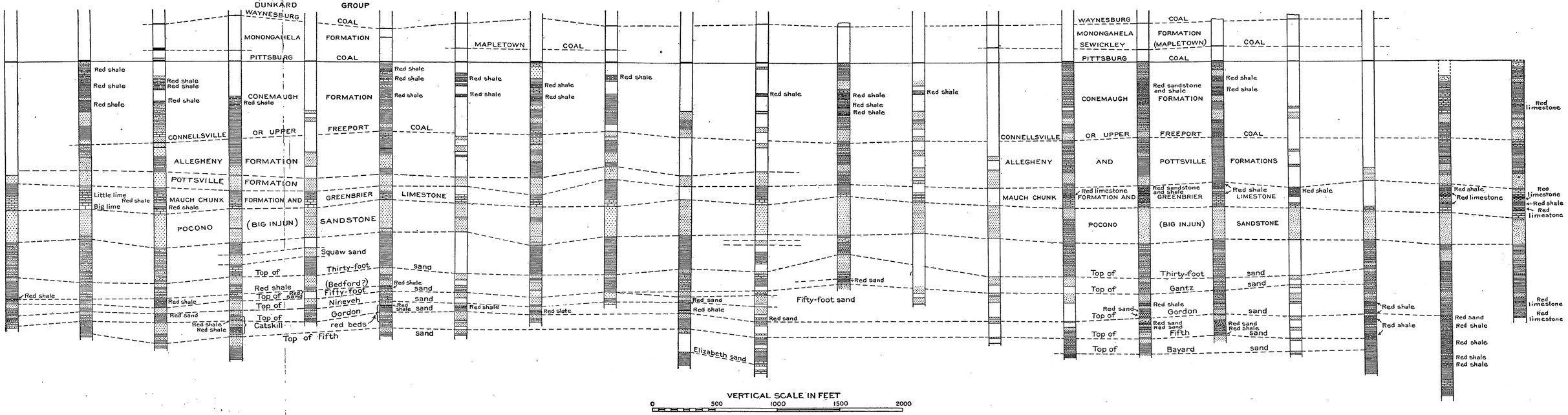
WELL SECTIONS.

In Pl. II the sequence of the rocks in 21 deep wells is represented graphically. Nineteen of these wells are in Greene County, one is at Washington, 20 miles north of Waynesburg, and one is at Lone Pine, 13 miles north of Waynesburg. They are arranged in an east-west line from Monongahela River to Morris Township, and thence irregularly southwestward to the corner of the State. Besides showing the correlation of sands throughout the county, these sections also show the correlation of the Nineveh and Gordon sands into Washington County, a subject about which there has been a difference of opinion and which is discussed on pages 44–45. The sections are aligned on the Pittsburg coal. The correlation lines show the gradual diminution in thickness and final disappearance of the Mauch Chunk red shale in the northern and western parts of the county, as the result of the unconformity at the base of the Salt sand. The positions of the various oil and gas sands are shown and their relations are indicated.

GEOLOGIC STRUCTURE.

INTRODUCTION.

Greene County is near the center of the great bituminous coal basin. The structural features have the general northeast-southwest trend which is characteristic of most of the Appalachian province, while the crests of the anticlines and the troughs of the synclines crossing this county are successively lower from east to west. These folds in the rocks are shown by the contour lines (or lines of equal elevation) on the accompanying map (Pl. I). The floor of the



DEEP-WELL SECTIONS IN GREENE COUNTY AND VICINITY.

Pittsburg coal is the reference surface, and at all points along a given contour line the Pittsburg coal has the same elevation above sea level; and on the adjacent contour the coal is 50 feet higher or lower, as the case may be. Thus the contour lines represent the shape of the folds. The Pittsburg coal is seen at the surface in Greene County only at the mouth of Tenmile Creek and on Monongahela River above Grays Landing. In other parts of the county its position has been calculated from higher beds, which show at the surface and also from the records of a large number of deep wells. Enough such data have been obtained to make the determination of the position of the coal accurate within a contour interval, although the bed is several hundred feet below the surface throughout much of the area. The geologic structure is described from east to west across the county.

FAYETTE ANTICLINE.

This arch in the rocks is strongly developed across Fayette and Westmoreland counties. The axis crosses Redstone Creek above Waltersburg and approaches Monongahela River near the State line, entering Greene County, if at all, in the extreme southeast corner. Although the axis may not cross this county, the western flank of the anticline is shown in the dip of the rocks from Dilliner to Mount Morris. The evidence for determining the structure in this corner of the county is the outcrop of the Pittsburg coal along Dunkard Creek and its depth in wells drilled between Mount Morris and Davistown. The crest of the fold as it crosses Fayette County decreases in elevation toward the south, and at the Greene County line the Pittsburg coal is about 1,150 feet above tide. From the river to Mount Morris the dip of the beds down the flank is fairly regular and carries the coal down to 500 feet above tide.

LAMBERT SYNCLINE.

A basin next on the west of the Fayette anticline has an irregular outline, and its axis pursues an indirect course, crossing Monongahela River above Browns Ferry and entering Greene County with a westerly trend. A mile west of the river it turns southward, passing through Paisley and terminating somewhat indefinitely near Willow Tree. The axis rises to the south, so that the Pittsburg coal, which is 550 feet above sea level at the river, is 150 feet higher at the south end of the basin.

BROWNSVILLE ANTICLINE.

The rocks rise westward from the Lambert syncline in an irregular arch which is called the Brownsville anticline. The axis of this fold passes just east of the town of Brownsville, crosses Monongahela River at East Riverside, and pursues a southerly course to Turkey Knob. In Greene County this anticline is but a slight undulation

and poorly defined, but it has the effect of throwing the strike of the flank of the Fayette anticline in the vicinity of Davistown into a north-south direction. The Brownsville anticline is a minor wrinkle in a large synclinal basin, the eastern limb of which rises to the Fayette anticline and the western limb to the Bellevernon anticline, which lies farther west. The determination of structure here is from the outcrop of the Waynesburg coal.

WHITELEY SYNCLINE.

The Whiteley syncline lies between the Fayette and Bellevernon anticlines, as does the Port Royal syncline farther north. The Port Royal syncline, however, loses its basin-like character in the vicinity of Fayette City, on Monongahela River, and the axis does not seem to be continuous with the axis here described.

Conditions are such that the accurate determination of the structure of this basin is almost impossible. The rocks showing at the surface are of such a character that tracing and definite correlation are impracticable, and in the 60 square miles of the basin lying between Muddy Creek and the State line there are only seven deep wells which give any light on the depth of the Pittsburg coal below the surface. Therefore the location of the structure contours in this part of the area is regarded as approximate only and subject to revision when definite evidence is available.

The Whiteley syncline is broad and shallow, deepening toward the south. The axis of the trough probably corresponds with a line through Fordyce and Kirby and crosses Dunkard Creek just south of the State line, about a mile west of Pentress, W. Va.

BELLEVERNON ANTICLINE.

The term Waynesburg anticline was applied to this fold in the rock structure by J. J. Stevenson,[a] who also applied the same name to the syncline on the west. The first work of the United States Geological Survey on this anticline was in Washington and Westmoreland counties, where it attains its maximum development at Bellevernon, on Monongahela River, and the anticline was named from that place, there being some doubt at the time as to its continuity with the axis supposed to exist at Waynesburg and also as to the applicability of the term Waynesburg to both the anticline and syncline lying next to the west. Later the survey of the Waynesburg quadrangle proved the continuity of the fold, but its location is so far east of the village of Waynesburg and it has in that area lost so much of its prominence that the term Waynesburg seems more appropriate for the syncline, and the name Bellevernon is retained for the anticline.

[a] Second Geol. Survey Pennsylvania, Report K, 1876.

The Bellevernon anticline is the most pronounced and important structural feature in Greene County. Its axis crosses Tenmile Creek and the county line a mile northeast of Clarksville and holds a direct southwest course for 14 miles to the head of Smith Creek, where it turns to the south between Roberts and Rudolph runs and gradually flattens out.

A normal continuation of the axis would cross the State line nearly a mile west of Blacksville, but for 2 miles west of that village the rocks are horizontal or rise to the east. It seems probable that the anticline disappears soon after entering West Virginia, if it crosses the State line at all. A low anticline which is seen just east of Blacksville probably has no connection with this fold, but is the north end of another axis.

The Pittsburg coal, which is the reference stratum on which the structure contour lines are drawn, is at an elevation of 1,000 feet at the point where the Bellevernon anticline crosses Monongahela River between Bellevernon and Charleroi; it is 750 feet above tide at Clarksville and only 400 feet above tide at Blacksville. It should be noted that conditions are favorable for the accurate determination of the position of the reference stratum along the Bellevernon anticline in Greene County. The Waynesburg coal outcrops on Tenmile Creek from Monongahela River to Waynesburg, and the interval between it and the Pittsburg coal is known. Moreover, the depth of the Pittsburg coal below the surface is shown in 140 deep wells located along the anticline, and when the elevation of the well mouths is known the elevation of the reference stratum above mean sea level is easily determined. It is believed that the true position of the Pittsburg coal at any point on the west flank of the anticline down to the 400-foot contour line varies scarcely more than 10 feet from the position indicated on the map.

The eastern slope of the Bellevernon anticline is short and gentle in the region of the greatest development of the Waynesburg gas field. From the crest of the fold near the mouth of Braden Run on Tenmile Creek to the bottom of the Whiteley syncline on Muddy Creek is a fall of scarcely more than 200 feet. From the same point to the axis of the Waynesburg syncline on the west the Pittsburg coal descends fully 400 feet. The regularity of the western flank of the Bellevernon anticline is shown by the contour lines on the map.

WAYNESBURG SYNCLINE.

The structural basin which lies west of the Bellevernon anticline was called the Waynesburg syncline by Stevenson.[a] He located the axis somewhat farther east than is shown on the accompanying map, but the basin is essentially the same as that described by him, and

[a] Second Geol. Survey Pennsylvania, Rept. K, 1876.

hence the name is retained. The axis is continuous with that of the Pigeon Creek syncline, described in the Brownsville-Connellsville folio (No. 94). When the Brownsville quadrangle was surveyed it was recognized that the Pigeon Creek and Waynesburg synclines might be one and the same, but mine data in the vicinity of Bentleyville, Washington County, seemed to indicate cross structure, and so the basin was given the local name of Pigeon Creek. Subsequent survey of the Amity quadrangle proved that these synclines are continuous, and consequently the name Pigeon Creek is dropped. On Pigeon Creek, Washington County, the Pittsburg coal is 700 feet above tide, while on Wisecarver Run, Greene County, it is at least 400 feet lower.

The axis of the Waynesburg syncline crosses the Washington-Greene county line about a mile west of Castile, Ruff Creek near the mouth of Boyd Run, and Browns Creek at Rees Mill, 2 miles west of Waynesburg. Continuing in a southwesterly direction it intersects South Fork of Tenmile Creek one-half mile above Pursley Creek, then swings southward, strikes Wayne Township near the head of Pursley Creek, turns slightly southwestward, and passes just west of the village of Hoovers Run. It crosses Pennsylvania Fork of Dunkard Creek 1 mile east of Jollytown.

The structure of this basin is determined by the records of several deep wells which show the position of the Pittsburg coal, and in the northern part of the county by the elevation at the surface of the Upper Washington limestone. It is possible that the basin may be somewhat deeper in the vicinity of Waynesburg than represented on the map. A well on the Wisecarver farm, on Wisecarver Run, found the Pittsburg coal about 285 feet above sea level, but the evidence was not sufficient to warrant drawing the 300-foot contour line on the coal. Near the head of Pursley Creek the coal lies about 350 feet above tide, and on the southern boundary of the State its elevation is about 300 feet.

AMITY ANTICLINE.

From the trough of the Waynesburg syncline the rocks rise to the west more gradually than to the east, and a low anticlinal fold enters the county in the northwest corner of Washington Township. This fold has been traced northward into Washington County beyond the village of Amity and is named from that place. Stevenson and White called it the Pinhook anticline, from a locality in Amwell Township, Washington County. The name was taken from a burlesque appellation of the little village of Lone Pine, and for that reason it is not suitable for geologic nomenclature. Where the fold enters Greene County from the north its crest is probably not more than 100 feet above the axis of the Waynesburg syncline, but it rises

rapidly in Washington County and becomes a more pronounced structural feature.

According to deep-well records the Pittsburg coal is about 475 feet above sea level on the crest of the Amity anticline at the point where it crosses the northern border of the county. One mile east of Hackneys, Washington County, where the axis crosses Tenmile Creek, its elevation is 495 feet. At Amity it is about 550 feet and at Lone Pine about 650 feet. In the vicinity of Swarts the Amity anticline turns directly southward, but at Browns Creek it veers slightly to the southwest and passes almost directly through the town of Rogersville, near which it seems to die out. At Rogersville the coal is probably less than 350 feet above sea level. West of the Amity anticline the rocks dip with a medium grade to the bottom of the Nineveh syncline.

By reference to the structure map (Pl. I) a dome-like arrangement of the contours is seen nearly in line with a continuation of the Amity anticline in the vicinity of Buzz, Bluff, and White Cottage, suggesting a continuation of the anticline in this part of the county. The structure is not definitely known here on account of a lack of well records, but from the evidence gathered in tracing local limestones and associated beds on the surface it seems to be about as represented on the map. The Pittsburg coal is about 400 feet above sea level just east of White Cottage and about the same altitude 1 to 2 miles southeast of Bluff. Over a considerable area between White Cottage and Pursley Creek the structure is rather flat. South of this area there is a faint continuation of the anticlinal arch to the State line, but the rocks are descending, the coal being 342 feet above sea in a well on Blockhouse Run and 331 feet on Garrison Fork of Dunkard Creek. The arch is here barely 50 feet above the bottom of the adjacent syncline on the east.

NINEVEH SYNCLINE.

This is one of the most pronounced troughs in Greene County. It was recognized and named by Stevenson in 1876. It enters the county in Morris Township and takes a course averaging S. 40° W., but varies 25° from this course. It passes just west of Nineveh, 1 mile west of Rutan, 1 mile southeast of Bristoria, 1 mile northwest of Higbee, and nearly through Aleppo and Morford.

The Nineveh syncline is located about the center of the Appalachian basin, of which it is one of the deepest troughs. At two points, near Rutan and in the vicinity of Morford, the Pittsburg coal at the center of the basin is only about 100 feet above sea level. The Morford depression is very small and rather hypothetical, but the Rutan basin contains one well in which the coal was found as low as 95 feet above sea level. The location of the axis of the Nineveh syncline is

better determined than any of the other axes in this part of the county, as numerous wells have been drilled on both sides of it for a great part of its course. Between Aleppo and Lick Run especially it is clearly defined by the wells of the Bristoria and the north end of the New Freeport oil fields. The mapping at Nineveh is likewise very close. At the northern edge of the county, between Rutan and Nineveh, and southwestward from Aleppo, however, it has been necessary to interpolate the coal contours entirely on the basis of surface rocks. With the exception of the two deep basins mentioned above, the coal in the bottom of the Nineveh syncline lies in general between 100 and 200 feet in elevation. North of Nineveh it is rising and on the edge of the county attains an altitude of about 300 feet.

East of the Nineveh axis the structure is rather diverse. In the vicinity of Nineveh there is a fairly uniform rise to the crest of the Amity anticline, but south of this place the anticline dies out and the dips grow more gentle. In western Gilmore and southwestern Jackson townships is an area of 15 to 20 square miles in which little can be determined of the structure, as rock exposures are poor and no wells have been drilled. From indications gathered along the eastern border of the New Freeport gas field and from the records of two wells in southern Gilmore Township there seems to be a slight depression here, like the north end of a syncline which may possibly develop to the south, but nothing is known of this basin outside of Greene County. Between New Freeport and Triumph, in the depression mentioned, the Pittsburg coal is less than 240 feet above sea level. The small anticline separating this minor basin from the Nineveh syncline is well marked, passing directly through New Freeport and thence continuing in a southwesterly direction. On the west side of the Nineveh axis from Bristoria southward to Fish Creek the positions of the 200- and 250-foot coal contours are in places well determined, owing to the great oil development in this locality. Northwest of Deep Valley and northwest of Morford the dips of the surface sandstones and limestones seem to indicate two small domes in the structure. In the southwest corner of the county the positions of the contours are fairly well determined, owing to a few scattering wells.

West of the Nineveh syncline throughout its entire length the rocks rise rapidly to the crest of the Washington anticline. The greatest rise is between Rutan and Jacksonville, and amounts to 600 feet.

WASHINGTON ANTICLINE.

This fold is a prominent structural feature. Stevenson named it in 1876 from the town of Washington, near which it passes and from which it extends southwestward, entering Greene County in Richhill Township near Simpson Store. Thence it sweeps to the west in a fairly regular curve, passing through Jacksonville and just southeast of Ryerson Station, and thence into West Virginia with a course S. 60°–70° W. The elevation of the Pittsburg coal on the axis of this arch varies from 480 to 705 feet above tide.

The most prominent feature of the fold in this county is a roughly triangular dome, having its center at Jacksonville. North of this dome the axis plunges to the vicinity of Simpson Store, where the elevation of the coal is about 480 feet, but beyond this place it rises again.

The grade along the southeastern flank of the Washington anticline in general averages 100 feet per mile, but between Graysville and Bristoria it amounts to 250 feet per mile. In this region and as far north as Enslow Fork of Wheeling Creek the contours are rather accurately placed, being determined by logs of wells in the Richhill gas field.

The dips on the western flank of the Washington anticline are much more gentle. Information about the structure of this part of the county has been derived from outcrops of the Waynesburg and Washington coals on Crabapple Creek and Enslow Fork and from a few limestone and sandstone beds. There are a few scattering wells in this vicinity. The dip of the rocks rarely exceeds 100 feet per mile and in some places is less than 50 feet. West of Jacksonville a spur of the anticline shoots off to the northwest, reaching as far as the western edge of the county.

OIL AND GAS SANDS.

INTRODUCTION.

In western Pennsylvania all oil and gas yet discovered have been produced from beds of sandstone, or "sands," as they are called by the drillers. The beds penetrated have been given various designations from time to time, and these terms have gradually come into common usage as descriptive of the beds. In order to show their general relations the following table has been prepared, giving the drillers' terms, the corresponding geologic terms, and the formation to which the sands belong:

Drillers' terms for oil and gas rocks, etc., and their geologic correlation.

Formation.	Name applied by drillers.	Geologic name.	Approximate maximum thickness.	Correlation with sands in neighboring fields.
			Feet.	
Washington	Washington coal	Washington coal	3	
	Bluff sand	Waynesburg sandstone.	60	
Monongahela	Waynesburg coal	Waynesburg coal	5	
	Mapletown coal	Sewickley coal	8	
	Pittsburg coal	Pittsburg coal	10	
Conemaugh	Murphy sand	Morgantown sandstone.	30	
	Little Dunkard sand	Saltsburg sandstone	100	
	Big Dunkard or Hurry-up sand.	Mahoning sandstone	150	
Allegheny	Upper Freeport or Connellsville coal.	Upper Freeport coal	6?	
Pottsville	Gas sand[a]	Kittanning, Clarion, or Homewood sandstone.	150	
	Salt sand	Conoquenessing or Pottsville sandstone.	200?	
Mauch Chunk	Red rock or shale	Mauch Chunk shale	150	
	Little lime (or Salvation sand).	Greenbrier limestone	100	Maxton sand.
	Pencil cave			
	Big lime			
Pocono	Big Injun sand	Burgoon sandstone	300	Mountain sand.
	Thirty-foot sand		100	Berea sand.
	Gantz sand		40	First sand Hundred-
	Fifty-foot sand		60	foot sand.
Devonian	Nineveh or Nineveh thirty-foot sand.		40	
	Red rock		20	
	Gordon Stray sand		40	Gray, Bowlder, or Campbells Run sand.
	Gordon sand		100	Third or Flat Run sand.
	Fourth sand		40	
	Fifth sand		40	McDonald sand.
	Bayard sand		12	Sixth sand.
	Elizabeth sand		10	

[a] When this name refers to the Kittanning or the Clarion sandstone it designates a part of the Allegheny formation.

Oil and gas are found in Greene County in paying quantities at several horizons. The oil sands are the Dunkard, Big Injun, Gantz, Fifty-foot, Nineveh, Gordon, and Fourth. The important gas sands include those just given and, in addition, the Salt, Fifth, Bayard, and Elizabeth sands. In using the driller's designations of the various beds, it is not supposed that all of them are in reality continuous

sandstone beds underlying the entire area. That is true of a few beds such as the Big Injun and Salt sand, but if the extent of the others is anything like that of sandstone beds covering large areas of the surface in western Pennsylvania, they are generally lentils in the formation rather than distinct beds by themselves. In order to show the occurrence of the various sands 21 deep-well sections are given in Pl. II and the correlations of the various beds are indicated.

Knowledge of the sands is necessarily fragmentary, but the records of a large number of wells in the territory have been obtained and compared, and from them considerable information has been compiled regarding the thickness, intervals, and productiveness of the various beds. As the Pittsburg coal, which underlies the entire region, is easily recognized and is used by drillers as a datum surface in measuring to the various beds, the position of the sands will be referred to it.

In order to give a general idea of the sequence of sands to be described, the following table is given, showing the maximum, minimum, and average distances from the Pittsburg coal to the top of the well-known sands.

Distances from Pittsburg coal to gas sands in Greene County.

Sand.	Maximum.	Minimum.	Average.	Sand.	Maximum.	Minimum.	Average.
	Feet.	*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*
Murphy	232	170	211	Fifty-foot	2,044	1,902	1,937
Dunkard	575	390	478	Nineveh	2,121	1,997	2,051
Gas	856	674	765	Gordon	2,227	2,070	2,157
Salt	1,035	860	932	Fourth	2,298	2,140	2,230
Big Injun	1,345	1,073	1,221	Fifth	2,365	2,225	2,292
Thirty-foot	1,845	1,744	1,795	Bayard	2,464	2,388	2,433
Gantz	1,965	1,813	1,916				

DESCRIPTION OF SANDS.

MURPHY SAND.

In the western half of the county a sandstone called the Murphy sand is frequently reported by drillers. It generally occurs from 170 to 200 feet below the Pittsburg coal, but in Springhill Township the distance is as much as 220 feet. This sand runs from 5 to 30 feet in thickness and in exceptional cases reaches 70 feet. It corresponds approximately in stratigraphic position with a prominent surface sandstone known in southwestern Pennsylvania and northern West Virginia as the Morgantown sandstone, from the city of Morgantown, W. Va.

DUNKARD SAND.

According to identifications by various drillers in different parts of the county, the Dunkard sand lies from 300 to 575 feet below the Pittsburg coal, and its thickness ranges from 40 to 150 feet. In the

eastern part of the county some drillers find a small break in this sandstone, and in the western part it consists of two quite distinct beds, the upper and lower divisions being known as the Little and Big Dunkard sands. The name is taken from Dunkard Creek, near the mouth of which some producing oil wells were struck in this sand about 1863. The wells at Willow Tree and in the Garrison oil field, 2 miles south of Willow Tree, are producing oil from the Dunkard sand. In other areas this sand is generally unproductive, although in several townships it has shown traces of oil or gas. In the western part of the county the Big Dunkard is frequently called the Hurry-up sand.

GAS SAND.

The Gas sand is not important, but several wells produce gas from it in the Richhill field, between Durbin and Owens Run. In some places it holds considerable salt water. The position of this sand varies, according to different well records, and it is possible that there are a number of sandstones at this horizon, any one of which may be called the Gas sand. The average depth below the Pittsburg coal is about 765 feet.

This sandstone may be regarded as the Homewood, the uppermost member of the Pottsville formation, or as the Clarion, at the base of the Allegheny formation. Its recorded thickness ranges from 15 to 140 feet, the variations being due in part to undoubted changes in the amount of sandstone present at this horizon and in part to a tendency on the part of the driller to class everything as sandstone for a considerable distance, when in reality it may be much broken by shale beds.

SALT SAND.

The Salt sand is so named because salt water is often encountered in drilling through it. In the Richhill field and in several wells on the crest of the small anticline south of Deep Valley it produces considerable gas, and smaller quantities are occasionally found in it elsewhere in the county.

This sand is about 930 feet below the Pittsburg coal, and, according to the records in hand, varies in thickness from 15 to 175 feet. It should be noted that in Greene County the Salt sand lies above the Big Injun sand, while in Armstrong County the same name is used for a gas-bearing stratum below the Big Injun.

Those records which give a thickness of over 100 feet for either the Gas or the Salt sand omit mention of the other, which shows that possibly both sands, being but little separated, have been included under one name.

SALVATION SAND.

The Salvation sand is equivalent to the Maxton sand of West Virginia. It is reported only in Aleppo and Springhill townships, where it lies above the Big lime, separated from it only by the Pencil cave. Elsewhere in the county this horizon is represented by the Little lime. The sand is generally unproductive, but a number of wells in Springhill Township, on the small anticline south of Deep Valley, produce gas from it.

BIG INJUN SAND.

The Big Injun sand rock is always recognized by the drillers from its thickness and position. It is usually from 250 to 300 feet thick, and, as shown by the records of over 500 wells scattered through the county, lies at an average of about 1,220 feet below the Pittsburg coal, ranging from 1,073 to 1,345 feet. In a general way the distance decreases northwestward from Dunkard and Perry townships to Richhill Township. In the following table the maximum, minimum, and average distances are given for the townships in the eastern half of Greene County:

Distances from Pittsburg coal to Big Injun sand in eastern Greene County.

Township.	Number of wells.	Minimum.	Maximum.	Average.
		Feet.	*Feet.*	*Feet.*
Perry	5	1,240	1,345	1,278
Dunkard	8	1,250	1,295	1,276
Wayne	56	1,217	1,316	1,268
Whiteley	6	1,230	1,305	1,257
Franklin	47	1,152	1,270	1,224
Jefferson	6	1,180	1,265	1,219
Washington	4	1,184	1,220	1,209
Morgan	7	1,185	1,220	1,205

Cumberland, Greene, and Monongahela townships are omitted from the list because of lack of evidence. The writers know of only 6 wells in Cumberland Township, 5 of which are dry. The record of only one of these, the Biddle well (31), at Carmichaels, is at hand, and shows that the Big Injun sand was found 1,241 feet below the Pittsburg coal and carries a small amount of gas. Many holes have been sunk in the eastern part of Greene Township, but almost all are shallow-sand wells. In Monongahela Township wells have been drilled at frequent intervals along Whiteley Creek, but most of them are shallow. A number of wells on Monongahela River begin below the Pittsburg coal, and of the others it is difficult to obtain records.

The intervals for the western half of Greene County are given by fields rather than by townships, because the records of neighboring groups of wells show considerable variation in the same township and

the amount of information available makes the finer discrimination of areas possible.

Distances from Pittsburg coal to Big Injun sand in western Greene County.

Field.	Number of wells.	Minimum.	Maximum.	Average.
		Feet.	*Feet.*	*Feet.*
Fonner	9	1,158	1,235	1,183
Rogersville and Deerlick	4	1,120	1,225	1,177
Nineveh	11	1,168	1,213	1,194
Grays Fork	5	1,147	1,215	1,174
Richhill	18	1,073	1,215	1,149
Wright Run	3	1,200	1,234	1,215
Sugar Grove	8	1,119	1,210	1,162
Aleppo	13	1,215	1,248	1,227
Bristoria	124	1,180	1,280	1,221
Woodruff	7	1,203	1,268	1,236
Gilmore	3	1,275	1,283	1,280
New Freeport	162	1,171	1,265	1,234
Board Tree	5	1,240	1,269	1,250

It will be seen from the figures given in the tables that the interval decreases to the northwest. In other words, the average interval in

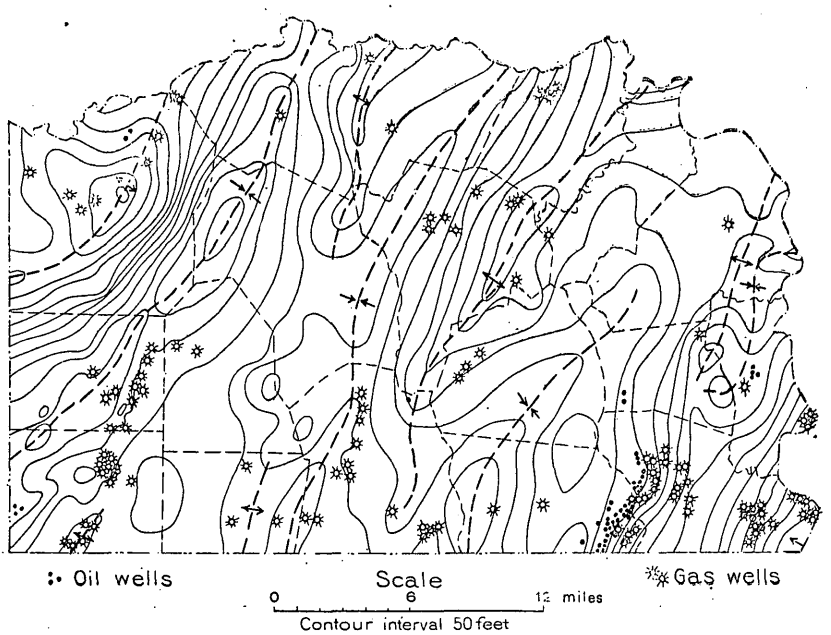


FIG. 2.—Structure map of oil and gas in Big Injun sand.

the southeast quarter of the county is over 1,270 feet and in the northwest quarter less than 1,200 feet. This decrease in distance between the Pittsburg coal and Big Injun sand is due to the thinning of the Mauch Chunk formation, as described in the section on stratigraphy (p. 18).

The Big Injun sand is generally expected to carry some gas. It does so in Morgan, Franklin, Richhill, and Dunkard townships, and in the New Freeport field. In the Hoovers Run field and in scattering

wells in Gilmore Township it ranks next to the Fifth sand as a gas producer. In the Mount Morris and Board Tree fields the Big Injun produces oil and, on the margins of some of the oil pools, gas.

The accompanying sketch map (fig. 2) of the geologic structure in Greene County shows the distribution of gas and oil in the Big Injun sand, so far as it can be determined from the records in hand. This map and those which follow (figs. 3–6) are necessarily somewhat incomplete, because many records fail to state which is the producing sand. Fig. 2 indicates the wide distribution of Big Injun gas throughout the county and shows particularly the structural relation of the Mount Morris oil pool.

SQUAW SAND.

An unproductive sand, usually less than 50 feet thick, is infrequently reported at distances varying from 50 to 150 feet below the base of the Big Injun. Wherever found it is known as the Squaw sand.

THIRTY-FOOT SAND.

The first sand commonly recognized below the Big Injun in Greene County is the Thirty-foot. Its distance below the Pittsburg coal varies from 1,729 to 1,882 feet. So far as known, it does not produce oil or gas anywhere in this county, nor can it be recognized by its thickness, as in that particular the well records show variations from 20 to 100 feet. In the Rebecca Hook (51) and John Miller (53) wells in the Waynesburg field the recorded thickness is 120 feet, but these records include in the Thirty-foot in one case the overlying shale and in the other probably the Gantz sand. In this county the Thirty-foot sand is not the same as the Thirty-foot in Butler and Armstrong counties, but probably corresponds with what is sometimes known there as the Gas, Butler, or Murrysville sand. It agrees closely with the Berea sand of Beaver County, Pa., Jefferson County, Ohio, and Brooks County, W. Va. It is sometimes difficult to decide whether a sand noted as Thirty-foot in well records is in reality the Thirty-foot, Gantz, or some local sand, but this question can generally be answered by noting the positions of the red beds encountered by the drill. Between the Thirty-foot and Gantz sands lies a thin bed of red shale which is found in the wells of Washington County and generally in western Greene County, and which has been provisionally correlated with the Bedford shale of Ohio. The next lower red bed occurs 100 to 200 feet deeper, at the horizon of the Nineveh sand.

GANTZ SAND.

The Gantz sand is struck in the northern part of the county at distances varying from 1,870 to 1,946 feet below the Pittsburg coal. It takes its name from a well on the Gantz farm at Washington,

which was drilled in 1885 and was the first paying oil well in Washington County. The sand was found 1,827 feet below the Pittsburg coal, the interval being less than in Greene County because of the disappearance of the Mauch Chunk shale toward the northwest. The Gantz sand is usually 10 to 25 feet thick. It produces oil and some gas in the Fonner field in Morris Township and is the principal gas sand in the vicinity of Clarksville.

FIFTY-FOOT SAND.

A producing sand which closely underlies the Gantz sand and in many places merges with it is known as the Fifty-foot. Here and there the interval between them amounts to as much as 40 feet, but in the western half of the county the two sands run together and in that region are nearly always reported as the Fifty-foot. Frequently where the two sands are separated only by a thin shale they are recorded as continuous. These sands correspond in horizon with the Hundred-foot sand in Butler, Armstrong, Beaver, and other counties.

The distance of the Fifty-foot below the Pittsburg coal in the western half of the county varies from 1,900 to 2,034 feet. The figures for the various townships are given in the following table:

Distances from Pittsburg coal to Fifty-foot sand.

Township.	Number of wells.	Minimum.	Maximum.	Average.
		Feet.	*Feet.*	*Feet.*
Richhill	35	1,900	1,992	1,954
Morris	16	1,905	1,966	1,948
Washington	4	1,930	1,997	1,953
Morgan	10	1,915	1,995	1,963
Franklin	31	1,920	2,000	1,955
Center	13	1,907	1,995	1,951
Jackson	77	1,930	1,995	1,968
Aleppo	96	1,913	2,021	1,978
Springhill	115	1,952	2,034	1,982
Wayne	35	1,920	1,980	1,950
Whiteley	6	1,925	1,975	1,954
Jefferson	4	1,952	1,995	1,973

The distance of the Fifty-foot sand below the top of the Big Injun varies from 624 to 845 feet, as shown in the following table:

Distances from top of Big Injun to Fifty-foot sand.

Township.	Number of wells.	Minimum.	Maximum.	Average.
		Feet.	*Feet.*	*Feet.*
Richhill	31	690	845	762
Morris	11	710	815	754
Washington	6	715	805	761
Morgan	10	715	810	745
Center	13	715	772	755
Jackson	75	686	765	745
Aleppo	96	690	835	756
Franklin	30	690	800	731
Jefferson	3	730	765	746
Springhill	112	675	805	743
Gilmore	1			706
Wayne	33	624	725	684
Whiteley	4	704	735	715

In view of the fact that the interval between the Pittsburg coal and the Big Injun sand decreases from south to north, it is interesting to note from the above table that the interval between the top of the Big Injun and the top of the Fifty-foot increases in the same direction. This southward thinning of the rocks below the Mauch Chunk about compensates for the above-mentioned northward thinning.

NINEVEH SAND.

The Nineveh sand occurs from 60 to 150 feet below the top of the Fifty-foot sand. It may be either white or red and ranges from 10 to 40 feet in thickness. It is the principal producing sand of western Greene County. In the Nineveh, Grays Fork, Bristoria, and Spring-

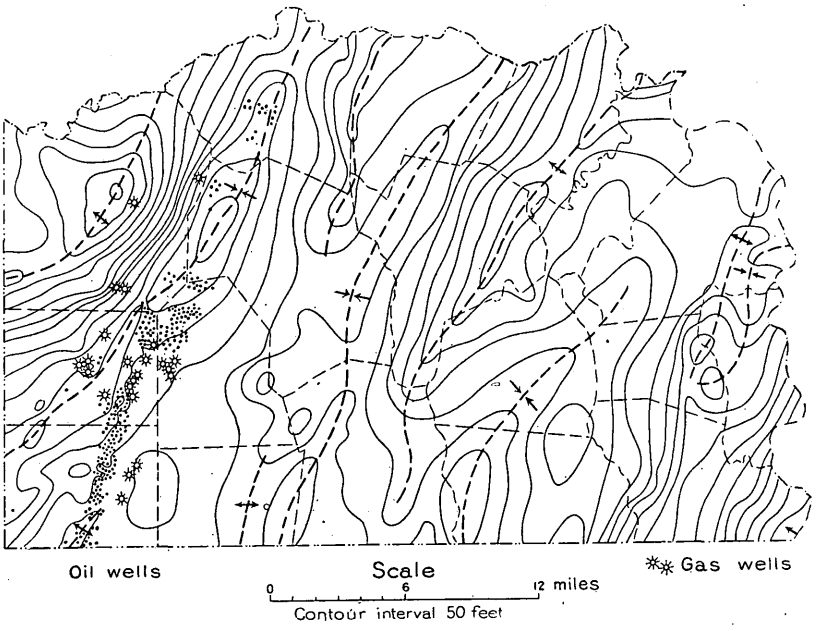


FIG. 3.—Structure map of oil and gas in Nineveh sand.

hill fields it is the principal oil sand and locally holds gas. One gas well is reported from it in Gilmore Township and it contains traces of gas elsewhere. Fig. 3 shows the present development of oil and gas in this sand.

The Nineveh sand has been erroneously called the "Gordon" and sometimes the "Gordon Stray" over the greater portion of the Nineveh district, as explained on pages 44–45 of this bulletin and in greater detail by F. G. Clapp in a paper on "The Nineveh and Gordon oil sands of western Greene County, Pa."[a] It takes its name from the village of Nineveh, in Morris Township, where it was first discovered to be productive. The sand is not reported in the eastern

[a] Bull. U. S. Geol. Survey No. 285, 1906, pp. 362-366.

part of the county. Red rock, commonly found directly below this sand, aids in identifying it. It lies from 1,997 to 2,121 feet below the Pittsburg coal, as shown in the following table. On account of mistaken identification in most of the original records, it was necessary to change the original names of the sands to the correct ones before calculating the averages.

Distances from Pittsburg coal to Nineveh sand.

Township.	Number of wells.	Minimum.	Maximum.	Average.
		Feet.	*Feet.*	*Feet.*
Morris	6	2,028	2,110	2,055
Richhill	32	1,997	2,054	2,036
Center	8	2,005	2,120	2,039
Jackson	66	2,024	2,065	2,044
Aleppo	101	2,018	2,098	2,056
Wayne	2	2,033	2,045	2,039
Gilmore	2	2,065	2,113	2,089
Springhill	116	2,033	2,121	2,053

GORDON STRAY SAND.

The Gordon Stray is a thin sand occurring in places a short distance above the true Gordon and at varying distances below the red rock associated with the Nineveh sand. The name has been often applied to the Nineveh, but such usage is obviously incorrect, as the Nineveh and Gordon sands are separated by red rock. The Gordon Stray seems to be the least definite of any of the commonly recognized sandstone beds; it may be either a split from the Gordon or a new sand. In the Delphene field and at a few isolated points elsewhere it produces gas. In the small Wright Run field, at several scattering points in the Bristoria field, and in one or two wells in the Board Tree field it produces oil.

GORDON SAND.

The Gordon sand lies at an average distance of 2,159 feet below the Pittsburg coal, or 200 feet below the top of the Fifty-foot sand, and is from 15 to 20 feet thick. In places it produces small amounts of gas and oil. The sand is usually recorded in wells which reach its depth.

As explained above, the term "Gordon" has been generally applied in western Greene County to the Nineveh sand, but such usage is incorrect. Also the Gordon has been erroneously called the "Fourth" sand by many drillers in the district. The Gordon is not generally productive in this area, but contains gas at one or two wells in western Aleppo Township and in southeastern Center Township, one or two in the midst of the Bristoria field, and a number of wells in the Richhill, Hoovers Run, and Waynesburg fields. Oil is found in

it in one or more wells in the Board Tree field, in one well on the southeastern edge of the Bristoria field, and in several wells on the western edge of the New Freeport field, in southern Aleppo Township.

Fig. 4 shows the location of the wells in which gas and oil have been found in the Gordon and Gordon Stray sands and their relation

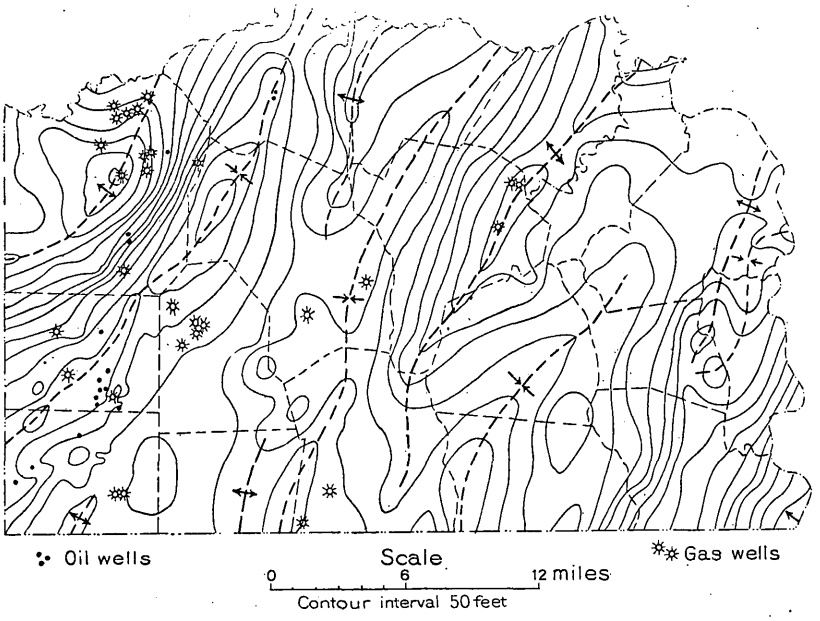


FIG. 4.—Structure map of oil and gas in Gordon and Gordon Stray sands.

to the approximate structure of the sand. In the following table the distances from the Pittsburg coal to the top of the Gordon sand are given:

Distances from Pittsburg coal to Gordon sand.

Township.	Number of wells.	Minimum.	Maximum.	Average.
		Feet.	*Feet.*	*Feet.*
Richhill	17	2,094	2,155	2,136
Morris	6	2,100	2,144	2,133
Washington	4	2,144	2,222	2,169
Morgan	4	2,145	2,184	2,163
Jefferson	1			2,205
Franklin	40	2,086	2,205	2,143
Center	8	2,083	2,170	2,127
Jackson	16	2,070	2,175	2,111
Aleppo	30	2,110	2,183	2,157
Springhill	8	2,130	2,205	2,166
Gilmore	3	2,177	2,189	2,181
Wayne	15	2,160	2,227	2,203
Whiteley	2	2,130	2,165	2,148

It will be seen by this table that so far as can be told from average intervals by townships there is no marked irregularity in the position of the Gordon sand with relation to the Pittsburg coal.

FOURTH SAND.

Another sand which locally yields small amounts of gas or oil is the Fourth sand. It is reported at distances varying from 2,154 to 2,316 feet below the Pittsburg coal and from 20 to 120 feet below the top of the Gordon sand. Its thickness ranges from 7 to 20 feet. The irregularity and occasional running together of the Gordon Stray, Gordon, and Fourth sands classes them as a group (the Gordon group) rather than as entirely distinct beds of sand.

In the Aleppo oil field the Fourth is the principal producing sand, and a number of wells have been drilled to it. Gas is produced from it at several wells on the borders of the New Freeport oil field, south of New Freeport and Deep Valley, and at some scattering wells in the Hoovers Run field and in Franklin, Jackson, and Richhill townships.

FIFTH SAND.

The great gas producers in Greene County are the Fifth and Bayard sands. Practically all wells in the eastern part of the county,

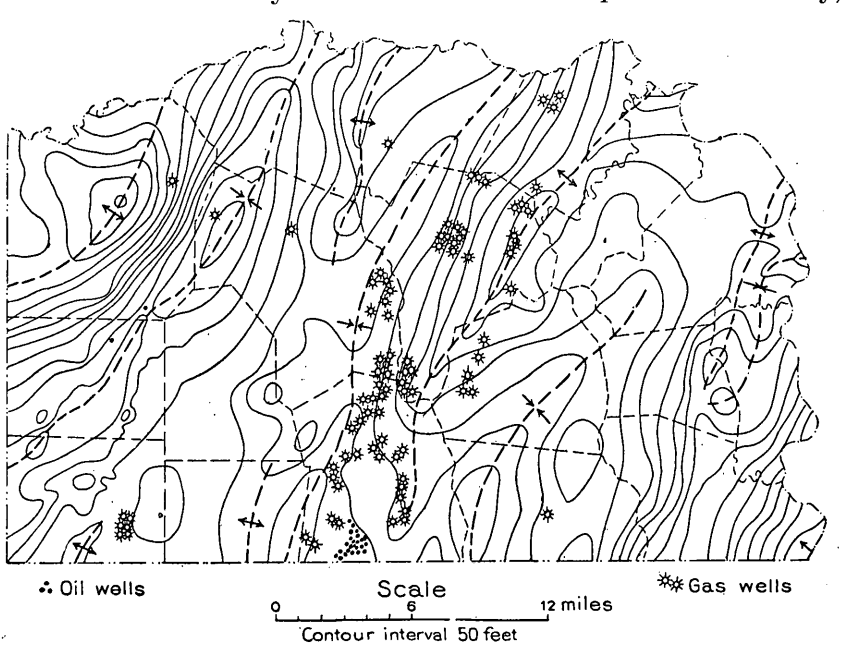


FIG. 5.—Structure map of oil and gas in Fifth sand.

except those in Dunkard, Greene, and Monongahela townships, are sunk to one or both of these beds. The Fifth sand lies from 2,225 to 2,365 feet below the Pittsburg coal and ranges in thickness from 10 to 65 feet. It is known to some drillers as the McDonald sand, from the town of McDonald, Washington County. This sand yields some gas in the northern part of Morgan Township and in the Waynes-

burg field, and is the principal source on Pursley Creek and Hoovers Run. In the Hoovers Run field the Fifth sand occasionally goes by the name of Gas sand and in several instances has been called Gordon. In the Lantz field the Fifth sand yields oil from two pay streaks. Oil was found in this sand in one well at Waynesburg and also in the Aleppo field. Few of the wells in the western half of Greene County have gone deep enough to reach the Fifth sand, but it is known to yield gas in one well in Richhill Township and in two wells in northern Center Township.

The location of wells producing oil and gas from the Fifth sand is shown in fig. 5. Probably other wells in Franklin and Morgan townships found gas in the Fifth sand, but it was in small amount in comparison with the yield from the Bayard sand and the records do not mention the fact. A discussion of the curious relation of the oil and gas to the structure in Wayne Township will be found on page 82. The position of the Fifth sand with relation to the Pittsburg coal is shown in the following table:

Distances from Pittsburg coal to Fifth sand.

Township.	Number of wells.	Minimum.	Maximum.	Average.
		Feet.	*Feet.*	*Feet.*
Richhill	6	2,230	2,270	2,242
Morris	4	2,270	2,283	2,276
Washington	4	2,275	2,345	2,309
Morgan	5	2,292	2,365	2,316
Franklin	44	2,258	2,355	2,318
Center	8	2,225	2,335	2,260
Jackson	4	2,232	2,325	2,271
Aleppo	1			2,275
Springhill	1			2,294
Gilmore	2	2,335	2,352	2,344
Wayne	45	2,269	2,339	2,300
Whiteley	5	2,282	2,325	2,295

This table shows that in the eastern half of the county, at least, there is a marked parallelism between this sand and the coal, for in five townships the average distances vary only 23 feet. The following table shows the relation of the Fifth sand to the Big Injun in townships where it is reported:

Distance from top of Big Injun to Fifth sand.

Township.	Number of wells.	Minimum.	Maximum.	Average.
		Feet.	*Feet.*	*Feet.*
Morris	3	1,076	1,155	1,115
Morgan	5	1,075	1,150	1,109
Washington	4	1,075	1,129	1,101
Franklin	39	1,015	1,200	1,084
Center	9	1,035	1,112	1,075
Richhill	5	1,018	1,102	1,066
Jackson	3	1,035	1,086	1,059
Wayne	45	970	1,101	1,033
Whiteley	10	1,020	1,055	1,043

The figures in this table show a decrease in the interval from north to south. It is shown on page 34 that the interval from the Pittsburg coal to the Big Injun sand decreases in the opposite direction, owing to an unconformity in the Mauch Chunk. A comparison of these intervals in six townships which form a broad area from the northern to the southern boundary of the county is as follows:

Average distances from top of Big Injun sand to Pittsburg coal and Fifth sand.

Township.	Pittsburg.	Fifth.	Total.
	Feet.	*Feet.*	*Feet.*
Morris	1,183	1,115	2,298
Washington	1,209	1,101	2,310
Center	1,208	1,075	2,283
Franklin	1,224	1,084	2,308
Wayne	1,268	1,033	2,301
Whiteley	1,257	1,043	2,300

The total of average distances for each township shows a rather striking parallelism between the Pittsburg coal and the Fifth sand in this part of the county. It must not be inferred, however, that this regularity is at all constant in other sections. In western and northwestern Greene County the unconformity in the Mauch Chunk formation causes all intervals measured from the Pittsburg coal to the lower sands to diminish rapidly toward the north and west.

BAYARD SAND.

In the eastern half of the county gas is found more frequently in paying quantities in the Bayard than in any other sand. In the western half of the county the Bayard horizon has been reached by only a score of wells. Of these, ten report the Bayard present and one found gas in it. A few have past the horizon without recognizing it. Fig. 6 shows the large number of Bayard sand wells in the northeastern part of the county, on the Bellevernon anticline.

In eastern Greene County the distance from the top of the Fifth to the top of the Bayard sand in 60 wells averages 120 feet, and as the logs of the few wells which report the Bayard in the western part of the county record 130 feet between the same beds, the interval seems to be rather constant. The depth below the Pittsburg coal varies from 2,388 to 2,464 feet, averaging about 2,433 feet for five townships in the eastern half of the county, as shown in the following table:

Distances from Pittsburg coal to Bayard sand in eastern Greene County.

Township.	Number of wells.	Minimum.	Maximum.	Average.
		Feet.	*Feet.*	*Feet.*
Washington	3	2,446	2,457	2,455
Morgan	6	2,425	2,460	2,440
Franklin	44	2,388	2,464	2,435
Whiteley	4	2,405	2,430	2,414
Jefferson	3	2,400	2,415	2,405

The thickness of the Bayard sand seems to vary considerably. A few wells have passed completely through it and their logs give 3 to 12 feet as the thickness, except the Eaton well (83) in Jefferson

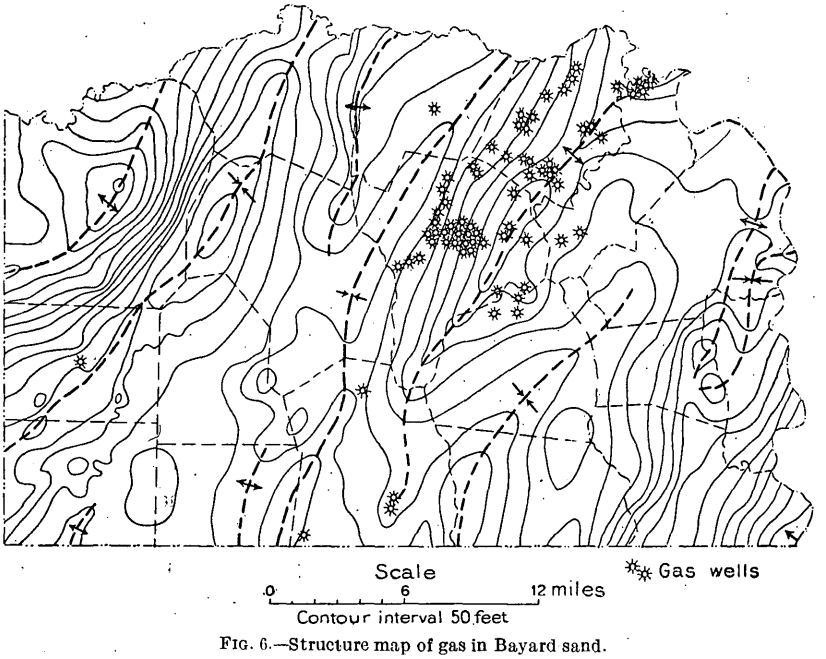


FIG. 6.—Structure map of gas in Bayard sand.

Township, in which 50 feet was recorded. In other wells which stopped when gas was struck and did not go to the bottom of the sand a thickness of 20 to 30 feet is noted. The Bayard is sometimes known as the Sixth sand, although this name has also been applied to the Elizabeth. The name Bayard was introduced in gas-sand nomenclature in February, 1895, when a successful well (167) was completed on the Thomas Bayard farm in Whiteley Township, Greene County.

ELIZABETH SAND.

This term is applied to a sand which carries some gas and is found at depths ranging from 100 to 175 feet below the top of the Bayard. Its thickness as recorded in three logs is not more than 7 feet; it rarely exceeds 10 feet, but in one well 12 feet of it are reported. Probably the number of holes sunk to this sand in Greene County is

less than 15. In the Warren Mankey well (101), near Nineveh, and in several wells farther south, the Elizabeth is reported as a red sand.

DEEPEST WELLS.

The deepest well ever drilled in Greene County is also the second deepest well in the United States. It was drilled in 1904 on the Benson heirs' farm (203), in western Aleppo Township, and reached a depth of 5,322 feet below the surface, or 4,722 feet below the Pittsburg coal. This well recorded the Bayard sand 7 feet thick at a depth of 3,235 feet below the surface, and below this sand over 2,000 feet of rock are reported only as "shells and slate."

The second deepest well in Greene County was drilled on the Lewis Kuhn heirs' farm (204) in Wayne Township, and reached a depth of 3,780 feet from the surface, or 3,030 feet below the Pittsburg coal. In this well a sand 15 feet thick was struck at a depth of 2,900 feet below the coal. This sand lies several hundred feet below the horizon of the Elizabeth sand and is provisionally correlated with the Speechley sand of Butler and Armstrong counties.

MISTAKEN IDENTIFICATION OF SANDS.[a]

In 1885, when the Devonian rocks were first penetrated by the drill in the oil field at Washington, Pa., the name Gordon was given to a sand about 250 feet below the top of the Gantz sand in a well on the Gordon farm. As drilling progressed southward the names used at Washington were naturally carried into Greene County. Thus it happened that when operations began in the Nineveh field the names Gordon and Fourth were applied to sands which were then believed to be equivalent to the beds called by those names at Washington. In eastern Greene County and in some areas in the western part of the county the names have been correctly used. This is true of a majority of the wells in Wayne Township, of a few in Center, Morris, and Springhill townships, and of most of the wells drilled by the Natural Gas Company of West Virginia in Richhill Township. Few records of other companies in Richhill Township are correctly correlated. Throughout the oil field extending southward from Nineveh beyond the West Virginia line, however, the name Gordon has been erroneously applied to a sand at the very top of the Catskill formation lying between the true Gordon and the Fifty-foot, and the name Fourth has generally been applied to the true Gordon sand. The name Gordon Stray has been used in that field to designate any bed occurring a short distance above what the drillers considered as Gordon.

In studying the stratigraphy of the Amity and Rogersville quadrangles a large number of well records were plotted on a uniform

[a] See also Clapp, F. G., The Nineveh and Gordon oil sands in western Greene County, Pa.: Bull. U. S. Geol. Survey No. 285, 1906, pp. 362-366.

scale and placed side by side in a manner similar to the arrangement on Pl. II (p. 22). A line of wells was taken, beginning at the original Gantz well, near the Gordon well in Washington, and extending southward to the Fonner field in Morris Township and thence to all parts of western Greene County. As can be seen by Pl. II, the Gordon sand was found to maintain its interval of 150 to 200 feet below the top of the Fifty-foot sand and to lie below the sand hitherto called Gordon in the Nineveh oil field.

In Richhill Township the names Nineveh Thirty-foot, Nineveh, or sometimes Thirty-foot, have been variously applied to the sand lying at the top of the Catskill formation. The name was taken from the village of Nineveh, near which the sand has produced oil. These identifications are correct, but for the sake of simplicity the word Nineveh alone will be used in this report. Hitherto the sand has been generally called Gordon throughout the oil field, but has sometimes been called Gordon Stray. The name Gordon sand will here be used in its correct sense as designating the sand more often called Fourth sand in this oil field.

By referring to Pl. II, the correctness of this tracing of the Nineveh sand from Washington into Greene County can be seen. It is not recorded in the Gantz well, but in the Baker well near Lone Pine, 8 miles southeast of Washington, it occurs 102 feet below the top of the Fifty-foot sand. In that region and frequently throughout eastern Washington County the name Gordon Stray is used for this sand. In the Baker well it attains an unusual thickness. The next section in line is that of the Fonner No. 2 well (205) in the Fonner field, Morris Township. In this well the Nineveh sand consists of 13 feet of red sand lying 48 feet below the top of the Fifty-foot, and a second red layer occurs 68 feet below it and a few feet above the Gordon sand. In the John Lewis well (206) in the same township the Nineveh sand was called Gordon, and from this point the sand can be traced almost continuously the whole length of the oil field, being known to the drillers either as Gordon or Gordon Stray.

In this connection the following statements should be made concerning the correlation of sands. It is recognized that the familiar names of gas and oil sands used by the drillers constitute a serviceable terminology, but it should be understood that the names indicate only approximate geologic position and not actual identity of sandstones. It can not be proven that the sands which are given the same name in different fields are continuous beds. In fact, the manner in which sandstone beds showing at the surface locally thin out and are replaced by shale or rocks of other character makes it probable that similar conditions exist in the deeper lying sandstones, so that these gas and oil reservoirs may be large lenses of sandstone rather than continuous beds.

METHOD OF FINDING DEPTH OF SANDS.

In using the contours represented on the structure map (Pl. I) it should be remembered that few beds are exactly parallel, and hence allowance must be made for the increase and diminution of intervals in various directions. The causes of variation are twofold—(1) increase or decrease in thickness of beds due to differences in sedimentation and (2) the marked changes in the Mauch Chunk formation resulting from an unconformity at its top. The thickness of the Mauch Chunk decreases from southeast to northwest.

To get the depth of a sand below the surface at any point find the depth of the Pittsburg coal by substracting its elevation as shown by the structure contours from the elevation of the surface. Add to this the average depth of the sand below the coal as given in the table on page 31, or as given more accurately on a subsequent page in the discussion of that particular sand, and the result will be the approximate depth of the sand below the surface.

DESCRIPTION OF THE OIL FIELDS.

The oil fields of Greene County may be divided into two groups. The first group is in the southeast corner of the county and comprises the Dunkard Creek, Garrison, Whiteley Creek, Blackshire, and Mount Morris fields. The western group is known as the Nineveh district, and includes a belt running from the northeast corner of Morris Township to the West Virginia line south of Deep Valley. This belt follows in a general way the axis of the Nineveh syncline, and consists of the Fonner, Nineveh, Grays Fork, Wright Run, Bristoria, Aleppo, New Freeport, and Board Tree fields. The Lantz field in Wayne Township stands alone.

EASTERN GREENE COUNTY.

DUNKARD CREEK FIELD.

Oil was first discovered in Greene County at a place once known as Bobtown, on Dunkard Creek, between 2½ and 3 miles above its mouth. Bobtown was the location of Maple's woolen mill a generation ago, but the mill has long been abandoned and demolished.

The first well was drilled on the Cephas Wiley farm (207), on the bank of Dunkard Creek, a few hundred feet above the covered bridge, which is 1 mile south of Wiley post-office. This well was begun in 1863 and finished in 1864, and the fact that it produced oil in considerable quantities started active drilling in this locality. Within a year drilling had progressed both up and down the stream,

and between 75 and 100 holes had been sunk to the Dunkard sand. Stevenson wrote of Bobtown in 1876 as being "in the immediate vicinity of a vast number of oil derricks." The oil in this field was found mostly in the Dunkard sand, at a depth of about 450 feet below the Pittsburg coal. Pay streaks carrying heavier oil were found occasionally in the Morgantown sandstone about 175 feet below the coal.

As the Pittsburg coal outcrops along the bank of the creek, the wells were not over 500 feet deep. Well drilling was a new business then and primitive methods were used. Wells were started by digging a hole with pick and shovel to bed rock and putting in a wooden conductor. The process of spudding seems not to have been known at that time. Drilling was done by means of a spring pole, a method which can be used only in "shallow wells." Many of the wells were drilled close to the outcrop of the coal, and all of them were in the flood plain of the creek or but slightly above it. Most of them produced more or less oil, although some wells but a few rods from producing wells proved to be dry holes. The wells yielded very abundantly for a time, but, having been drilled without casing, the soft shales were soon converted to mud by the flow of oil and water, and the holes caved, thus effectually stopping the flow. Had they been properly cased the field might have had a long life.

Several wells in the Dunkard Creek field were pumped for ten years or more. The oil was all barreled and hauled to the mouth of the creek, whence it was shipped by boat to Pittsburg. It is said that the original well netted its owner $40,000. A well was drilled in 1865 on the B. Ross farm which produced a heavy oil from a sand about 175 feet below the Pittsburg coal. Twenty-four barrels of oil a day were pumped from this well for a number of months and sold for $20 a barrel or retailed at 50 cents a gallon.

But few traces remain of this old field at present. In many cases the location of the well holes can be recognized only by a slight depression in the sod of the pasture or by the hollows in which the rig timbers stood. In fact, the Bobtown field is now but a matter of history.

This field is located at a point midway up the flank of the Fayette anticline, where for a short distance the rocks dip less than at any other place between Mount Morris and Monongahela River. Indeed, a slight fold crosses the creek, for the sandstone under the Pittsburg coal is seen dipping eastward at the covered bridge 1 mile south of Wiley. This fold is only a very minor feature in the structure, but may account for the accumulation of oil at this point.

In his report on Greene County, published in 1876, Stevenson[a] gives the following notes on this field:

The productive oil territory begins about 2 miles above the mouth of Dunkard and extends along the line of the creek for barely 2 miles, including the Elliott, Maple, Garrison, Bailey, and Ross farms. For the most part the wells were bored on the bottom, and the curbs are only a few feet below the Pittsburg coal.

Elliott farm: Three wells were bored here, all of which were productive. One of them, the Bobtail, flowed for nearly three weeks, giving an average of 80 barrels per day, but the flow gradually diminished and at last ceased. Its total yield is not far from 5,000 barrels. Only 1 well is now in operation, and that gives to the pump 1 or 2 barrels each day. The oil comes from the lower horizon, about 400 feet below the Pittsburg coal. In each of the wells some oil was found at the upper horizon, but the quantity was very small.

Maple farm: Between this and the Elliott farm wells were bored at several localities, but they proved either insignificant or utterly barren. A great number of borings were made on the Maple farm, and it was the main center of the oil excitement. The yield was extensive, but in the absence of all records I am unable to estimate it even approximately. The Wiley well No. 1 has produced more than 5,000 barrels and still yields a little each day. The Allegheny well at first flowed at the rate of 125 barrels per diem, but the flow gradually decreased until the well ran dry. The Lone Star still yields a small quantity—2 or 3 barrels a week. It flows on provocation, pumping being needed only to stir up the gas. The oil was obtained on this farm at two horizons—175 and 440 to 460 feet below the Pittsburg coal. Salt water was found at various depths, but no tests were made to determine its quality.

Garrison farm: This adjoins the Maple farm northward and includes Deep Run, on which the Butler well was bored. This well, like the Lone Star, flowed upon provocation, and yielded in all about 1,500 barrels. The flow was stopped by caving of the walls. No oil was obtained here at the upper horizon, and very little water, either salt or fresh, was encountered in the boring.

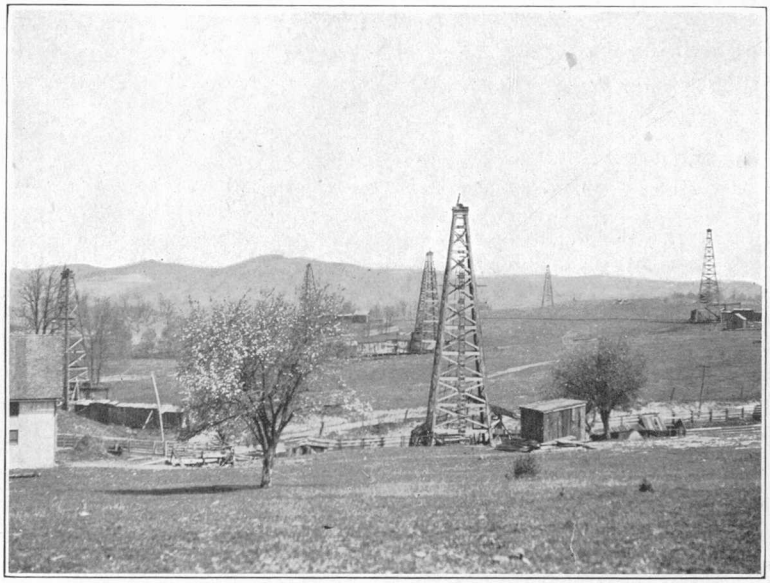
Bailey farm: This adjoins the Maple farm along the creek. Only three wells were bored here. No. 1 found a good supply at the upper horizon and yielded at first from 30 to 40 barrels daily. It now gives only 1 or 2. No. 2 has proved almost unproductive, and No. 3 is known as the "Drywell," as no oil and very little water have been found in it. Good brine, said to be 10°-strong, was obtained from Nos. 1 and 2.

Ross farm: This is next above the Bailey farm on the creek. Of the 15 wells put down here, 12 are on the "bottom" beginning at about 10 feet below the Pittsburg coal. Oil was obtained in large quantities at both horizons. The first well, known as Ross No. 1, flowed 200 barrels during the first day, and then suddenly stopped, as the walls had fallen in. A similar mishap befell several other wells which opened in an equally promising manner. Two are now in operation, which yield 7 to 8 barrels per week from the lower horizon.

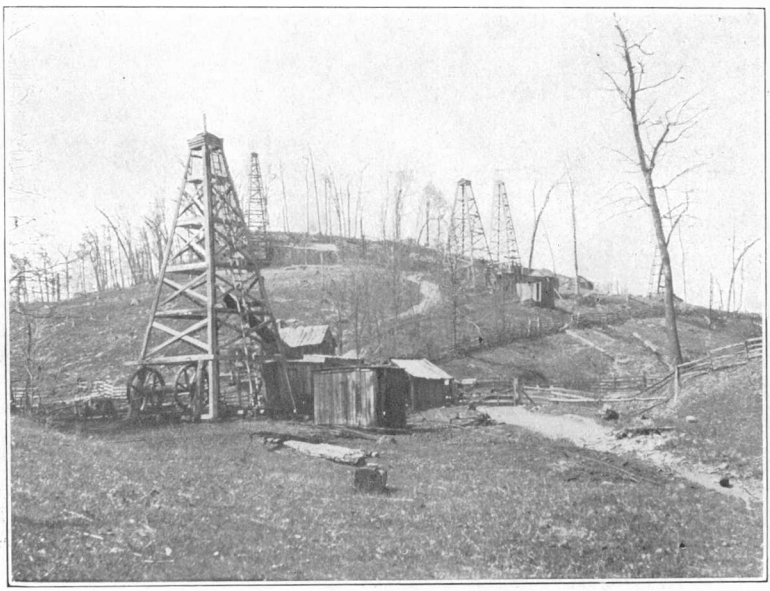
Borings have been made at several localities along the creek above the Ross farm, but they have proved uniformly unsuccessful. As no oil has been obtained at any point below the Elliott farm, it is easy to define the limits, north and south, of the productive territory.

Oil from the upper horizon, 170 to 180 feet below the Pittsburg coal, is uniformly heavy, usually about 32°. The only exception is the Bailey well No. 1, in which the gravity is 40°. The lower horizon, in the Mahoning sandstone, yields a much lighter oil of 40° to 42° gravity. This oil is much valued in the raw condition for cleaning wool, and when reduced by exposure or steaming to about 34° it becomes a lubricating oil of excellent quality. By some of the inhabitants crude oil is used for illuminating purposes. Experience there leads me to assert that it is not well adapted to that use.

[a] Second Geol. Survey Pennsylvania, Rept. K, 1876, pp. 100-102.



A. OIL WELLS ON DONLEY FARM, NORTHERN EDGE OF MOUNT MORRIS VILLAGE.



B. GROUP OF OIL WELLS IN GARRISON FIELD.

Original Tanner well in foreground.

GARRISON FIELD.

After a lapse of several years drilling was attempted again a few miles farther north. In June, 1876, Abner P. Tanner, of Pittsburg, put down a well (208) 2 miles south of Willow Tree, on the Garrison farm, at the point where the highway crosses the run. The result was a 50-barrel well in the Dunkard sand. So great was the excitement that people came from far and near to see it, and it is said that on an occasional Sunday 500 people visited the spot. For twenty-eight years, or until 1904, this well was pumped steadily, the yield falling off gradually until it amounted to so little that the casing was pulled and the well abandoned. Although this well was successful, so far as can be learned no further drilling was done until 1889, when several holes were put down. Of recent years drilling has been going on almost constantly in this vicinity, and there are now about 70 wells in the field, 47 holes having been drilled on the Dan Garrison farm. This field is also known as the Tanner field, in honor of the man who sunk the first well. Pl. III, *A*, shows a group of wells in the Garrison field, with the original Tanner well in the foreground.

The total production at present for this field is about 25 to 30 barrels a day. Out of 47 wells on the Garrison farm, 16 are producing oil at present. Many of the others yielded oil when first drilled, but have been pumped dry. Besides these, 2 wells on the Alfred Harrison farm, 1 on the Sycks farm, 4 on the Cumston farm, and 1 on the Long farm are producing small amounts of oil. For years the oil from this field was hauled to Monongahela River in barrels, but it is now transported by pipe line. Structurally the Garrison oil field is located on a small, gently sloping bench at the south end of the Lambert syncline. It is at the top of the steep grade in the vicinity of Davistown, where the dip changes from more than 100 feet to less than 50 feet to the mile.

WHITELEY CREEK FIELD.

The Whiteley Creek field lies on Whiteley Creek, in the southeast corner of Greene County, about halfway between Whiteley and Mapletown. A well was drilled at Vance's mill (212), at some time previous to 1876, in regard to which Stevenson[a] says:

> This well was bored by Mr. G. Vance, who obtained oil at 120, 368, and 395 feet below the Pittsburg coal. When the lowest horizon was reached, oil of light specific gravity, about 40°, flowed at the rate of 2 barrels per diem; but soon, as in so many other instances in this region, the walls caved and the flow ceased. An attempt to clean it out was made, but was unsuccessful, resulting in the loss of two sets of tools which, with 100 feet of rope,

[a] Second Geol. Survey Pennsylvania, Rept. K, 1876, p. 122.

still remain in the well. Notwithstanding all these obstructions, there is an energetic flow of gas, and oil is obtained whenever pumping is resorted to. Oil from the top horizon was heavy and that from the bottom was light.

In later years 5 or 6 other wells have been drilled at this old mill. The tools stuck in a second well and 1 was dry, but 2 are still being pumped.

In 1885, more than twenty years after the Bobtown development, E. M. Hukill, of Pittsburg, acquired leases covering about 60,000 acres, extending from Rices Landing, on Monongahela River, southward thru Greene County and into Monongalia County, W. Va., as far as Pawpaw Creek. Drilling along this line resulted in the discovery of oil at Willow Tree, on the farm of Stephen Garard, in 1886. The first well on the farm was begun 50 feet below the Waynesburg coal and was drilled to a depth of 2,500 feet without getting oil. A second well (209) was drilled on the same farm, 1,000 feet east of No. 1, and oil was found in paying quantities in the Dunkard sand, which is 450 to 480 feet below the Pittsburg coal in this locality. A small field was developed in the immediate vicinity, a number of other wells being sunk on the Gregg farm (68). Most of these were successful, some yielding as high as 100 barrels of oil a day at the start.

About 1895 J. L. Garard began drilling for oil at Willow Tree and has sunk over 40 wells, most of them within half a mile of the crossroads. Up to the close of 1905 about 50 wells had been drilled in the Whiteley Creek field. About one-third of these were dry; the rest produced oil in varying amounts. Some of the wells which yielded oil at first have gone dry, but nearly half of the wells in the field are being pumped and yield a total of about 80 barrels of oil a day. The producing wells are on the following farms: J. L. Garard (209), 3; J. C. Gregg (68), 10; W. L. Longanecker (210), 8; N. H. Minor (211), 1.

The Whiteley Creek field is located at the south end of the Lambert syncline. Near the oil field is a shallow local basin, with its center about three-quarters of a mile east of Willow Tree. From this point the rocks rise gently in all directions, the most marked rise being to the west. The wells of the Whiteley Creek field are located on this westward rise, the altitudes of the rock strata varying from 30 to 60 feet above their position at the center of the basin. The log of the original Gregg well is given herewith.

Record of Gregg well (68), one-half mile south of Willow Tree.

	Thickness.	Depth.
	Feet.	*Feet.*
Limestone	60	60
Slate and slaty sandstone	30	90
Coal, Mapletown	5	95
Limestone with slaty partings	60	155
Shale, black, and cannel coal	20	175
Sandstone, coarse	50	225
Coal, Pittsburg	9	234
Slate	30	264
Limestone shells	20	284
Slate	40	324
Sandstone, coarse (water)	20	344
Slate	50	394
Sandstone ("First Dunkard")	80	474
Slate, white	70	544
Red rock	70	614
Slate, white	15	629
Sandstone	15	644
Slate, white	40	684
Sand (Dunkard)	30	714
Slate	10	724
Sandstone, white (Mahoning)	66	790
Sandstone, black (Mahoning)	16	806
Slate and shells	86	892
Sandstone, white	32	924
Slate and shells	120	1,044
Slate	20	1,064
Sandstone, black (oil show)	17	1,081
Coal	8	1,089
Sandstone, white (salt water at 1,109 feet) (Pottsville)	50	1,139
Slate (Pottsville)	35	1,174
Sandstone, white (salt water at 1,209 feet) (Pottsville)	90	1,264
Red rock (Mauch Chunk)	145	1,409
Sandstone, white (gas and salt water at 1,587 and 1,629 feet) (Big Injun)	320	1,729
Slate and shells	15	1,744
Slate	30	1,774
Sandstone, red (oil show)	39	1,813
Slate and sand shells	140	1,953
Sandstone, gray	36	1,989
Slate and shells	95	2,084
Sandstone, brown	30	2,114
Slate and pebbles	15	2,129
Sandstone, gray, supposed to be the Gantz sand	25	2,154

BLACKSHIRE FIELD.

The Blackshire is a pool of very limited area situated on Whiteley Creek at the point where it is crossed by the direct road between Mapletown and Sigsbee, Monongahela Township. The original Blackshire well (213), drilled about 1865, gave 100 barrels or more a day at the start and was the incentive for the sinking of a number of other wells surrounding it. The production of the original well rapidly declined and soon ceased. Oil was found in the Big Injun sand at depths of 1,250 to 1,350 feet below the Pittsburg coal. A second well (214), located a few rods below the bridge, is said to have yielded to the pump at first 80 barrels a day. A well drilled about 1865 on the Stilwell farm (215), a quarter of a mile below the bridge, is said to have gushed over the derrick for three or four hours, but the oil softened the shale and the well caved about a day after it was finished. A number of wells were drilled to the Dunkard sand along Whiteley Creek east of Sigsbee and up the creek toward Mapletown, but none produced either oil or gas. The pool is located on the outer portion of the western slope of the Fayette anticline. The dips are

very gentle, though the rocks show a perceptible pitch to the northwest. In the immediate vicinity of the wells there appears to be a local flattening, which interrupts the general northwestward dip and may account for the occurrence of oil at this point.

MOUNT MORRIS FIELD.

The oil field which terminates in Dunkard Township, between Glade Run and Bowen Fork, three-quarters of a mile west of Davistown, is the northern extension of the great Mannington-Mount Morris pool. This pool is marked by a continuous line of producing wells from a point about 6 miles southwest of Mannington, W. Va., to Dunkard Creek, a distance of 35 miles. It lies at the foot of the western limb of the Fayette anticline.

The development of the Mount Morris field dates from October 21, 1886, when E. M. Hukill got a 20-barrel well (106) in the Big Injun sand. This well was located on the D. L. Donley farm, on Morris Run, half a mile southeast of Mount Morris, in Perry Township. In 1887 the tools were put in again and the well was drilled to the deep sands, without, however, increasing the production. In November, 1887, the lower part of the hole was plugged and a torpedo exploded in the Big Injun with satisfactory results. A well (216) drilled in 1888 on the same farm one-eighth of a mile east of the original well produced 350 barrels of oil daily at first. Practically all the wells drilled on the eastern side of the village were successful and have been pumped for many years. A hole (217) sunk on the Asa Lemley farm in 1888 was thought at the time to be good for 5 barrels of oil a day, but this was too small a production to bother with, and after drilling thru the Big Injun the well was abandoned. The map shows a dry hole (218) on the Williams farm at the mouth of Calvin Run and another (219) one-half mile to the southeast, on the place of J. L. Donley. These holes seem to be in productive territory, but were never completed because the tools were lost.

The Dunkard Oil and Gas Company was organized in 1892 and developed the field northward into Dunkard Township. The pool is about 1,000 feet wide and very rich. Wells drilled east of the oil belt and higher up on the flank of the Fayette anticline yield gas.

Oil in this pool is found in the Big Injun sand. The records of 13 wells in Dunkard Township show that the first pay streak is reached at 1,367 to 1,392 feet below the Pittsburg coal, or about 100 feet below the top of the sand. The average distance between the coal and the oil horizon in the 13 wells is 1,377 feet. What is known as the "oil pay" or "pay streak" is a soft, porous part of the formation filled with oil and gas. In the early days the rock pressure in this pay streak was 350 pounds to the square inch, but it has fallen off to

about 80 or 100 pounds. In the oil belt the "pay" has a maximum thickness of 8 feet and a minimum of 6 inches. It thins out as the western boundary is approached and thickens toward the southeast, having at several of the big gas wells east of the oil belt a thickness of 35 feet. Some wells in the Big Injun sand have two pay streaks, which are separated by 3 to 6 feet of very hard sandstone. There is no water in the upper part of the Big Injun, but salt water is found from 14 to 20 feet below the oil. At no place in this field, however, has the water been of sufficient quantity to interfere with drilling to the deep sands, nor does there seem to be a greater amount of water in the syncline within a mile west of the oil belt. Nearly all wells in this field have been drilled to the salt-water horizon and pump some brine. There is an impression prevalent that as the production of oil decreases the flow of salt water increases; this, however, is easily explained by the fact that when a well is yielding 50 to 100 barrels of oil a day, a small amount of water is scarcely noticed, but when the oil falls off to 2 barrels a day, the same amount of water becomes more evident.

The Mount Morris oil belt, as mentioned above, is at the base of the western limb of the Fayette anticline. It will be noticed on the map (Pl. I) that the line of producing wells follows closely the 550-foot contour on the Pittsburg coal. East of this belt the dip of the strata for a short distance is about 125 feet to the mile, while west of it the dip is about 50 feet to the mile. This change in the dip may be the cause of the accumulation of oil along this line, and the structure suggests that a continuation of the pool may be found by drilling on Meadow Run at the road forks $1\frac{3}{4}$ miles above Davistown.

Within half a mile of the hotel at Mount Morris about 50 wells have been drilled and more than half of them are being pumped at the present time. Northward from the village the principal oil wells are on the Donley, Patterson, McClure, Stoneking, Pride, and Litman farms. Pl. III, *B* (p. 48), shows a group of wells on the Donley farm.

A pipe-line system controlled by the Standard Oil Company transports the product of the field to the seaboard. Pump stations are located at Mount Morris, Dolls Run, Jakes Run, Fairview, and Mannington. The oil is pumped from these stations to a central station on Monongahela River 2 miles above Morgantown, W. Va.

The character and succession of the rocks in this field are shown in the following log, which is the record of one of the early wells drilled near Mount Morris.[a] This well is south of the village, a few rods over the State line in West Virginia.

[a] Bull. Geol. Soc. America, vol. 3, 1891, p. 189.

Record of Core well No. 2, Monongalia County, W. Va.

	Thickness.	Depth.
	Feet.	*Feet.*
Conductor	21	21
Slate	104	125
Sandstone (Waynesburg)	45	170
Coal (Waynesburg)	10	180
Limestone and shale	120	300
Sandstone	25	325
Limestone (Benwood or "Great" limestone)	85	410
Slate, black	10	420
Coal (Sewickley ?)	10	430
Limestone	85	515
Coal (Pittsburg)	10	525
Slate	70	595
Sandstone	55	650
Shale, red	35	685
Sandstone	15	700
Shale, red	10	710
Shale, blue	25	735
Sandstone (Morgantown)	55	790
Slate, blue	40	830
Slate, blue and red	20	850
Limestone and hard beds	80	930
Slate, red	5	935
Sandstone	25	960
Slate, dark	60	1,020
Sandstone (Mahoning)	30	1,050
Slate, light gray	60	1,110
Sandstone (Freeport)	80	1,190
Slate, dark	25	1,215
Limestone	40	1,255
Slate, dark	40	1,295
Sandstone, hard	5	1,300
Slate	60	1,360
Sand, Salt	150	1,510
Slate	10	1,520
Limestone (?) (Pottsville)	20	1,540
Slate	10	1,550
Sand, dark pebbly	20	1,570
Sandstone, light colored	95	1,665
Limestone, hard	22	1,687
Shale, red	13	1,700
Slate, dark (Mauch Chunk)	45	1,745
Shale, red	3	1,748
Limestone (Greenbrier)	56	1,804
Sand, Big Injun (Pocono) (oil)	101	1,905

WESTERN GREENE COUNTY.

FONNER FIELD.

The Fonner field is in the northeast corner of Morris Township, on the western flank of the Amity anticline, and extends northward into Washington County. The wells in Greene County are on the Fonner, Brooks, Bristor, and Shoup farms.

Oil was discovered in this field in March, 1897, in a well (230) drilled on the farm of William Fonner. This first well produced 1,800 barrels a day for a short time and then declined. A number of wells were drilled in 1898–99 to the Gantz sand, which yields the oil. In several cases gas was found just above the oil. The average depth of the oil-bearing sand below the Pittsburg coal, as shown by the records of 7 wells, is 1,943 feet. The Pittsburg coal (reported in the Fonner No. 5 (98) to be 7 feet thick) is 400 to 450 feet above sea level in this field, and the elevations of the well mouths vary from 1,180 to 1,500 feet above tide. This gives a variation in the depth of the Gantz sand below the surface from 2,680 nearly to 3,000 feet, depending on the elevation of the well.

A number of dry holes were drilled in territory immediately adjoining productive wells. There were 10 producing wells in the Fonner field in February, 1903, with a total daily yield of about 50 barrels. The oil is pumped into small tanks and transported by the South West Pennsylvania Pipe Lines to storage tanks at Meadowlands, Washington County.

A typical well record from this field is given below:

Record of Fonner well No. 5 (98), Morris Township.

	Thickness.	Depth.
	Feet.	*Feet.*
Slate and lime		510
Coal (Waynesburg A)	5	515
Slate and lime	45	560
Coal (Waynesburg)	5	565
Slate and lime	330	895
Coal (Pittsburg)	7	902
Lime and slate		1,160
Cave, very bad	120	1,280
Limestone, black	20	1,300
Slate and sand	65	1,365
Sand and lime	449	1,814
Sand, Gas (top)		1,814
Sand, Salt (top)		1,914
Lime, Big	21	2,100
Sand, Big Injun	225	2,325
Slate and shells	375	2,700
Sand, Thirty-foot	108	2,808
Sand, Gantz (top) (gas at 2,830 feet; oil at 2,832 feet)		2,808
Sand, blue	35	2,869

This well was abandoned in 1899.

NINEVEH FIELD.

Between 15 and 20 oil wells, situated within 1½ miles of Nineveh, Morris Township, have constituted the Nineveh field. The oil has come for the most part from the Nineveh sand, but seems in two or three instances to be derived from the Gordon Stray.

Oil was struck in quantity in this field July 26, 1888, in the John H. Smith No. 3 well (104) of the Nineveh Petroleum Company, situated 0.8 mile northwest of Nineveh. This well, according to Carll [a]—

when drilled 20 feet in the sand, struck oil and flowed 3,940 barrels during the first thirty days. In attempting to clean it out and drill through the sand, a string of tools was dropped. A long fishing job ensued, which was further complicated by the burning of the rig November 15, 1888, and the loss of other tools. Finally, after there had been anchored in the hole one full set of 4¼-inch tools, one full set of 5½-inch tools, and one 5½-inch bit, in all about 130sfeet of iron, fishing was abandoned. A string of 4¼-inch casing was then let down to the obstruction, and through this a new hole was drilled by the side of the fastened tools, and without disturbing them, down to and through the sand. Oil was struck the second time March 16, 1889, and the well again started to flow at the rate of 310 barrels per day without a torpedo.

[a] Carll, John F., Seventh report of the oil and gas fields of western Pennsylvania: Second Geol. Survey Pennsylvania, Rept: I 5, 1890, p. 310.

The eastern portion of this field lies in the bottom of the Nineveh syncline, but the greater part of the wells are on the western side of the axis, less than 50 feet above the bottom of the trough.

GRAYS FORK FIELD.

Southwest from the Nineveh field, along the strike for nearly 3 miles, a number of holes were drilled in a fruitless endeavor to continue the productive area in that direction. In the vicinity of Grays Fork, at the south end of this line of dry holes, a few wells nearly a mile west of the synclinal axis have produced oil from the Nineveh sand.

BRISTORIA FIELD.

Southwest of Grays Fork is another gap of 3 miles in which only a few dry holes have been drilled. Between Bristoria and Delphene and in the vicinity of Higbee is the Bristoria field, covering an area of about 6 square miles, in which a large quantity of oil has been produced since 1896. This field lies in portions of Jackson, Aleppo, Richhill, and Center townships, and occupies the valley and interstream areas of Job Creek and Long Run. It is almost entirely on the east side of the syncline, though a few productive wells lie west of the axis. Most of the oil comes from the Nineveh sand, although one or more wells on the southeastern border of the field obtain it from the Gordon. Scattered throughout the field are a few gas wells, and to the southeast, on the anticlinal slope in the vicinity of Delphene, lies a small gas field. Most of the gas is produced from the Nineveh, Gordon Stray, and Gordon sands, and in one or two wells from the Fourth sand.

NEW FREEPORT FIELD.

In Aleppo Township, south of the Bristoria field, there is an area about 1½ miles long, parallel with the syncline, in which little oil is found. Beyond this area the productive belt is continued southward thru Aleppo and Springhill townships to the State line south of Deep Valley. This field also has been operated since 1896. As in other fields in the belt, the Nineveh is the productive sand, although a few wells obtain oil in the Gordon. In the New Freeport field the Salt, Gordon, and Fourth sands produce some gas, and on the eastern side of the oil field, from New Freeport southward, lies a gas field in which the Fifth sand is the valuable bed.

BOARD TREE FIELD.

The Board Tree field lies about 2 miles west of the New Freeport field and is separated from it by a minor anticlinal fold. Most of the oil in this field comes from the Big Injun sand. The Nineveh

and Gordon sands have also produced small quantities of oil in this vicinity. High up on the anticlinal slope, southeast of this field, several wells produce gas from the Big Injun and Salt sands.

ALEPPO FIELD.

There is a small group of wells lying on the west side of the Nineveh syncline in which oil is obtained mainly from the Gordon and Fourth sands. Some gas is found in the Fifth and Nineveh sands, along the upper border of this field, and one well reports oil in the Fifth.

WRIGHT RUN FIELD.

Three wells on Wright Run, 1¼ miles northeast of Bristoria, constituted the Wright Run field, when last visited in 1904. The oil in these wells is believed to occur in the Gordon Stray or upper part of the Gordon sand. They are light wells, and one of them produces gas. On account of its position, halfway up the steep anticlinal slope, the field probably does not contain much oil.

LANTZ FIELD.

The Lantz pool is the north end of a large field extending over the State line into West Virginia. It lies in Wayne Township, near the junction of Hoovers Run and Dunkard Creek, just east of the village of Shamrock. Operations in this field date from 1899, when the William Lantz No. 1 well (231) was drilled. Most of the oil is produced from the Fifth sand, which also yields considerable gas in Wayne Township. Some drillers have erroneously called this sand the Gordon, and some name it the Gas sand.

The position of this oil pool, higher up the limb of the syncline than the gas field on the west, is a curious feature that is discust on page 82.

MISCELLANEOUS WELLS.

Besides the wells in the above-described fields a number of others in the eastern half of the county have obtained oil in small amounts. Two wells drilled in 1893 on the Lantz farm at the mouth of Woods Run, Greene Township, have an interesting history. According to a letter from C. E. Lantz, written in December, 1905, the well (220) in the road corner tapped the first pay streak in the Big Injun sand and filled up 300 feet with oil. The tools were lost in the hole and a set of fishing tools lost on top of them. Some oil was removed by the sand pump. A second well (221) was drilled on the same farm, on the bank of Whiteley Creek, and went to the Bayard sand, getting only a small pocket of gas in the Big Injun. The third well (222) was drilled on Woods Run, a few rods above the first, and is said

to have filled up about 100 feet with oil when the Big Injun pay was tapt. Because of some irregularity in the business transactions, these wells were never pumped. If oil appeared in these wells, as described, it may be considered good evidence that the continuation of the Mount Morris pool should be sought in this direction, for a line of equal elevation on the producing sand in that pool passes close to the mouth of Woods Run.

A small showing of oil was found in the Big Injun sand in a well (223) on the A. Rice farm, three-fourths of a mile west of Whiteley. The L. L. Thomas well (164), at Blacksville, produced some oil from the Fifth sand.

A well (224) near the pottery at Greensboro was started about 150 feet below the outcrop of the Pittsburg coal and 30 feet above Monongahela River. The Mahoning sandstone, or Dunkard sand, was encountered at 300 feet, and it is said to have yielded about a barrel of oil a day. The Big Injun sand yielded some gas and a show of oil.

Oil wells on the Brown and Shriver farms on Dunkard Creek, at the mouth of Blacks Run, are in West Virginia. The Molesey well (225), 1½ miles east of Jefferson, obtained some oil from the Dunkard sand. This well was sunk to the Elizabeth sand, which proved to be a good gas producer. The Ellen Ross well (226) on Ruff Creek, five-eighths of a mile above Ruff Creek post-office, obtained about 1 barrel of oil daily from the Gantz sand. The flow of gas in this well was weak. A well (56) on the land of E. M. Sayers, at Waynesburg, got a trace of oil in the Fifth sand. Oil was found also in small quantities in the J. Marshall well (227), near Brock. None of these wells yielded enough to pay for pumping. The Headley well (228), on Little Shannon Run, is said to have made a good showing of oil, but when the well was shot the oil was drowned by salt water. The record does not state in what sand this oil was found. On the Joseph Morris farm, 3 miles northwest of Blacksville, W. Va., a well (229) got oil in the Gordon sand and was pumped several years. In 1904 it was drilled down to the Fifth sand and is now producing gas from the lower horizon.

The record of the H. M. Spragg well (162), which was drilled by the South Penn Oil Company, one-half mile south of Spraggs, Wayne Township, in 1895, and showed a trace of oil in the Big Injun sand, is given on the next page.

Record of H. M. Spragg well (162), Roberts Run.

	Thickness.	Depth.
	Feet.	*Feet.*
Coal, Pittsburg (top)	.....	615
Sand, Dunkard	70	1,200
Sand, Gas	30	1,525
Sand, Salt	110	1,690
Sand, Big Injun (gas at 2,116 feet; oil at 2,130 feet)	254	2,150
Sand, Thirty-foot	30	2,425
Sand, Gantz (gas at 2,550 feet)	27	2,573
Sand, Fifty-foot	45	2,630
Sand, Gordon	14	2,853
Sand, Fourth	7	2,920
Sand, Fifth	15	2,946
Total depth, steel-line measurement	.....	3,215

DESCRIPTION OF THE GAS FIELDS.

In earlier reports on Greene County the distribution of gas has been discussed by fields, but now that intervening territory has been drilled and found productive, some of the small fields have become merged. In such cases no well-defined lines can now be drawn between the separate groups of wells formerly described as fields, and therefore it seems best to discuss the distribution of gas by townships. They will be taken up in geographic order from Monongahela River westward.

CUMBERLAND TOWNSHIP.

So far as has been learned only 6 deep holes have been drilled in Cumberland Township, and all were unproductive. Three of these are on Muddy Creek—the Biddle well (31), one-half mile below Carmichaels, 2,432 feet deep; the Rea well (232), 1 mile above Carmichaels; and the Rich well (233) at Khedive, said to be 3,100 feet deep. D. C. Stevenson drilled a well (234) at Ceylon in 1864 and got a showing of oil. This well was 700 feet deep, the curb being 36 feet below the Waynesburg coal. The following paragraph relative to this hole is from the report of the Second Survey:[a]

At 288 feet the Pittsburg coal was reached, giving the interval between the coals as 324 feet, which is much less than at any locality south from this where direct measurements have been made. Oil was obtained at 460 and between 600 and 700 feet. These answer to the first and second horizons of the Dunkard wells. Brine was found in close proximity to the oil. The lower stream was strong and yielded excellent salt, but no thorough test was ever made to determine the strength of the brine, nor has anyone attempted to utilize it by the manufacture of salt.

Mr. Stevenson writes under date of January 25, 1906:

The well was completed in 1864. At that time we had no casing, and the water was hard to shut off. The hole was drilled 250 feet with a 4½-inch bit and 450 feet with a 4-inch bit. Salt water was struck and flooded the well within 6 feet of the surface. It could not be exhausted with the appliances we had. All the oil we got was by means of the sand pump.

[a] Stevenson, J. J., Second Geol. Survey Pennsylvania, Rept. K, 1876, p. 127.

A well was drilled at the mouth of Little Whiteley Creek many years ago, but its exact location is not known. The record of only one well in this township is available, and is given below:[a]

Record of Biddle well (31), Cumberland Township.

	Thickness.	Depth.
	Feet.	*Feet.*
Conductor	7½	7½
Limestone and layers of slate	48½	56
Limestone, soft	147	203
Limestone, hard	62	265
Slate and shell	35	300
Sandstone	30	330
Slate	5	335
Coal, Pittsburg	9	344
Slate and shells	176	520
Sandstone (salt water)	50	570
Slate and shells	62	632
Sandstone	23	655
Slate	40	695
Red rock	5	700
Slate	95	795
Sandstone	35	830
Slate	35	865
Sandstone, "Dunkard Third sand"	40	905
Slate	4	909
Sandstone	11	920
Slate	35	955
Slate and shells	80	1,035
Sandstone, dark gray (gas at 1,040 feet; salt water at 1,050 and 1,180 feet)	165	1,200
Slate and shells (1,167 feet of 7⅝-inch casing)	35	1,235
Sandstone (fresh water at 1,240 and 1,250 feet)	180	1,415
Slate	10	1,425
Limestone	75	1,500
Red rock, red shale	25	1,525
Limestone	60	1,585
Sandstone, "Big Injun" (salt water at 1,600 feet; some gas and oil; 1,613 feet of 5⅜-inch casing)	240	1,825
Slate and shells	40	1,865
Sandstone, hard	35	1,900
Slate	80	1,980
Sandstone	220	2,200
Slate and hard sand shells	10	2,210
Slate	210	2,420
Red rock to bottom	12	2,432

MONONGAHELA TOWNSHIP.

Aside from the oil wells and dry holes in the Dunkard Creek and Blackshire fields, described on pages 46–48, 51–52, but few deep holes have been drilled in this township. Most of these are on the bank of Monongahela River. Wells above and below the mouth of Whiteley Creek on the Gray (235) and Keener-Durr (236) farms found some gas in the Gantz sand. Gas has also been obtained on the Silas Ross farm (237) at the mouth of Dunkard Creek, and in a single well on Whiteley Creek, 1 mile west of Mapletown. Four wells were drilled in the northern outskirts of Greensboro in 1904, and three of them are producing gas from the Big Injun sand. These are the Mary Reed (238), John Steele (239), and B. F. Gabler (240) wells. A well (88) on the Williams farm, one-half mile southwest of Greensboro, also drilled in 1904, was dry, getting only a show of gas, tho it started at the Pittsburg coal and went down 2,120 feet.

The record of a dry hole drilled by the Greensboro Gas Company on the land of Dr. Ben Birch, one-half mile north of Greensboro, is exceptionally good and is given on the next page.

[a] Second Geol. Survey Pennsylvania, Rept. I 5, 1890, p. 315.

Record of Dr. Ben Birch well (86) near Greensboro.

	Thickness.	Depth.
	Feet.	*Feet.*
Mud and gravel	37	37
Slate	40	77
Lime	10	87
Sand	23	110
Slate	15	125
Lime, white	38	163
Slate	10	173
Lime, white	30	203
Lime, red	25	228
Lime, white	28	256
Slate	30	286
Coal	3	289
Lime	11	300
Coal, gas, and water	5	305
Slate	8	313
Water	69	382
Sand, Little Dunkard	10	392
Slate	12	404
Sand	5	409
Slate	11	420
Sand	5	425
Slate	20	445
Lime	5	450
Slate	15	465
Sand	10	475
Slate	5	480
Lime	15	495
Sand	20	515
Lime	33	550
Slate	25	575
Sand	15	590
Slate	42	632
Sand and lime	25	657
Slate	15	672
Coal	5	677
Slate	20	697
Lime	20	717
Slate	15	732
Coal	5	737
Sand: hole full of water	13	750
Bottom of sand	35	785
Slate	25	810
Lime	8	818
Sand, salt	82	900
Lime	5	905
Slate, dark	20	925
Red rock	35	960
Lime	10	970
Lime, red	40	1,010
Lime, white	23	1,033
Sand	23	1,056
Lime, red	15	1,071
Slate	29	1,100
Lime, big	40	1,140
Sand, Big Injun (show of gas at 1,337 feet)	264	1,404
Slate	10	1,414
Sand	12	1,426
Shells	11	1,437
Sand, Squaw	108	1,545
Slate and shells	160	1,705
Sand, Gantz	20	1,725
Slate	40	1,765
Sand and shells	15	1,780
Slate	20	1,800
Sand, Fifty-foot	50	1,850
Sand and shells	40	1,890
Slate and shells	110	2,000
Sand, red (Gordon)	25	2,025
Sand, white	15	2,040
Slate	20	2,060
Sand	10	2,070
Red rock	25	2,095
Lime	20	2,115
Red rock	200	2,315
Sand, Bayard	15	2,330
Red rock	20	2,350
Slate	25	2,375
Sand, Elizabeth	15	2,390
Red rock	20	2,410
Slate	110	2,520
Lime and shells	78	2,598
Slate and shells	68	2,666

DUNKARD TOWNSHIP.

Dunkard Township has been pretty thoroughly prospected, except in the northwest corner, and gas wells are numerous. There are 6 on the bank of Monongahela River between Dunkard Creek and the State line. These are on the Maple (36), Dilliner (241), Chisham (242), Sterling (243), and Sturgiss (244) farms. The Jennie Miller (245) and Stone (246) wells, on the hill above the Sturgiss farm, opposite Point Marion, are producing. A little over a mile east of Dunkard village there are over a dozen gas wells on the Durr, Keener, Watson, and Titus farms, which were drilled in 1904–5. All of these wells are on the steep flank of the Fayette anticline Gas was found in the Myrtle Gabler well and in two or three others on the east and, structurally, higher side of the Garrison oil field. In the vicinity of Davistown and Bald Hill a number of wells are yielding good quantities of gas, and there are a few along the east side of the Mount Morris oil field where the anticlinal slope becomes steeper. A gas well (247) on the Hathaway farm, one-half mile north of the Valley House, at Davistown, was drilled by E. M. Hukill and plugged. It is said that the gas blew the plug out, and that when the well was closed a second time gas appeared in the coal mines at Davistown in such abundance that the miners had to stop work. Practically all the gas produced in this township comes from the Big Injun sand.

GREENE TOWNSHIP.

Three wells in Greene Township have produced gas. One of these, the Hugh Keenan well (248), near Turkey Knob, struck a pocket of gas in the Big Injun sand. It was allowed to blow for several days, and each time it was tested the rock pressure fell off so much that the gas was never piped away. Two wells (249) on the Fordyce farm, on Frosty Run, came in fairly strong in 1905.

JEFFERSON TOWNSHIP.

The first two wells in Jefferson Township were drilled at Rices Landing. One of these (250) was sunk in 1860 on the bank of Monongahela River, 50 feet from the mouth of Pumpkin Run, and got a little gas. Another well (251), drilled about the same time, at the old mill half a mile up the run, showed a sign of oil. Nothing is known of the depth of these wells or in what sands they found signs of oil, but it is said that neither paid for drilling.

This township lies along the east flank of the Bellevernon anticline, and the western half, at least, should be good gas territory. Over 30 wells have been drilled here, with a very small percentage of failures. The Degood No. 2 (252) and Jacob Crayne (253) holes were dry,

while wells on the Haver (254), Eaton (83), Denny (255), and Scott (85) farms yielded but little gas. A group of wells on the Luse (256), Degood (257), Horner (84), Sprowles (258), Robinson (259), and Williams (260) farms, at the north end of the township, has been described as part of the Clarksville field, much of which is in Washington County. Gas comes largely from the lower sands.

MORGAN TOWNSHIP.

Between 50 and 60 wells have tested all parts of Morgan Township. So far as known, only 2 wells—the Cotterell (90), on Browns Run, and the Shape (92), at Castile—were abandoned when completed. The wells in this township are described in the Waynesburg folio (No. 121) as being in the Zollarsville, Clarksville, and Waynesburg fields, but developments of 1904–5 have filled in the intervening areas so that such discrimination is no longer possible. Near Clarksville the gas comes largely from the Gantz and Bayard sands. Elsewhere the Big Injun, Fifty-foot, and Fifth sands carry some gas, tho the largest flow comes from the Bayard sand. The axis of the Bellevernon anticline crosses the eastern part of the township, and from the structure and evidence of wells already drilled it seems that gas should be obtained almost anywhere except in the vicinity of Castile, an area which has proved to be barren. Drilling should not stop short of the Elizabeth sand, however, as many wells farther north in the Zollarsville field are strong producers from this sand. The Shape well (92), at Castile, 1 mile east of the Waynesburg synclinal axis, one of the deepest holes in Greene County, struck a strong flow of salt water in the Big Injun. The record of the John Bennett No. 1 well, drilled by the Carnegie Natural Gas Company in 1900, is given herewith:

Record of John Bennett well No. 1 (89), Morgan Township.

[Depths are to the top of the respective beds.]

	Thickness.	Depth.
	Feet.	*Feet.*
Coal, Mapletown		480
Coal, Pittsburg		580
Sand, Dunkard (show of oil at 1,080 feet)	135	1,015
Sand, Salt (water at 1,490 feet)		1,480
Sand, "Keenan" (?)		1,570
Lime, Big		1,720
Sand, Big Injun		1,800
Sand, Fifty-foot		2,550
Sand, Gordon	20	2,735
Sand, Fourth	30	2,830
Sand, Fifth	30	2,890
Sand, Sixth or Bayard (gas at 3,020 feet)	15	3,015

The gas in this part of the township is found mostly in the Fifty-foot and Bayard sands, altho in many wells the Big Injun and Fifth sands produce light flows.

FRANKLIN TOWNSHIP.

More than 100 wells have been drilled in Franklin Township and about 10 per cent of these were failures. The Bellevernon anticline crosses the eastern part of the township and the Waynesburg syncline the western part. A larger number of the wells are in the northeast section of the township and extend from the crest of the anticline well down its western flank. The territory along the axis near the heads of Laurel and Sugar runs has been shunned because of two dry holes—the Inghram well (261), on Laurel Run, and the Wood well (262), on Smith Creek—evidence which seems hardly sufficient for condemning so large an area as is at present avoided.

Drilling for gas in Greene County was begun, so far as records show, at Waynesburg in 1885, when a well (201) was sunk by the Waynesburg Gas Company on the north bank of Tenmile Creek, at the mouth of Purmans Run. The record of this well was published in the Annual Report of the Geological Survey of Pennsylvania for 1886, part 2, page 772. The well, although favorably located, was not successful, for while drilling in a promising sand, with a show of oil at a depth of 2,745 feet, the cable parted; the drillers were unable to regain the tools and the hole was abandoned. Subsequent drilling in the immediate vicinity shows that if the well had been sunk a few feet deeper a strong flow of gas would, without doubt, have been struck. As it was, several years past before gas was found in paying quantities in this locality.

Probably the first producing well (263) in this field was drilled in April, 1889, on the Grimes farm, on Grimes Run, 1½ miles above its mouth and 2 miles northeast of Waynesburg. It is 2,900 feet deep and is still yielding a small amount of gas. A well (202) drilled on the Robert A. Sayers farm in February, 1889, at the site of the Carnegie Gas Company's pump station, 2 miles east of Waynesburg, reached a depth of 2,675 feet without producing gas in paying quantity. The records of the Grimes and Sayers wells were published by the Second Geological Survey of Pennsylvania in Report I 5, 1890, pages 312, 313.

A portion of this district is sometimes spoken of as the Bayard field, taking its name from the well (167) on the Thomas Bayard farm, Whiteley Township, where the Sixth or Bayard sand was discovered in February, 1895, at a depth of 2,400 feet below the Pittsburg coal. This sand is the largest producer in the Waynesburg field. The average distance between the Pittsburg coal and the Bayard sand is 2,433 feet.

Active drilling in the immediate vicinity of Waynesburg followed the discovery of gas on the E. M. Sayers farm (56), just west of the Waynesburg and Washington Railroad station. This well was sunk

in the flood plain of the creek and reached the Bayard sand at a depth of 2,945 feet below the surface. It was drilled by the Manufacturers' Light and Heat Company, Reese & Heasley, contractors, and was completed in February, 1900. The following is the record:

Record of E. M. Sayers well (56), Waynesburg.

	Thickness.	Depth.
	Feet.	*Feet.*
Conductor	16	16
Slate	79	95
Coal	3	98
Slate and lime	76	174
Coal, Waynesburg	3	177
Slate and lime	216	393
Coal, Mapletown	4	397
Lime	97	494
Coal, Pittsburg	6	500
Slate, red rock, and shells	575	1,075
Sand, Dunkard	50	1,125
Slate and shells	130	1,255
Sand	30	1,285
Slate	165	1,450
Sand, Salt	75	1,525
Slate, red rock, and shells	144	1,669
Lime, Big	43	1,712
Sand, Big Injun	298	2,010
Slate and shells	290	2,300
Sand, Thirty-foot	30	2,330
Slate and shells	100	2,430
Sand, Gantz, and Fifty-foot combined	55	2,485
Slate and sand shells	30	2,515
Red rock	10	2,525
Sand, Gordon Stray	25	2,550
Slate	2	2,552
Sand, red	20	2,572
Red rock	5	2,577
Sand, hard, and shells	10	2,587
Shells, red	43	2,630
Sand, pebble	36	2,666
Red rock	3	2,669
Slate, white	5	2,674
Shells, red	10	2,684
Sand, hard	20	2,704
Red rock	3	2,707
Sand, red	18	2,725
Sand, pebble	19	2,744
Sand shells	30	2,774
Sand, gray	10	2,784
Slate	10	2,794
Sand, Fifth	44	2,838
Slate, black	89	2,927
Sand, Bayard	18	2,945

The most recent and extensive development in Franklin Township has been the drilling of a group of wells at the head of Smith Creek. These wells are close to the crest of the anticline and all but one have given good quantities of gas when completed. They are mostly Fifth sand wells. Many of the wells in this township get small quantities of gas in the Big Injun, Gantz, Gordon, and Fifth sands, but the Bayard is the greatest producer. Several holes west of Waynesburg are dry, and one, the Wisecarver well (65), on Wisecarver Run, got a flow of very salty water in the Bayard sand, which filled the hole, 1,200 feet, in three hours.

WHITELEY TOWNSHIP.

Fourteen wells in the northern and western parts of Whiteley Township are yielding gas and 3 are dry. The southeastern half of the township is so far down in the Whiteley syncline that it probably is barren, as is shown by the dry holes on the Stevens (264) and Bowers (265) farms. The Thomas Bayard well (167), in which a deep sand lying below the Fifth and now known as the Bayard sand was discovered, is on Mount Phoebe Run in this township. The large and productive field about Waynesburg has been developed since the disclosure of a new source of gas by the drilling of this well in February, 1895. The distance from the Pittsburg coal to the top of the Bayard sand in the original well is 2,410 feet.

Two wells on the Iseminger farm, altho lying between producing wells less than half a mile apart, were dry. No. 1 (266) yielded so very little gas that it was abandoned when completed, and No. 2 (267) was wholly barren. This may be due to the density of the reservoir rock. The record of the Josephus Bowers well (265) is detailed and is given here with correlations. This well is on Lantz Run, three-fourths of a mile above Whiteley Creek.

Record of Josephus Bowers well (265), Whiteley Township.

	Thickness.	Depth.
	Feet.	*Feet.*
Coal, Pittsburg (top)	.....	560
Sand, Salt	120	1,560
Lime, Big (top)	.....	1,775
Sand, Big Injun	235	2,050
Slate	40	2,090
Slate and shells	60	2,150
Sand	15	2,165
Slate	20	2,185
Sand	8	2,193
Slate and shells	47	2,240
Sand	30	2,270
Slate	25	2,295
Sand, Thirty-foot	25	2,320
Slate and shells	75	2,395
Sand	10	2,405
Slate	15	2,420
Sand, Gantz	20	2,440
Slate and shells	60	2,500
Sand	30	2,530
Slate	20	2,550
Sand	15	2,565
Red rock	40	2,605
Slate	15	2,620
Sand, dark	12	2,632
Red rock	40	2,672
Sand, Gordon	10	2,682
Red rock and shale	80	2,762
Sand	18	2,780
Slate and shale	40	2,820
Red rock and shale	50	2,870
Sand, dark, Fifth	10	2,880
Slate and shale	45	2,925
Sand, white	6	2,931
Slate	29	2,960
Sand, Bayard (dark)	15	2,975
Slate and shale	50	3,025
Shell (gas)	2	3,027
Slate	130	3,157

PERRY TOWNSHIP.

On the eastern side of the Mount Morris oil pool gas has been obtained in several wells, including those on the Bowen (268), Evans (269), Ryan (270), and Gump (271) farms. About 6 wells have been drilled west of Mount Morris. The Williamson well (272), on Shannon Run, about a mile above its mouth, is said to have shown a little oil in the Fifth sand, while the Delaney (105) well, just below the mouth of Hobbs Run, has been supplying gas to Newtown for a number of years. A well (228) on the Headley heirs' farm, drilled about 1890, is said to have yielded a strong flow of oil at first, but when the well was shot the oil was drowned by a rush of salt water. The Samuel Minor well (273), at the head of Hackelbender Run, produced a little gas from the Big Injun, but was abandoned when completed. This line of wells across the township seems to be considered as conclusive proof of the barrenness of the sands between Mount Morris and Rudolph Run, but the Shriver and Brown oil wells at the mouth of Blacks Run, a short distance south of the State line, and the report of salt water and oil in the Headley well (228) suggest that a small pool might be found by drilling on the ridge east of Blacks Run or on Little Shannon Run about one-fourth of a mile below the Headley well.

WASHINGTON TOWNSHIP.

Less than 20 wells have been drilled in Washington Township to date. Several of these in the Fonner field west of Hope produce oil. Two wells on the Closser farm (147), on Overflowing Run, found gas, but a third was dry. The Conger well (148), at the mouth of Overflowing Run, is a light "gasser," as is also the Allison well (146), on Wisecarver Run. At Ruff Creek post-office a well (226) drilled on the Ellen Ross farm gave at first about a barrel of oil a day and a little gas from the Gantz sand, but it has been considered a dry well.

Dry holes were completed on the Hoge (149), Hoffman (274), and Stilwell (151) farms. All the evidence shows that the township as a whole may be considered rather barren of either oil or gas, a condition which seems to be explained by the course of the Waynesburg syncline and the low dip of the rocks, together with the absence of water in the deep sands.

WAYNE TOWNSHIP.

About 120 deep wells have been drilled in Wayne Township; of this number, 30 are oil wells, 75 gas wells, and 13 unproductive. The group of oil wells described above as the Lantz field is located near the mouth of Hoovers Run and extends southward into West Virginia.

The gas wells are scattered over the northern-central part of the township and thickly distributed along its western side in the Waynesburg syncline. Most of these wells have been drilled since the summer of 1902, but the first well in the Lantz oil field was drilled in 1899.

To a group of wells around Kneisley schoolhouse at the head of Pursley Creek the name Kneisley field is given. All the wells in this field were completed in the Fifth sand with a good flow of gas, except the Cornelison (275), which was dry in the Fifth sand but struck a good flow of gas in the Bayard sand. The Guthrie No. 1 (276) showed a gas pressure of 810 pounds in ten minutes and a rock pressure of 865 pounds. The Arthur Hoy well (156) was completed at a depth of 3,492 feet, with a big flow of gas from the Fifth sand. It was drilled by the Carnegie Natural Gas Company in 1903, and the record is as follows:

Record of Arthur Hoy well (156), Wayne township.

	Thickness.	Depth.
	Feet.	*Feet.*
Coal, Mapletown	5	1,031
Coal, Pittsburg	8	1,124
Slate and red rock (water at 1,472 feet)	365	1,489
Sand	16	1,505
Slate	45	1,550
Sand, Big Dunkard	40	1,590
Slate and shells	390	1,980
Sand, gas	30	2,010
Slate	40	2,050
Sand, Salt (hole full of water at 2,072 feet; water at 2,145 feet)	150	2,200
Slate, shells, and lime	110	2,310
Lime, Big	57	2,367
Sand, Big Injun (some gas at 2,397 feet)	265	2,632
Sand, Thirty-foot	32	2,947
Sand, Gantz	5	3,020
Sand, Fifty-foot	160	3,200
Sand, Gordon Stray	20	3,314
Sand, Gordon	10	3,329
Sand, Fourth	20	3,395
Sand, Stray	25	3,445
Sand, Fifth (little gas at 3,453 feet; big gas at 3,460 feet)	.....	3,450
Total depth (completed in black sand)	.....	3,492

On Roberts Run, between Spraggs and Blacksville, 8 or 10 wells have been drilled. All seem to be near the anticlinal axis, but the fold is low, disappearing to the south. About half of these wells produced strong flows of gas when they were completed, while others were so weak that they were abandoned. A number of companies have been engaged in the attempt to develop a field in this region, some looking for gas and others for oil, but without marked success. A small quantity of oil was found in the Big Injun sand in a well (162) on the H. M. Spragg farm. The Worley well (277), 1 mile northeast of Blacksville, is said to have been one of the biggest gas producers in Greene County. The Pittsburg coal was found higher in this well than in those around it, and the fact that all the others in the vicinity except the Brock No. 1 (278) were dry led the drillers to believe that the gas belt was "so narrow it could be cut in two by a 10-inch bit."

There is some evidence to indicate that this well is at the north end of an anticline which crosses the State line just east of Blacksville.

South of the Kneisley group of wells the field in western Wayne Township generally goes by the name of the Kuhntown or Hoovers Run field. Most of the wells in this belt lie on the east side of the syncline, but Tustin heirs' well (279) is west of the axis and the H. L. Granlee well (280) occupies a position almost exactly in the center of the basin. South of Blockhouse Run the field bends westward and extends over a mile across the synclinal axis in Gilmore Township. At Pennsylvania Fork of Dunkard Creek the breadth of the producing area from east to west is 2½ miles. In general the eastern edge of this field as at present developed can be said to lie one-half mile southeast of Hoovers Run village and to cross Pennsylvania Fork at the mouth of Toms Run. Three gas wells, namely, the T. E. Eddy (281), Henderson No. 2 (282), and Jacob Eddy No. 2 (283), lie on a line one-half mile east of this, and the last two of these are approximately on the western border of the oil field. Between the oil and gas fields is a gap of more than half a mile in which no wells are known to have been drilled.

A dry hole (204) drilled in 1900 on the Lewis Kuhn heirs' farm, in a side valley 1 mile southeast of Hoovers Run village, reached a depth of 3,780 feet below the surface, or over 500 feet below the horizon of the Elizabeth sand, without striking gas in any quantity. As this is the second deepest hole in Greene County the record is given here.

Record of Lewis Kuhn heirs' well (204), Wayne township.

	Thickness.	Depth.
	Feet.	*Feet.*
Coal, Pittsburg		750
Sand, Dunkard	30	1,150
Sand, Salt (salt water at 1,628 feet)	147	1,767
Sand Big Injun	174	2,200
Sand, Fifty-foot	58	2,774
Sand, Gordon	15	2,946
Sand, Fifth (?), hard	50	3,098
Sand, limy, hard	300	3,550
Red rock, soft	5	3,555
Lime, sandy	20	3,575
Slate, soft	15	3,590
Lime, sandy	60	3,650
Sand, white (Speechley?)	15	3,665
Slate, soft	10	3,675
Lime, sandy	105	3,780

Gas at 2,026, 2,985, 3,052, and 3,092 feet; oil in Dunkard sand.

At the time the Kuhn well was drilled the sands had not been definitely identified in this field, and consequently few details were recorded, and even the position of the Fifth sand is doubtful. The record of the Felix Bell No. 1 well (152),[a] 1.7 miles south of Hoovers Run village, is exceptionally good, and is given on the next page.

[a] West Virginia Geol. Survey, vol. 1 (a), 1904, p. 122.

Record of Felix Bell No. 1 well (152), Wayne Township.

	Thickness.	Depth.
	Feet.	*Feet.*
Conductor	9	9
Unrecorded	266	275
Sand, Bluff (Waynesburg) (water)	45	320
Coal, Mount Morris (Waynesburg) (top)		320
Unrecorded	250	570
Coal, Mapletown (Sewickley) (top)		570
Unrecorded	95	665
Coal, Pittsburg (top)		665
Unrecorded (10-inch casing at 685 feet)	20	685
Lime and slate	90	775
Red cave	10	785
Slate and shells	90	875
Sand, dark	25	900
Slate	20	920
Red cave	40	960
Slate	30	990
Sand, dark gray	15	1,005
Coal		
Slate	35	1,040
Red cave	20	1,060
Slate and shell	95	1,155
Red cave	10	1,165
Sand, gray	55	1,220
Coal (Upper Freeport)		
Slate	25	1,245
Sand, light gray	130	1,375
Slate and shell	25	1,400
Sand, light gray	50	1,450
Slate and lime	25	1,475
Sand, white	70	1,545
Slate	45	1,590
Sand, white	25	1,615
Slate	10	1,625
Sand and lime, black	20	1,645
Sand, white	30	1,675
Slate	5	1,680
Sand, dark gray	70	1.750
Red cave	70	1.820
Slate and shell	40	1,860
Lime, Big lime	65	1,925
Sand, Keener (gas)	20	1,945
Sand, Big Injun, white and gray	50	1,995
Slate	20	2,015
Sand, gray (bottom of Big Injun)	70	2,085
Slate	5	2,090
Sand, gray	110	2,200
Slate and shell	90	2,290
Sand, black	5	2,295
Slate and shell	15	2,460
Sand, dark gray	35	2,495
Slate and shell	130	2,625
Sand, gray (Fifty-foot)	25	2,650
Slate	5	2,655
Sand, brown	8	2,663
Slate	4	2,667
Sand, pink	18	2,685
Shelly	45	2,730
Sand, gray (Stray)	30	2,760
Slate and shell	10	2,770
Sand, gray...10 Slate...3 Sand, white..22 } Gordon	35	2,805
Slate and shell	20	2,825
Sand, dark	5	2,830
Slate and shell	20	2,850
Sand, brown	5	2,855
Slate and shell	10	2,865
Sand, pink	5	2,870
Slate	2	2,872
Sand, dark gray (Fourth) (gas)	13	2,885
Slate and shells	29	2,914
Shells	6	2,920
Sand, dark	10	2,930
Slate, red, and shells	17	2,947
Sand, gray...10 Slate... 2 Sand, dark...12 Slate...10 Sand, dark... 3 Slate... 3 Sand (small pebbles)..15 } McDonald or Fifth sand (gas at 3,001 feet)	61	3,008

In this well and in most wells throughout the Hoovers Run field the greatest amount of gas is produced from the Fifth sand, although a number of wells obtain large supplies from the Big Injun and small amounts are found by two wells in the Fifty-foot sand and by several in the Gordon and Fourth sands. As the Fifth sand is the principal producing bed in this township, it is sometimes called the Gas sand.

MORRIS TOWNSHIP.

More oil wells and more dry holes have been drilled in Morris Township than gas wells. Three wells at Simpson Store and 4 wells about one-half mile northwest of Deerlick were producing gas at the time this region was last visited. Four other wells scattered over the area are said to have produced small quantities. These are the James Iams wells (284), on Bates Fork midway between Deerlick and Swarts; the Samuel Phillips well (285), on Browns Fork, 2½ miles southeast of Nineveh; one well near the western edge of the Nineveh oil field; and the Laban L. Gray well (286), 1.4 miles east of Deerlick. On account of the wild-cat nature of these wells and consequent lack of available records, it is not possible to give any definite information regarding them, but the production is believed to have been small. Near the west end of the Fonner oil field a number of dry holes have been drilled, which serve to define its limits in this direction. Other dry holes were drilled south of the Nineveh oil field in a vain endeavor to enlarge the productive territory. In 1903 a dry hole (97) was drilled on the James Dunn farm, midway between the Fonner field and the gas field northwest of Deerlick. This well passed through the Bayard sand, which was unproductive. At Deerlick, 1.2 miles southeast of the Dunn well, a dry hole was drilled in 1895 through the same bed. Two miles farther south-southeast there is a dry hole (103) on the Hugh Simpson farm, 1 mile southwest of Swarts. This hole passed through the Fifth sand. The Samuel Phillips well (285), mentioned above, is 1½ miles south of the Simpson well and is said to have produced a little gas. Another dry hole was drilled in 1889 on the Hugh Auld farm (94), 1.7 miles northwest of Nineveh. This hole is said to have reached the Gordon and to have found some gas and much salt water. West of the Nineveh field dry holes have been drilled on the John Parkinson farm (326), 1.6 miles northeast of Time, and on the James Carl farm (287), 1 mile farther north.

The following record of the John Lewis well (206) is given to show the general character of the section:

Record of John Lewis well No. 1 (206), Morris Township.

	Thickness.	Depth.
	Feet.	*Feet.*
Clay, yellow, soft	16	16
Shale, black	164	180
Sand, white	15	195
Shale, black	105	300
Lime, white, hard	100	400
Shale, black, soft	150	550
Sand, white, hard	25	575
Shale, black, soft	25	600
Lime, white, hard	35	635
Coal, Waynesburg	5	640
Lime, white, hard	195	835
Coal, Mapletown	5	840
Lime, white, hard	95	935
Coal, Pittsburg	5	940
Lime, white, hard	100	1,045
Shale, red, soft	55	1,100
Lime, white, hard	100	1,200
Shale, black, soft	135	1,335
Sand, Little Dunkard	15	1,350
Shale, black, soft	100	1,450
Sand, Big Dunkard, white, hard	60	1,510
Shale, white, soft	50	1,560
Sand, white, hard	25	1,585
Shale, black, soft	100	1,685
Sand, gas, soft and very open	85	1,770
Shale, black, soft	32	1,802
Sand, salt, white, hard	108	1,910
Shale, black, soft	170	2,080
Lime (Big lime), white, hard	55	2,135
Sand, Big Injun, white, hard	250	2,385
Shale, white, soft	320	2,705
Sand, Thirty-foot, white, hard	30	2,735
Shale, black, soft	115	2,850
Sand, Fifty-foot, white, hard	50	2,900
Shale, white, soft	30	2,930
Sand, Nineveh, white, hard (gas at 2,940 feet)	35	2,965

CENTER TOWNSHIP.

A dozen or more wells on Stewart Run and Pursley Creek below Oak Forest constitute the only gas field in this large township. Most of the wells have been drilled since 1903 and, although low in the syncline, are giving fair quantities of gas from the lower sands. A few other scattering wells are producing gas. These include the James Adamson well (288) and the W. M. Boler well (289), 0.7 mile and 1.3 miles, respectively, east of Rogersville. Several wells in various parts of the township, namely, the A. R. White well (290) near Bluff, the B. L. Woodruff No. 1 (291) at Woodruff, the Thomas Grove well (24) in a ravine on Hargus Creek 1.4 miles east of Woodruff, and one or more wells in the Grays Fork field, are said to have produced some gas, but at present they are unproductive. The following is a record of the Thomas Grove well:

Record of Thomas Grove well (24), Center Township.

	Thickness.	Depth.
	Feet.	*Feet.*
Coal, Waynesburg	.....	335
Coal, Mapletown	.....	625
Red cave	115	1,115
Sand, Gas	.....	1,500
Sand, Salt (salt water at 1,620 feet; break in Salt sand at 1,650 feet)	216	1,789
Slate and red slate	74	1,863
Lime, Big	75	1,938
Sand, Big Injun (break at 2,100 feet)	284	2,222
Slate	98	2,320
Sand, Squaw	80	2,400
Slate and lime	108	2,508
Sand, Thirty-foot	62	2,570
Slate and shells	140	2,710
Sand, Fifty-foot (gas and show of oil at 2,715 feet)	76	2,786
Slate	5	2,791
Shells and sand	33	2,824
Sand, gray (Nineveh)	11	2,835
Slate and shells, red rock	30	2,865
"Pencil cave"	5	2,870
Sand, Gordon (gas at 2,876 feet)	37	2,907
Slate and shells	18	2,925
Red rock	57	2,982
Sand, Fourth	23	3,005
Sand, hard, shells and slate	45	3,050
Sand, Fifth	35	3,085
Slate	105	3,190

Most of the dry holes are located in the northwest corner of the township, on a continuation of the belt of holes extending between the Nineveh and Bristoria oil fields. East of the Nineveh syncline wells have been drilled for oil on the Ross heirs' farm (292), 0.6 mile north of Rutan, and on the Scott farm (28), 1 mile southwest of Rutan, but both were dry. On the structural slope rising toward the Amity anticline no wells have been drilled for about 2 miles; but near the head of Clover Run an unsuccessful attempt was once made for oil on the A. I. Lindsey farm (293).

JACKSON TOWNSHIP.

In the vicinity of Delphene, on the southeastern border of the Bristoria oil field and extending up the anticlinal slope for over a mile, lies a field of about a dozen wells which produce gas mainly from the Gordon, Gordon Stray, and Fourth sands. As can be seen from the structure contours the relation of this field to the adjacent oil field is normal. All the wells at present producing gas lie southeast of a line passing in a northeast-southwest direction thru the mouth of the run entering Job Creek below the store at Delphene. The wells west of this line in the township once produced gas, but are now abandoned. At least 4 wells—the J. L. Pethtel No. 2 (78), L. C. Johnson No. 2 (294), and Karl Crawford Nos. 1 (295) and 2 (296)—in the Bristoria oil field have produced gas. In these scattering wells the gas is derived from the Gordon and Gordon Stray sands and is found only in cases where the drill passes below the producing oil sand.

Outside the Delphene and Bristoria fields, gas has been produced in two wells higher up on the anticline. These are the A. C. Fordyce well (297), about 1 mile northwest of Bluff, and the Elijah Maple well (298), 2.8 miles south of Delphene. A little gas is reported in 2 wells in the vicinity of Woodruff and in 1 well 1½ miles southeast of Delphene. The Hughes No. 1 well (73), at White Cottage was dry. The only part of this township which has been thoroughly tested for oil or gas is the northwest corner, and in the entire area east and southeast of Delphene only 7 holes are known to have been drilled. In a strip 2½ miles wide crossing the southern side of the township, so far as known, only 1 hole has been put down.

GILMORE TOWNSHIP.

The Hoovers Run field, which lies mainly in Wayne Township, veers to the west into the southeast corner of Gilmore Township as far as Jollytown, near which about a dozen wells are now producing gas. The principal producing sands in this field are the Fifth and Big Injun.

Gas has been found in the Garrison well (67), on Garrison Fork, 1½ miles west of Jollytown, and in the J. P. Hagan well (299), 2 miles west of Jollytown, near the mouth of Six Run. The J. B. Fordyce well (66), 2 miles west of Pinebank, and the Josephus Rice well (300), 2 miles east of New Freeport, also produce gas. There is a dry hole on Blockhouse Run 1 mile below Triumph and another on Garrison Fork three-fourths of a mile above Bloody Run. The areas between Garrison Fork and Ashtree and that west of Six Run had not been tested by the drill up to the time this region was visited.

In view of the peculiar relations of the Hoovers Run field to the geologic structure, the probability of the further extension of the field in this township seems almost hopeless. However, an anticlinal axis crosses the township less than a mile west of Pinebank and Jollytown, and as gas is most likely to be found on anticlinal folds, it would seem worth while to test rather thoroly the territory in the vicinity of this axis. West of Jollytown and Pinebank only six wells have been drilled in the township, and as four of these have found gas there would seem to be a good chance of profit in prospecting the area.

RICHHILL TOWNSHIP.

The largest producing gas area in western Greene County is the Richhill field, which covers most of the northern-central part of this township. This field occupies the broad, triangular, knob-like summit of the Washington anticline. Gas is found at a number of horizons, including those of the Salt, Big Injun, Nineveh, Gordon Stray, Gordon, and Fourth sands. Owing to its occurrence in the

upper sands, gas is generally used in drilling the lower portion of the well. The principal operations here are conducted by the Natural Gas Company of West Virginia. This field contains about 35 wells, including 2 wells on the boundary line of Morris Township near Simpson Store. One of the best sections in this field is given by the Orndorf No. 1 well (301), near Graysville:

Record of Orndorf No. 1 well (301), Richhill Township.

	Thickness.	Depth.
	Feet.	*Feet.*
Coal, Waynesburg	.....	312
Coal, Mapletown	.....	512
Coal, Pittsburg	.....	618
First red rock	15	800
Second red rock	10	820
Coal	2	847
Red rock	40	925
Slate, white	20	945
Coal	3	995
Sand, Hurry up	75	1,188
Slate, soft	10	1,390
Sand, Gas	.....	1,490
Sand, Salt, containing a little coal	125	1,690
Lime, Big lime	45	1,790
Sand, Big Injun (some bad-smelling oil at 1,890 feet)	253	2,043
Sand, Thirty-foot	30	2,405
Sand, Gantz	15	2,510
Sand, Fifty-foot (considerable gas at 2,572 feet; bottom of first streak of sand at 2,581 feet)	30	2,599
Sand, Nineveh Thirty-foot, red (no sign of oil)	13	2,682
Cave above the Gordon	37	2,719
Sand, Gordon Stray (oil at 2,737 feet; slate at 2,743 feet)	31	2,750
Sand, Gordon	8	2,777
Sand, Fourth	10	2,814
Sand, Fifth	10	2,872

Outside the Richhill field natural gas is widely distributed in this township. Near the junction of Long Run and Job Creek and between that place and the mouth of Wright Run are six wells, producing gas from various sands. In the valley of South Fork, within 1½ miles of McCracken, are situated several gas wells, and to this small group the name Sugar Grove field has sometimes been applied, after an old name for McCracken. The first wells obtained gas in the Fifty-foot sand. Southeast of Jacksonville the crest of the Washington anticline is not known to have been tested. West of South Fork, within 1½ miles of the State line, there are five gas wells, proving the continuity of the Richhill field in this direction. In the southwest corner of Richhill Township the well records are generally very poor and therefore no further statement can be made regarding the producing sands. From what is known of the occurrence of gas elsewhere in this and in Aleppo Township it seems reasonable to suppose it may be found in almost any sand from the Salt down to the Fifth. This township has been fairly well tested both for gas and oil. The locations of dry holes, which are valuable as danger signals, are shown on the map. Several of these are located in the valley of Long Run in the extreme southeast corner of the township, near the

axis of the Nineveh syncline, in the northwest border of the Bristoria oil field. The absence of oil or gas may possibly be due to the local occurrence of salt water, but in this region salt water is generally absent. A well drilled through the Bayard sand, three-fourths of a mile north of Bristoria, was unproductive. In 1904 a well was drilled 1 mile northeast of McCracken and proved to be dry. Two attempts have been made to find gas and oil on the steep flank of the anticline between the Richhill and Grays Fork fields in the vicinity of Graysville, but without success.

ALEPPO TOWNSHIP.

Considerable gas has been found in various parts of Aleppo Township, but no well-defined fields of any size occur. At the southwest corner of the Bristoria oil field there are two gas wells which may be considered as the western extension of the Delphene field. Two dry holes have been drilled 1 mile and 1½ miles south-southwest of Higbee. Around the north end of the New Freeport oil pool there are several gas wells. With one exception these wells obtain gas in the Nineveh sand. The S. C. Leighliter No. 1 well (302) is productive in the Big Injun sand and did not go below that horizon. The John T. Elbin No. 2 (4) is producing both from the Big Injun and Nineveh sands. This well was drilled into the Fourth and obtained a show of oil in the Gordon. The following is its record:

Record of J. T. Elbin No. 2 well (4), Aleppo Township.

	Thickness.	Depth.
	Feet.	*Feet.*
Coal, Pittsburg		950
Sand, Salt	80	1,950
Lime, Big lime	70	2,193
Sand, Big Injun (first gas at 2,193 feet; second gas at 2,283 feet)	254	2,447
Sand, Thirty-foot	25	2,800
Sand, Fifty-foot	45	2,995
Sand, Nineveh (gas at 3,029 feet)	18	3,038
Sand, Stray	45	3,088
Sand, Gordon (show of oil at 3,129 feet)	20	3,140
Sand, Fourth	12	3,209
Total depth		3,263

A dry hole (303) was drilled on the Robert Ullom farm, 2 miles southeast of Aleppo and 0.3 mile east of the Morris L. Pethtel No. 1 (17) well. This small group of wells and also the two wells mentioned above as forming the west end of the Delphene field lie on a westward projection of the structure, between the Bristoria and New Freeport oil fields. West of the north end of the New Freeport oil field, lying lower down the synclinal slope than most of the oil wells, is a group of four gas wells. One of these wells (304), on the Elizabeth Sammons farm, obtained gas in the Big Injun sand and went no deeper. A second well on this farm obtained gas in the Nineveh and Gordon

sands, in addition to a small show of oil in the Gordon. The westernmost of these four wells—the Christ. Grim No. 1 (7)—has been abandoned, but the record shows that it found gas in the Big Injun and Fourth sands and oil in the Gordon. A well (305) drilled in 1897 on the Anderson Hinerman farm, 1½ miles east of Morford, was abandoned, having found nothing but a small show of oil in the Gordon sand.

In this township there are a few scattering gas wells west of the Nineveh syncline. Several of them lie just outside the Aleppo oil field and on all sides except its lower or synclinal side. These are the Lewis Kuhn (306), John Moore (307), John Riggle (308), Clara Riggle (309), and Rachel Grim (310) wells, all of which are within a mile of Aleppo. The Rachel Grim well produces both gas and oil, the gas being derived from the Big Injun and Nineveh sands and the oil from the Fourth. The rock pressure of this well was 1,380 pounds. Gas is produced from several horizons in these wells, but the greater part of it probably comes from the Nineveh sand. The record of the Clara Riggle well (309), which obtained gas in the Bayard sand, is given below:

Record of Clara Riggle well (309), Aleppo Township.

	Thickness.	Depth.
	Feet.	*Feet.*
Coal, Mapletown	.....	895
Coal, Pittsburg	.....	997
Sand, Murphy	45	1,155
Sand, Dunkard	60	1,445
Sand, Gas	65	1,810
Sand, Salt	110	2,010
Lime	80	2,230
Sand, Big Injun	270	2,500
Sand, Gantz (top)	.....	2,770
Sand, Fifty-foot (gas at 2,998 feet)	37	3,030
Sand, Nineveh (gas at 3,065 feet)	15	3,075
Red rock	3	3,078
Sand, Gordon Stray	39	3,117
Sand, Fourth	13	3,221
Sand, Bayard (top) (gas)	.....	3,410
Total depth	.....	3,447

Along the run between Aleppo and Morford there are 3 dry holes, and another lies half a mile west of Morford. These 4 holes lie very nearly along the strike and close to the synclinal axis. They penetrated the Gordon or the Fourth sand.

About 1 mile northwest of the Aleppo field a dry hole (19) was drilled on the J. E. Staggers farm, but it penetrated only a short distance beyond the Nineveh sand, in which a show of gas was found. Across the road northwest of this well is a gas well (311) on the Charles Bean farm. As can be seen from the map, the contours indicate something of a structural flat here. From the best evidence obtainable the Staggers well seems to be situated on the sharp edge of this bench and the Bean well a short distance west of

the edge. It seems possible that further drilling on this bench may obtain more gas. At a point 0.4 mile northeast of the Staggers well, or 1.1 miles northwest of Aleppo, a dry hole was once drilled on the Grimes farm. This well has about the same structural relations as the Staggers well, but is a little farther down in the syncline. Along the strike to the northeast, however, is a well (312) on the Thomas Thorpe farm, 1.7 miles north of Aleppo, on Blacks Creek, where gas is said to have been obtained. Gas is said to occur also in the Levi Thorpe well (313), 0.6 mile farther west on the same creek; the John Lewis well (314), on South Fork at the Richhill Township line; the M. L. Polen well (315), on Mudlick Fork, 0.8 mile south of McCracken; the Anderson well (316), on a tributary to Mudlick Fork, one-half mile southwest of the Polen well, and the Benjamin Phillips well (317), on Hewitt Run near the State line. On a tributary to Mudlick Run, 0.9 mile west-southwest of the Anderson well and 1.8 miles southwest of McCracken, a well (203) was drilled in 1904 on the Benson heirs' farm to a depth of over 5,300 feet, but was unproductive. Lying south of the Benson well and northwest of the line of dry holes extending from a point near Morford to the vicinity of Aleppo is an area of about 5 square miles which is not known to have been tested; but as its structural relations are similar to those of the Aleppo field, it may be expected to yield some oil or gas.

SPRINGHILL TOWNSHIP.

The New Freeport gas field covers a small area lying east of the oil field of the same name and extending southward from New Freeport. This field contains about 15 productive wells. Gas is produced from the Nineveh, Gordon, Fourth, and Fifth sands. According to report the rock pressure in one well in the Gordon was as high as 1,000 pounds, but in other instances it is less, being generally 500 to 550 pounds. This field lies on the east slope of a minor anticlinal fold which enters Greene County from the south. At present the field extends less than 2 miles south of New Freeport, but it seems possible that further drilling may enlarge it in this direction. It is also possible that other productive wells will be found northeast of New Freeport, as a test well about a mile northeast of that village is said to have found gas. Gas is also produced in the A. J. Dye well (318), 1.4 miles north of New Freeport and half a mile east of the productive oil belt. It would seem worth while to test the territory between these 2 wells and also farther northeast along the strike in the direction of Nettle Hill.

Another group of gas wells lies near the crest of the small anticline between Deep Valley and the State line on the south. These wells are less than 10 in number and do not form a definite gas field, but are scattered among producing oil wells or along the west side of

the oil field. The gas is obtained mainly from the Salvation sand, but a few wells find it in the Gas, Salt, and Big Injun sands. The lack of oil in these wells is explained by the fact that they do not reach the Nineveh sand. When the supply of gas fails they will doubtless be drilled to a greater depth. Three miles southwest of Deep Valley, near the State line, a well (136) was drilled in 1903 on the D. R. Meigham farm, and gas was found in the Salvation sand. This well was drilled through the horizon of the Gordon sand for oil, but without success. It is probable that the gas field will be extended in this part of the township. The record of the Meigham well is as follows:

Record of D. R. Meigham No. 1 well (136), Springhill Township.

	Thickness.	Depth.
	Feet.	*Feet.*
Coal, Pittsburg	6	1,086
Sand, Big Dunkard	110	1,680
Sand, Gas	60	1,890
Lime (water at 1,960 feet; gas at 2,010 feet)	25	1,970
Lime, Big	75	2,335
Sand, Big Injun	165	2,590
Sand, Fifty-foot	15	3,090
Sand, Nineveh	11	3,128
Sand and shells	7	3,140
Do	7	3,175
Do	9	3,195
Sand, with slate	5	3,243
Shells	5	3,295
Total depth	.....	3,424

About two-thirds of the distance between the Meigham well and the Hutchinson well (131), in the Board Tree oil field, a dry hole (319) was once drilled on the J. L. Riggs farm, on Knob Run. Dry holes have been drilled on the Caseman farm (128), 1.2 miles west of Deep Valley, and on a farm (320) on Wagonroad Run, 1 mile north of Deep Valley. At least 1 well in the New Freeport oil field, near the northern border of the township, produces gas.

RELATION OF OIL AND GAS POOLS TO GEOLOGIC STRUCTURE.

From a study of the relation of oil and gas pools to the geologic structure shown on the accompanying map (Pl. I), certain general statements can be made in respect to their mode of occurrence. It will be seen by reference to the map that in this county gas is found most abundantly along the axes of the anticlines, but it also occurs on the steep flanks of the folds, on synclinal axes, and in the midst of oil pools. The location of oil pools in relation to structural features has been mentioned in the description of the fields. It has been shown that the Blackshire and Garrison pools are on the flank of an anticline along the line where there is a marked change in grade. The Dunkard Creek pool bears the same relation, accompanied by a short

and slight reverse dip, while the Willow Tree pool lies around a small basin. The Mount Morris pool, which is near the base of the western limb of the Fayette anticline and also at a point of decreased grade, is limited on the lower or western side by a thinning out of the porous pay streak. On the other hand, the Fonner oil field laps over an anticlinal axis, while the Nineveh and Bristoria fields cross a synclinal axis. From Bristoria southward to the State line there is an almost continuous belt of oil wells, the north end of which is in the bottom of the Nineveh syncline and the south end 175 feet higher, on a minor anticline.

As shown on the map, the Wright Run pool, which contains two oil wells midway between Bristoria and Jacksonville, lies on the steepest slope of the Washington anticline. This is a very unusual position for the accumulation of oil, and it seems probable that the pool is small.

The Lantz oil pool, in Wayne Township, is 1½ miles east of the syncline and separated from it by a gas pool, quite out of accord with the anticlinal theory.

Thus it is apparent that in Greene County there is not such a close agreement between the occurrence of oil and gas and the geologic structure as has been noted in other parts of the Appalachian basin. The anticlinal theory, of which so much has been written, does not seem to apply here, or at least it must be modified materially before it will account for the facts.

Since the ability to determine the location of new fields in advance of drilling and the most favorable line of extension of the existing fields depends on knowledge of the laws governing the flow of hydrocarbons through the rocks and of the conditions controlling the action of these laws, it is desirable to analyze somewhat closely the conditions which prevail in this area and to determine why it differs from others that are regarded as typical of the Appalachian region.

In undertaking such an analysis the first thing to be determined is the amount of water in the oil and gas bearing rocks—are they saturated, do they contain a little water, or are they dry? Unfortunately this is a sort of information that the driller rarely notes, unless the flow of water is phenomenal; consequently in old fields it is difficult to obtain reliable data on this point. Present knowledge regarding water in the rocks may be summarized as follows: The Salt sand is almost universally wet—so saturated with water as to fill up the hole and retard drilling. Fifty barrels an hour have been bailed from it without exhausting the flow. Water is found where the sand is soft. Where the Salt sand is very hard it may be dry. The Big Injun sand in some wells has a little very salty water near the top and bottom. At Mount Morris water occurs in a soft streak of rock a few feet below the oil pay streak and separated from it by dense, hard strata.

Water has been reported in widely scattered wells at various horizons, but the occurrences below the Salt sand are uncommon. A few wells in the Waynesburg syncline filled with water from the Bayard sand. In fact, some gas wells along the western edge of the Waynesburg field show a tendency to fill with water from the Bayard sand as the gas becomes exhausted. As a rule, however, water is not found in any abundance below the Salt sand, many wells being perfectly dry below that horizon.

In accounting for the accumulation of oil and gas it is therefore safe to assume that the rocks, at least below the Salt sand, are practically dry; but it is equally safe to say that they have not always been in this condition, as they originally consisted of water-laid material and so must have been thoroughly saturated. What caused the water to disappear and how it departed is a mystery, but in the lower rocks of Greene County it is practically all gone.

It is difficult to account for the circulation of hydrocarbons through dry rocks, but if the rocks were originally saturated is it necessary to suppose that the oil reached its present position since the rocks became dry? Is it not more reasonable to suppose that the accumulation of the oil dates back to the time when water was plentiful and that it played an all-important part in the movement of the oil? This being so, oil formed in the underlying shales would naturally be forced upward on the water as a medium until it reached the upper limit of the medium or encountered an impervious barrier. The amount of oil which will accumulate under such conditions depends largely on the texture of the rock in which it occurs. If the porous rock is a coarse sandstone, it will afford opportunity for the accumulation of a large quantity of oil; but if the texture is fine, the reservoir will hold only a small amount. If the impervious stratum is level, oil and gas will collect beneath it in a thin sheet having nowhere any great volume. If, however, the cap rock is inclined, oil and gas will be forced along beneath it until a reverse dip occurs or until the top of the water is reached. Here the oil will rest. Thus oil and gas from a considerable area may be collected in a belt or pool. To assume the existence of a continuous porous stratum is not wholly safe, however. The sand rocks are of varying degrees of porosity, being in some places composed of fine sand densely packed and in others made up of coarse pebbles. Also the sand grains may be loosely or tightly cemented together by silica, iron oxide, or calcite. In any case these differences in the porosity of the reservoir strata may produce results in the accumulation of gas and oil quite different from what they would have been were the rocks of uniform texture.

On the supposition that, whether the rocks be wet or dry, natural gas will rise in a porous stratum on account of its specific gravity,

which is less than that of water or air, until stopped by an impervious cover, then anticlinal crests, provided they are unbroken, are the best places to look for gas. Oil in water-bearing rocks that are tilted should be found accumulated on the crest of anticlines that are below water level and floating on the water at its upper limits. It can ascend through rocks only so far as they are saturated and must stop at water level.

The structural position of the oil pools and the dryness of the rocks in Greene County suggest the hypothesis that the oil accumulated in pools after the formation of the rocks, while they were yet saturated with water, but that with the recession or disappearance of the water the oil moved by gravity back down the slope of the bed to its present position. Under these conditions the oil would be stopped in its downward progress by a reversed dip, by a dip of lower angle, or by increased density or thinning out of the reservoir rock.

The position of the Dunkard Creek pool is believed to be due to a slight, short reversal of the dip. A structural bench across which gravity could not overcome friction holds the Blackshire and Garrison pools. Lessened grade and thinning out of the reservoir rock may account for the Mount Morris pool. The Lantz field, in Wayne Township, is distinctly higher structurally than the gas pool on the west. While there is a change in dip here which may explain the presence of the oil, it is possible also that lessened porosity retarded further downward movement of the oil, but did not prevent the large amount of gas in this region, by its expansive force, permeating the lower portion of the same sand. It does not seem impossible that where gas is formed in such abundance as to fill an anticline it may by its own abundance and expansion be forced into all those portions of the reservoir rock not occupied by oil. The oil pool from Nineveh to Deep Valley lies in the syncline, indicating the nonsaturation of the rocks.

The anticlinal theory holds good for the extension of pools where the rocks are saturated with water, but the points at which oil is likely to occur can not be judged in undeveloped territory until the structure has been accurately determined and the presence or absence of water in the rocks ascertained.

PROSPECTIVE TERRITORY.

In the preceding pages a few hints have been given in regard to further development of the gas and oil fields in this county. It is hazardous to make suggestions of this sort and they should be considered as only of speculative value. The writers are of the opinion that there are yet some areas of considerable extent which might well be tested. The occurrence of gas and oil can not be foretold, but the following localities are proposed for consideration:

An area of several square miles lying south of Waynesburg between Laurel Run and Smith Creek has been tested by two holes on the Inghram (261) and Wood (262) farms. These holes were dry, but this is not convincing evidence that gas may not be found on Sugar Run and on Laurel Run.

The Mount Morris pool possibly might be extended to Whiteley Creek by drilling just west of the 550-foot structure-contour line, as shown on the map (Pl. I). This opinion is based on the geologic structure, which swings to the northwest, on the position of the Litman well (325), and on the reported occurrence of oil (pp. 57–58) at the mouth of Woods Run. If the pool extends across Whiteley Creek, it must be narrow, for the Lantz well No. 2 (221), which is farthest down the dip, was dry and the Rice well (223), which is supposed to be near the upper limit of the pool, had only a small showing of oil.

Blacks Run or the ridge to the east, in Perry Township, is along the strike north from the Brown and Shriver oil wells, which are on Dunkard Creek just over the State line in West Virginia. The report that a strong flow of oil (p. 58) was obtained in the Headley well (228) on Little Shannon Run suggests the possibility that drilling on or near Blacks Run might result in the discovery of more oil.

Since many of the wells in the Dunkard Creek field were not exhausted but were abandoned because the flow of oil softened the rocks and the mud plugged the holes, it may be that considerable oil still remains in this pool. Testing the field would not be expensive, as the oil is only about 500 feet below the surface and either coal or gas for fuel can be obtained readily.

Except 6 wells on Grays Fork, a line of holes drilled on the west side of the Nineveh syncline, between Nineveh and Bristoria, proved unproductive, although the geologic structure suggests the possibility that there is a continuous pool of oil in this district. There is a chance that drilling along the axis or on the east side of the syncline between Nineveh and Delphene might be more successful. Only 2 holes, both of which were unproductive, have been drilled on the east side of the syncline between Nineveh and the head of Lick Run. This is hardly sufficient reason for condemning so large an area. It

would also seem desirable to prospect farther southwest and northwest of Deep Valley before those territories are finally given up as unproductive.

Other areas to test for oil lie between Higbee and the north end of the New Freeport field, just west of the group of gas wells, and between Aleppo and Bristoria west of the syncline. Between Morford and the Benson heirs' well (203) is a considerable area in which no tests are known to have been made. The same is true of the region between the Delphene and New Freeport gas fields, east of the oil belt. Throughout southern Jackson and northern Gilmore townships less than half a dozen holes have been put down and there is still probability of discovering pools of oil or gas. Gas should be found along the Washington anticline 1 mile east of Ryerson Station.

WELL RECORDS.

The advantage of keeping accurate and complete records is almost universally underestimated by the drillers. In the great majority of cases only one or two coal beds and the principal oil and gas horizons are noted. These records may answer the purpose for recognizing the sand, but tell nothing of the character or distribution of the intervening formations, and therefore it is impossible to draw from them any geologic conclusions of value.

A few drillers and contractors have kept very good records, in which the thickness and depth of all beds from the surface down to the very lowest have been noted. It is urged that more such records be kept. It is especially important to note the positions and character of all coal, red shale, and limestone beds, as on these the geologist depends most of all for his correlations. Such data frequently enable him to determine the limits of a certain formation and therefrom the geologic name corresponding to the driller's term for a certain sand. In keeping records care should be taken to distinguish between limestones and hard sandstones. Limestone can always be distinguished from other rocks by its effervescence when treated with a few drops of dilute hydrochloric acid.

To meet the needs of drillers and other persons who wish to keep pace with the most approved methods of taking notes, the United States Geological Survey keeps in stock pocket record books which may be obtained, without cost, by all who desire them and will furnish records to the Survey. The covers of these notebooks contain a few brief geologic notes and suggestions to drillers.

In the accompanying table abbreviated records of 170 wells in the county are given. These records have been chosen from several hundred by reason of their wide distribution and their completeness. The following abbreviations are used in the column headed "Owner:"

Carnegie	Carnegie Natural Gas Company.
South Penn	South Penn Oil Company.
Fort Pitt	Fort Pitt Gas Company.
N. G. W. V	Natural Gas Company of West Virginia.
Utility	Union Utility Company.
Greensboro	Greensboro Gas Company.
Ross	Tim Ross & Co.
Dunn	J. L. Dunn & Co.
A. O. D. C	American Oil Development Company.
Hukill	E. M. Hukill & Co.
D. O. & G	Dunkard Oil and Gas Company.
Wheeling	Wheeling Natural Gas Company.
West. Penn	Western Pennsylvania Natural Gas Company.
Mfrs. L. & H	Manufacturers Light and Heat Company.
Phila	Philadelphia Company.
Peoples	Peoples Natural Gas Company.
Monong	Monongahela Natural Gas Company.
Nin. Pet	Nineveh Petroleum Company.
Jefferson	Jefferson Oil and Gas Company.

In the column of elevations the letter B indicates that the elevation of the well mouth was obtained by barometer; L by spirit level.

Summarized record of

[Elevation in feet above

No. on Pl. 1.	Name of well.	Township.	Owner.	Elevation.	Product.	Producing sand.
1	W. J. Bryan No. 5	Aleppo	South Penn	1,350 B.	Oil	Nineveh
2	W. J. Bryan No. 11	do	do	1,506 L.	do	do
3	Wm. Clendenning No. 3	do	do	1,332 L.	do	do
4	J. T. Elbin No. 2	do	do	1,175 B.	Gas	
5	Phil Garey No. 1	do	Carnegie	1,060 B.	Oil	Fourth
6	T. Z. Griffith No. 1	do	Tim Ross	1,202 B.	Dry	
7	Christ. Grim No. 1	do	do	1,165 B.	Gas	Fourth
8	Elias Grim No. 1	do	Dunn	1,134 B.	Oil	do
9	Wm. McQuay No. 3	do	South Penn	1,323 B.	do	Gordon
10	Jas. McVey No. 1	do	do	1,260 B.	Dry	
11	Jas. McVey No. 2	do	do	1,418 L.	Oil	Nineveh
12	J. D. Miller No. 3	do	do	1,368 B.	do	do
13	Jacob Murray No. 1	do	Dunn	1,165 B.		
14	Lewis Parry No. 1	do	South Penn	1,220 L.	Oil	Nineveh
15	Z. T. Parry No. 1	do	do	1,261 L.	do	do
16	Peter Parson No. 2	do	do	1,462 L.	do	do
17	M. L. Pethtel No. 1	do	do	1,075 B.		
18	Russell Sammons No. 2	do	do	1,390 B.	Oil	Fourth
19	J. E. Staggers No. 1	do	do	1,219 L.	Dry	
20	Wm. Weimer No. 1	do	do	1,255 B.	Oil	Fifth
21	L. G. Whipkey No. 1	do	do	1,332 L.	do	Nineveh
22	John Woods No. 4	do	do	1,119 L.	do	do
23	A. J. Griffith No. 1	Center	do	1,160 L.	do	do
24	Thomas Grove No. 1	do	Carnegie	1,185 B.	Gas	
25	Samuel Harvey No. 2	do	South Penn		do	
26	G. P. Iams No. 1	do	N. G. W. V	1,280 B.	Dry	
27	Wm. Milliken No. 2	do	South Penn	1,130 B.	do	
28	E. S. Scott No. 1	do	do	1,090 B.	do	
29	E. T. Throckmorton No. 1.	do	Carnegie	1,125 B.	Oil	
30	Alex. Woodruff No. 2	do		1,055 B.	Dry	
31	Biddle	Cumberland	Hukill	935 B.	do	
32	Will Lynch	Dunkard	Utility	900	Gas	Big Injun
33	Lot McClure No. 2	do	A. O. D. C	1,140 B.	Oil	do
34	Lot McClure No. 3	do	do	980 B.	Gas	do
35	Wm. McClure	do	Carnegie	1,000 B.	do	do
36	Mary A. Maple	do	Home Co	810 B.	do	do
37	T. J. Miller	do	Carnegie	1,220 B.	do	do
38	Pride No. 1	do	D. O. & G	1,080 B.	Oil	do
39	Ira Ross	do	Carnegie	970 B.	Dry	
40	Gilpin South	do	do	880 B.	Gas	Gantz
41	Stoneking No. 2	do	D. O. & G	1,250 B.	Oil	Big Injun
42	Bell	Franklin	Carnegie	1,080 B.	Dry	
43	Bowlby & Co. No. 2	do	do	1,240 B.	Gas	
44	Bowlby & Donley No. 1	do	do	950 B.	do	
45	L. M. Carpenter	do	Wheeling	1,020 B.	do	
46	County poorhouse	do	Carnegie	980 B.	do	
47	David Crayne No. 1	do	do	1,070 B.	do	
48	Thos. Dougal No. 2	do	do	930 B.	do	Bayard
49	John Frye	do	West Penn	1,150 B.	do	do
50	Gordon heirs	do	Carnegie	1,280 B.	do	do
51	Rebecca Hook	do	Fort Pitt	950 B.	do	do
52	A. J. Lippincott No. 1	do	Carnegie	1,140 B.	do	
53	John Miller	do	Fort Pitt	970 B.	do	Bayard
54	D. R. Pratt	do	Carnegie	1,250 B.	do	do
55	Wm. Rinehart No. 2	do	do	1,270 B.	do	Fifth
56	E. M. Sayers No. 1	do	Mfrs. L. & H	940 B.	do	Big Injun
57	R. A. Sayers	do	Carnegie	960 B.	do	
58	Madison Scott	do	do	1,250 B.	do	Bayard
59	F. M. Shriver	do	do	1,340 B.	do	do
60	H. P. Slauterback	do	Fort Pitt	970 B.	do	do
61	J. Sowers	do		935 B.	do	do
62	Strosneider	do	Carnegie	1,150 B.	do	do
63	Tharp No. 1	do	Fort Pitt	1,135 B.	do	do
64	Silas Waters	do	Carnegie	1,000 B.	do	Fifth
65	T. Wisecarver	do	do	1,075 B.	Dry	
66	J. B. Fordyce No. 1	Gilmore	Phila	1,098 L.	Gas	
67	T. J. L. Garrison No. 1	do	Peoples	1,030 B.	do	Big Injun
68	J. C. Gregg	Greene	Hukill		Dry	
69	L. C. Grim No. 2	Jackson	South Penn	1,335 B.	Oil	Nineveh
70	L. C. Grim No. 5	do	do	1,390 B.	do	do
71	Hannah S. Grimes No. 1	do	do	1,225 L.	do	do
72	W. T. Grimes No. 1	do	do	1,478 L.	do	do
73	Thos. Hughes No. 1	do	Carnegie	1,085 B.	Dry	
74	Thos. Hughes No. 3	do	do	1,110 L.	do	
75	Eaton Kinney No. 2	do	South Penn	1,280 B.	Oil	Nineveh
76	Sarah M. Moore No. 1	do	do	1,205 L.	do	do
77	W. H. Morris No. 5	do		1,430 B.	do	do
78	J. L. Pethtel No. 2	do	South Penn	1,215 L.	Gas	Gordon

wells in Greene County.

sea level; depths in feet.]

Pittsburg coal.	Salt.	Big Injun.	Thirty-foot.	Gantz.	Fifty-foot.	Nine-veh.	Gordon.	Fourth	Fifth.	Bayard.	Depth of well.	No. on Pl. I.
1,130	2,070	2,361	.....	.....	3,124	3,198	.....	.....	.....	.....	3,219	1
1,316	2,221	2,533	3,153	.....	3,295	3,363	.....	.....	.....	.....	3,397	2
1,165	2,087	2,390	.....	.....	3,135	3,215	.....	.....	.....	.....	3,227	3
950	1,870	2,193	2,775	.....	2,950	3,043	3,120	3,197	.....	.....	3,263	4
873	1,835	2,108	2,684	2,857	2,882	2,959	3,052	3,101	.....	.....	.....	5
1,055	1,970	2,270	2,860	2,970	3,060	3,128	3,224	3,270	.....	.....	3,330	6
1,020	.....	2,224	.....	.....	2,993	3,068	3,162	2,228	.....	.....	3,245	7
972	.....	.....	.....	.....	2,960	3,038	3,122	3,176	.....	.....	3,209	8
1,100	2,031	2,325	2,922	.....	3,070	3,148	3,251	.....	.....	.....	3,428	9
1,050	1,950	2,270	2,845	.....	.....	3,109	3,206	.....	.....	.....	3,254	10
1,195	2,100	2,430	.....	.....	3,201	3,254	.....	.....	.....	.....	3,341	11
1,190	2,110	2,420	3,010	.....	3,170	3,245	.....	.....	.....	.....	3,280	12
1,047	1,958	2,290	2,855	.....	3,045	3,128	3,230	3,286	.....	.....	.....	13
1,025	1,980	2,210	.....	.....	2,990	3,067	.....	.....	.....	.....	3,089	14
1,080	1,970	2,300	2,860	.....	3,050	3,124	.....	.....	.....	.....	3,145	15
1,282	2,220	2,520	.....	.....	3,272	3,336	.....	.....	.....	.....	3,236	16
935	1,835	2,190	.....	.....	2,930	3,000	.....	.....	.....	.....	3,071	17
1,233	.....	2,448	3,047	.....	3,204	3,289½	3,384	3,454	.....	.....	3,478	18
925	1,775	2,145	.....	.....	2,920	.....	.....	.....	.....	.....	3,013	19
1,055	1,960	2,270	2,860	.....	3,025	3,122	3,220	.....	3,295	3,477	.....	20
1,145	2,000	2,360	.....	.....	3,110	3,171	.....	.....	.....	.....	3,191	21
945	1,795	2,125	.....	.....	2,906	2,988	.....	.....	.....	.....	3,007	22
1,039	1,953	2,246	.....	.....	3,000	3,088½	.....	.....	.....	.....	3,125	23
707	1,573	1,938	2,508	.....	2,710	2,824	2,870	2,982	3,050	.....	.....	24
1,040	2,000	2,220	.....	.....	2,990	3,075	3,140	.....	3,308	.....	3,549	25
1,127	2,077	2,274	2,865	.....	3,045	3,132	3,210	3,295	3,352	.....	3,377	26
1,026	1,805	2,181	2,755	.....	2,946	3,031	3,165	3,225	3,297	.....	3,320	27
964	1,879	2,160	2,720	2,910	2,945	3,011	.....	3,209	3,249	.....	3,469	28
720	.....	1,915	.....	.....	2,630	.....	2,890	.....	2,980	.....	.....	29
762	1,640	1,992	2,584	.....	2,719	.....	2,902	2,952	3,027	.....	3,080	30
344	1,235	1,585	.....	.....	.....	.....	.....	.....	.....	.....	2,432	31
105	1,040	1,395	.....	.....	.....	.....	.....	.....	.....	.....	1,528	32
580	.....	1,865	.....	.....	.....	.....	.....	.....	.....	.....	1,978	33
415	.....	1,680	.....	.....	.....	.....	.....	.....	.....	.....	1,830	34
420	.....	1,690	.....	.....	.....	.....	.....	.....	.....	.....	1,850	35
170+	.....	1,148	.....	.....	1,770	.....	.....	.....	.....	.....	1,833	36
415	.....	1,665	.....	.....	.....	.....	.....	.....	.....	.....	1,855	37
515	.....	1,770	.....	.....	.....	.....	.....	.....	.....	.....	1,900	38
31+	.....	1,275	.....	1,840	1,923	.....	2,135	.....	.....	2,330	2,431	39
115	.....	1,379	.....	1,978	.....	.....	.....	.....	.....	.....	2,620	40
665	.....	1,915	.....	.....	.....	.....	.....	.....	.....	.....	2,072	41
640	.....	1,840	.....	.....	2,570	.....	2,775	2,820	2,890	2,990	3,060	42
835	.....	2,075	.....	.....	2,795	.....	2,875	3,120	3,175	3,270	3,289	43
390	.....	1,628	.....	.....	2,350	.....	2,540	2,600	2,694	2,826	2,850	44
400	1,260	1,625	2,185	2,265	2,330	2,400	2,525	2,615	2,705	2,810	2,839	45
362	1,125	1,540	.....	2,175	2,290	.....	.....	.....	2,665	2,750	2,908	46
412	.....	1,640	.....	2,340	2,385	.....	2,554	2,580	2,712	.....	2,732	47
420	.....	1,640	.....	.....	2,385	.....	2,520	2,560	2,730	2,853	2,879	48
743	1,615	1,985	2,630	.....	2,790	.....	2,895	2,965	3,082	3,207	3,355	49
603	.....	1,793	.....	2,510	2,551	.....	2,721	2,870	.....	3,033	3,060	50
436	1,430	1,655	2,180	.....	2,380	.....	2,562	2,650	2,765	2,885	2,904	51
660	1,598	.....	2,385	2,510	2,580	.....	2,785	2,876	2,984	3,077	3,100	52
378	1,350	1,600	2,180	.....	.....	.....	2,500	2,633	2,690	2,807	2,842	53
748	.....	1,900	.....	.....	2,590	.....	2,930	.....	3,100	3,200	3,215	54
600	.....	1,850	.....	2,500	2,550	.....	.....	.....	2,890	.....	2,900	55
500	1,450	1,712	2,300	2,430	.....	.....	2,636	.....	2,794	2,927	2,945	56
390	.....	1,605	.....	.....	2,320	.....	2,590	2,615	2,670	2,808	2,833	57
615	.....	1,860	.....	2,530	2,575	.....	2,775	.....	2,895	3,020	3,030	58
872	.....	2,100	.....	2,835	2,870	.....	3,010	3,090	3,130	3,292	3,310	59
395	1,356	1,615	2,195	.....	.....	.....	2,540	2,649	2,705	2,823	2,854	60
517	1,475	1,733	.....	.....	2,477	.....	2,677	2,745	2,849	2,960	2,980	61
542	.....	1,768	.....	.....	2,442	.....	2,650	2,740	2,885	2,960	.....	62
710	1,600	1,910	.....	.....	2,710	.....	2,885	.....	3,060	3,163	3,175	63
446	.....	1,677	.....	2,375	2,395	.....	2,590	2,667	2,755	2,875	2,908	64
790	.....	2,026	.....	2,740	2,792	.....	.....	2,980	3,090	3,190	3,210	65
793	1,715	2,075	2,650	.....	.....	2,858	2,970	3,085	3,145	.....	.....	66
685	1,535	1,960	.....	.....	.....	.....	.....	.....	.....	.....	2,085	67
234	1,235	1,585	.....	.....	.....	.....	.....	.....	.....	.....	2,432	68
1,150	2,125	2,390	2,950	.....	3,111	3,193	.....	.....	.....	.....	3,220	69
1,200	2,120	2,435	3,010	.....	3,180	3,236½	.....	.....	.....	.....	3,256½	70
1,060	1,980	2,285	.....	.....	3,030	3,106	.....	.....	.....	.....	3,176	71
1,348	2,212	2,578	3,140	.....	3,318	3,390	.....	.....	.....	.....	3,418	72
925	.....	2,151	.....	.....	.....	2,980	.....	.....	.....	.....	3,211	73
803	.....	2,006	.....	2,743	2,773	.....	2,943	3,023	3,063	.....	3,125	74
1,100	1,988	2,330	2,900	.....	3,030	3,148	.....	.....	.....	.....	3,198	75
1,054	2,000	2,250	.....	.....	3,030	3,105	.....	.....	.....	.....	3,155	76
1,213	2,045	2,440	3,015	.....	3,203	3,243	.....	.....	.....	.....	3,267	77
1,045	1,970	2,295	.....	.....	3,015	3,093	3,135	.....	.....	.....	3,210	78

Summarized record of

No. on Pl. I.	Name of well.	Township.	Owner.	Elevation.	Product.	Producing sand.
79	Catherine Rinehart No.1	Jackson	South Penn	1,043 L.	Oil	Nineveh
80	Elisha Rinehart No. 1	do	do	1,110 B.	Gas	
81	Elisha Rinehart No. 2	do	do	1,470 B.	do	Nineveh
82	O. P. Scott No. 1	do	Carnegie	1,065 B.	Dry	
83	John Eaton	Jefferson	do	1,110 B.	Gas	
84	Horner No. 2	do	Monong	810 B.	do	
85	C. M. Scott No. 1	do	Carnegie	1,140 B.	do	
86	Dr. B. Birch	Monongahela	Greensboro	820 B.	Dry	
87	A. P. Longanecker	do	South Penn	960	Gas	Big Injun
88	Ben Williams	do	Greensboro	960	Dry	
89	John Bennett	Morgan	Carnegie	1,140 B.	Gas	Bayard
90	Cotterell	do	do	1,070 B.	Dry	
91	Montgomery	do	do	980 B.	Gas	Bayard
92	Eliza Shape	do	Fort Pitt	1,175 B.	Dry	
93	Van Kirk	do	Jefferson	895 B.	Gas	
94	Hugh Auld No. 1	Morris	Nin. Pet	1,085 B.	Dry	
95	Enoch Brooks No. 3	do	South Penn	1,455 B.	Oil	Fifty-foot
96	J. B. Carter No. 1	do		1,225 B.	do	Nineveh
97	James Dunn No. 1	do	Dunn	1,090 B.	Dry	
98	Wm. Fonner No. 5	do	South Penn	1,240 B.	Oil	
99	Wm. Fonner No. 6	do	do	1,425 B.	Dry	
100	T. F. Lightner No. 1	do	Carnegie	1,088 B.	do	
101	Warren Mankey No. 1	do		1,255 B.	do	
102	Shoup No. 5	do		1,235 B.	Oil	Gantz
103	Hugh Simpson No. 1	do		1,060 B.	Dry	
104	John H. Smith No. 3	do		1,070 B.	Oil	Nineveh
105	Hester Delaney	Perry	South Penn	970 B.	Gas	Fifth
106	D. L. Donley	do	Hukill	920 B.	Oil	Big Injun
107	John Ackley No. 1	Richhill	N. G. W. V	1,025 B.	Gas	Gordon
108	W. J. Bryan No. 1	do	Carnegie	1,020 B.	do	
109	Eva Buckingham	do	N. G. W. V	1,225 B.	do	
110	Jas. Burns No. 1	do	do	1,100 B.	do	Gordon stray.
111	Sarah Burroughs No. 1	do	South Penn	1,022 L.	Oil	
112	Durbin No. 1	do	N. G. W. V	1,215 B.	Gas	Big Injun
113	Fletcher No. 1	do	do	1,195 B.	do	
114	A. J. Headley No. 1	do	do	1,225 B.	Oil	Gordon
115	H. Hughes No. 1	do	South Penn	1,110 L.	Gas	
116	Jennings heirs No. 1	do	N. G. W. V	1,425 B.	do	
117	N. H. Johnson No. 1	do	South Penn	1,246 L.	Oil	Nineveh
118	John Leslie No. 1	do	do	1,155 B.	Dry	
119	J. K. Loughridge No. 1	do	Carnegie	1,255 B.	Gas	
120	G. W. McCullough No. 1	do	N. G. W. V	1,265 B.	do	
121	J. D. Spragg No. 1	do	South Penn	1,090 B.	Dry	
122	Thos. Staggers No. 1	do	do	1,180 B.	do	
123	Sugar Grove	do	Aleppo Oil Co	1,046 B.	Gas	
124	J. K. Anderson No. 1	Springhill	Carnegie	1,205 B.	do	
125	Jos. Ashbee No. 1	do	South Penn	1,190 B.	Oil	
126	Silas Barnhart No. 1	do	do	1,555 B.	do	Nineveh
127	Masters No. 1	do	do	1,075 B.	do	Gordon
128	Caseman No. 1	do	do	1,255 B.	Dry	
129	F. A. Gover No. 2	do	do	1,495 B.	Oil	Nineveh
130	W. B. Griffith No. 1	do	do	1,365 B.	do	Gordon
131	Hutchinson heirs No. 4	do		1,080 B.	do	do
132	Wm. Johnson No. 7	do	South Penn	1,407 L.	do	Nineveh
133	W. H. Main No. 1	do	do	1,060 B.	Dry	
134	S. E. Martin No. 2	do	do	1,405 B.	Oil	Nineveh
135	W. B. Martin No. 2	do	do	1,399 L.	do	do
136	D. R. Meigham No. 1	do	do		Gas	
137	Richard Pethtel No. 2	do	Peoples		do	
138	Wm. Petit No. 1	do	South Penn	1,305 B.	Oil	Nineveh
139	S. E. Phillips No. 2	do	do		do	do
140	Jacob Rice No. 3	do	do	1,275 B.	do	do
141	Jacob Rice No. 14	do	do	1,030 L.	do	do
142	J. A. Riffle No. 1	do	do		do	Gordon
143	John Sellers No 6	do	do	1,235 B.	do	Nineveh
144	Mathias Thompson No.1	do	Peoples	1,195 B.	do	
145	W. H. Wildman No. 6	do	South Penn	1,425 B.	do	Nineveh
146	Amos Allison	Washington	Carnegie	1,100 B.	Gas	Big Injun
147	J. W. Closser No. 1	do	Fort Pitt	1,150 B.	do	Fifty-foot
148	Conger	do		950 B.	do	
149	Robert Hoge	do	Carnegie	1,060 B.	Dry	
150	Tim Ross	do	Ross	1,000 B.	Gas	
151	Geo. Stilwell	do	Fort Pitt	1,040 B.	Dry	
152	Felix Bell No. 1	Wayne	do	1,010 B.	Gas	
153	G. W. Blaker No. 1	do	South Penn	975 B.	Oil	Fifth
154	G. W. Cole No. 1	do		1,325 B.	Gas	do
155	S. S. Eddy No. 1	do	South Penn	1,145 B.	Oil	do
156	Arthur Hoy	do	Carnegie	1,500 B.	Gas	do

wells in Greene County—Continued.

Pittsburg coal.	Salt.	Big Injun.	Thirty-foot.	Gantz.	Fifty-foot.	Nineveh.	Gordon.	Fourth	Fifth.	Bayard.	Depth of well.	No. on Pl. V.
890	1,730	2,110	.....	.....	2,860	2,938	.....	.....	.....	.....	2,957	79
.....	1,805	2,125	.....	.....	2,850	2,938	.....	.....	.....	.....	3,329	80
1,114	1,964	2,344	2,932	.....	3,030	3,170	.....	.....	.....	.....	3,189	81
812	.....	2,080	.....	.....	2,790	.....	2,950	.....	.....	.....	3,148	82
580	.....	1,785	.....	.....	2,550	.....	2,635	2,715	2,780	2,980	3,182	83
55	900	1,320	1,900	2,000	2,050	.....	.....	.....	.....	.....	.....	84
600	.....	1,810	.....	2,490	2,552	.....	.....	.....	.....	3,000	3,068	85
120+	.....	1,140	.....	1,705	1,800	.....	2,000	.....	.....	2,315	2,666	86
295	1,230	1,570	.....	.....	.....	.....	.....	.....	.....	.....	1,842	87
25+	926	1,316	.....	.....	.....	.....	.....	.....	.....	.....	2,120	88
580	1,480	1,800	.....	.....	2,550	.....	2,735	2,830	2,890	3,015	.....	89
465	.....	1,645	.....	2,347	2,405	.....	2,590	.....	2,730	2,855	2,906	90
523	.....	1,750	.....	2,455	2,495	.....	2,665	.....	2,800	2,956	2,975	91
776	1,670	1,975	2,555	.....	2,735	.....	2,950	3,025	3,080	3,215	3,607	92
285	.....	1,500	1,870	2,190	.....	.....	2,355	2,430	.....	.....	2,658	93
866	.....	2,060	.....	.....	.....	2,830	3,000	.....	.....	.....	.....	94
1,002	.....	2,150	.....	2,907	2,938	.....	.....	.....	.....	.....	2,984	95
1,070	2,023	2,283	.....	2,990	3,024	3,116	.....	.....	.....	.....	3,155	96
800	1,625	1,994	2,595	.....	2,725	2,855	2,940	2,985	3,070	3,200	3,265	97
902	1,914	2,100	2,700	2,808	.....	.....	.....	.....	.....	.....	2,869	98
1,025	.....	2,220	.....	2,956	2,990	.....	.....	.....	.....	.....	3,010	99
810	.....	2,035	.....	2,680	2,800	.....	2,940	2,965	.....	.....	.....	100
1,074	2,034	2,292	.....	3,005	3,031	3,125	3,215	3,292	3,350	(a)	3,651	101
897	.....	.....	.....	2,823	2,850	.....	.....	.....	.....	.....	.....	102
840	.....	1,960	.....	2,750	2,775	.....	2,990	3,030	3,115	.....	3,197	103
880	.....	2,065	2,655	.....	.....	2,935	.....	.....	.....	.....	2,970	104
505	.....	1,765	.....	.....	.....	.....	.....	.....	2,897	.....	2,927	105
368	1,260	1,635	.....	.....	.....	.....	.....	.....	.....	.....	.....	106
500	1,431	1,680	2,240	2,350	2,400	2,525	2,629	.....	.....	.....	2,640	107
482	.....	1,950	2,300	.....	2,424	.....	.....	.....	.....	.....	.....	108
620	1,560	1,790	.....	2,475	.....	2,640	2,753	.....	.....	.....	.....	109
415	1,356	1,711	2,185	.....	2,325	2,445	.....	.....	.....	.....	.....	110
875	1,830	2,095	.....	.....	2,855	2,929	3,030	.....	3,110	.....	3,175	111
555	1,525	1,830	.....	.....	.....	.....	.....	.....	.....	.....	.....	112
642	1,576	1,782	2,380	2,520	2,570	2,660	.....	.....	.....	.....	2,736	113
810	1,750	2,010	2,600	.....	.....	2,854	2,935	.....	.....	.....	2,952	114
850	1,768	2,055	.....	.....	2,824	2,901	3,004	.....	.....	.....	3,133	115
780	1,717	1,940	2,570	.....	2,720	2,797	2,890	.....	2,985	.....	3,045	116
1,100	2,055	2,315	.....	.....	3,080	3,148	.....	.....	.....	.....	3,200	117
759	.....	1,910	2,530	2,630	2,690	2,768	2,902	2,935	2,990	.....	3,274	118
685	.....	1,815	.....	.....	2,600	.....	.....	.....	.....	.....	3,040	119
724	1,656	1,866	2,485	2,620	2,645	2,750	.....	2,900	.....	.....	2,978	120
890	1,805	2,105	2,665	.....	.....	.....	2,969	3,054	3,123	.....	3,227	121
1,027	1,915	2,245	.....	2,945	.....	3,073	.....	.....	.....	.....	3,334	122
614	.....	.....	.....	.....	2,895	2,662	2,825	.....	.....	.....	2,841	123
615	.....	1,820	.....	.....	2,596	.....	2,771	.....	.....	.....	3,046	124
863	1,785	2,090	2,728	.....	2,865	2,925	.....	.....	.....	.....	.....	125
1,338	2,255	2,585	.....	.....	3,318	3,380	.....	.....	.....	.....	3,398	126
890	1,838	2,130	2,700	.....	.....	3,011	3,095	.....	.....	.....	3,109	127
1,096	2,018	2,340	2,950	.....	3,130	3,195	3,272	3,305	3,390	.....	3,408	128
1,170	2,095	2,410	.....	.....	3,150	3,233	.....	.....	.....	.....	3,043	129
1,216	2,020	2,485	3,010	.....	3,190	3,260	3,383	.....	.....	.....	3,405	130
945	.....	2,189	.....	2,904	2,965	3,042	3,111	.....	.....	.....	3,200	131
1,160	2,085	2,400	.....	.....	3,040	3,203	.....	.....	.....	.....	3,226	132
782	1,725	2,038	2,591	.....	2,790	2,841	2,925	3,018	.....	.....	3,050	133
1,235	2,260	2,485	.....	.....	3,220	3,278	.....	3,452	.....	.....	3,461	134
1,105	2,030	2,345	2,920	.....	3,115	3,165	.....	.....	.....	.....	3,180	135
1,080	1,945	2,335	.....	.....	3,075	3,117	.....	.....	.....	.....	3,424	136
1,193	2,118	2,430	3,015	.....	3,176	3,243	3,369	3,430	.....	.....	3,426	137
1,000	1,925	2,230	.....	.....	2,980	3,058	.....	.....	.....	.....	3,081	138
988	1,912	2,210	.....	.....	2,968	3,037	.....	.....	.....	.....	3,057	139
1,014	1,956	2,240	2,900	.....	2,996	3,060	.....	.....	.....	.....	3,080	140
765	1,690	2,005	.....	.....	2,746	2,817	.....	.....	.....	.....	2,838	141
1,245	2,200	2,490	3,080	.....	3,230	3,313	3,408	.....	.....	.....	3,451	142
898	1,820	.....	.....	.....	2,878	2,957	.....	.....	.....	.....	2,982	143
875	1,640	2,125	2,700	.....	.....	2,957	3,040	3,094	.....	.....	3,120	144
1,182	2,100	2,420	.....	.....	3,160	3,232	.....	.....	.....	.....	3,253	145
770	.....	1,985	.....	2,700	.....	.....	.....	.....	.....	.....	3,212	146
724	1,615	1,908	2,500	2,636	2,660	.....	2,868	.....	2,999	.....	3,048	147
600	1,500	1,820	2,400	.....	2,551	.....	2,759	2,825	2,928	3,057	3,165	148
655	1,565	1,855	.....	2,585	2,623	.....	2,805	2,895	2,955	.....	3,100	149
630	1,545	1,845	.....	.....	2,560	.....	2,780	2,830	2,920	3,076	3,076	150
643	1,606	1,859	.....	.....	2,640	.....	2,865	.....	2,988	3,098	3,441	151
665	.....	1,945	.....	.....	2,625	.....	2,770	2,872	2,947	.....	3,008	152
636	1,531	1,930	.....	.....	2,588	.....	.....	.....	2,932	.....	2,946	153
1,005	1,880	2,245	2,820	2,960	2,970	.....	3,270	3,290	3,345	.....	.....	154
793	1,650	2,055	.....	.....	2,740	.....	.....	.....	3,078	.....	3,093	155
1,124	2,050	2,367	2,915	3,015	3,040	.....	3,319	.....	3,450	.....	3,492	156

[a] Elizabeth sand, 3,580.

Summarized record of

No. on Pl. I.	Name of well.	Township.	Owner.	Elevation.	Product.	Producing sand.
157	Thos. Hoy No. 2	Wayne	South Penn	1,025 B.	Oil	Fifth
158	Ingham Kent No. 5	do	do	1,105 B.	do	do
159	Wm. Lantz No. 4	do	do	975 B.	do	do
160	Rachel Nichols	do		1,177 L.	Gas	do
161	Sayers & Brant	do	Carnegie	1,060 B.	do	do
162	H. M. Spragg	do	South Penn	1,050 B.	do	Big Injun
163	J. M. Stewart	do	Peoples	1,320 B.	do	do
164	L. L. Thomas	do	South Penn	1,120 B.	Oil	
165	Abraham Tustin	do	Peoples	1,122 B.	Gas	
166	Isaac Yager No. 1	do	Carnegie	1,075 B.	do	Fifth
167	Thos. Bayard No. 1	Whiteley	do	1,170	do	Bayard
168	S. J. Bradford	do	Fort Pitt	1,180 B.	do	Fifth
169	Thos. Mooney	do	do	1,110 B.		Big Injun
170	Zimmerman No. 1	do	Carnegie	1,250 B.	Gas	Fifth

wells in Greene County—Continued.

Pittsburg coal.	Salt.	Big Injun.	Thirty-foot.	Gantz.	Fifty-foot.	Nineveh.	Gordon.	Fourth	Fifth.	Bayard.	Depth of well.	No. on Pl. I.
710	1,565	2,000	.....	.....	2,660	.....	.....	.....	2,990	.....	3,021	157
787	1,650	2,065	.....	.....	.....	.....	.....	.....	3,056	.....	3,079	158
628	1,506	1,900	.....	.....	2,580	.....	.....	.....	2,912	.....	2,947	159
815	1,715	2,045	2,610	.....	2,752	.....	.....	.....	3,116	.....	3,136	160
660	.....	1,970	.....	2,575	2,625	.....	2,800	2,885	2,940	.....	2,948	161
615	1,580	1,896	2,395	2,546	2,585	.....	2,839	2,913	2,931	.....	3,215	162
940	1,770	2,218	.....	.....	.....	.....	.....	.....	.....	.....	2,260	163
720	.....	2,035	.....	.....	2,640	.....	.....	.....	.....	.....	3,052	164
740	1,614	1,988	.....	.....	2,695	.....	3,027	3,056	.....	3,182	3,240	165
650	.....	1,908	.....	.....	2,570	.....	.....	.....	2,890	.....	2,910	166
555	.....	1,800	.....	2,470	2,515	.....	2,715	.....	2,835	2,960	2,965	167
698	1,632	1,936	2,470	2,615	2,640	.....	.....	.....	2,980	.....	2,995	168
645	1,560	1,890	.....	2,575	2,620	.....	2,810	.....	2,935	3,049	3,065	169
690	.....	1,920	.....	2,620	2,655	.....	2,820	2,905	2,974	.....	3,000	170

In order to facilitate reference to the wells which are numbered above 200 on the county map (Pl. I) and mentioned in the text, but whose records are not given in this report, a list giving page references is appended.

Wells numbered above 200 which are mentioned in the text.

No.	Name.	Page.	No.	Name.	Page.
201	Waynesburg	15, 64	262	H. C. Wood	64, 83
202	R. A. Sayers	16, 64, Pl. II	263	Grimes	64
203	Benson heirs	44, 78, 84	264	Elizabeth J. Stevens	66
204	Lewis Kuhn heirs	44, 69	265	Josephus Bowers	66, Pl. II
205	Wm. Fonner No. 2	45, 54, Pl. II	266	Iseminger No. 1	66
206	John Lewis	45, 72, Pl. II	267	Iseminger No. 2	66
207	Cephas Wiley	46	268	Bowen	67
208	A. P. Tanner	49	269	Evans	67
209	S. & J. L. Garard	50	270	Ryan	67
210	W. L. Longanecker	50	271	Gump	67
211	N. H. Minor	50	272	Williamson	67
212	G. Vance	49	273	Samuel Minor	67
213	Blackshire	51	274	Hoffman	67
214	Blackshire	51	275	Cornelison	68
215	Stillwell	51	276	Guthrie No. 1	68
216	D. L. Donley	52	277	John I. Worley	68
217	Asa Lemley	52	278	S. C. Brock No. 1	68
218	Williams	52	279	Tustin heirs	69
219	J. L. Donley	52	280	H. L. Granlee	69
220	Lantz No. 1	57	281	T. E. Eddy	69
221	Lantz No. 2	57, 83	282	Henderson No. 2	69
222	Lantz No. 3	57	283	Jacob Eddy No. 2	69
223	A. Rice	58, 83	284	James Iams	71
224	Greensboro pottery	58	285	Samuel Phillips	71
225	Molesey	58	286	L. L. Gray	71
226	Ellen Ross	58, 67, Pl. II	287	James Carl	71
227	J. Marshall	58	288	James Adamson	72
228	Headley	58, 67, 83	289	W. M. Boler	72
229	Joseph Morris	58	290	A. R. White	72
230	Wm. Fonner No. 1	54	291	B. L. Woodruff No. 1	72
231	Wm. Lantz No. 1	57	292	Ross heirs	73
232	Rea	59	293	A. I. Lindsey	73
233	Daniel Rich	59	294	L. C. Johnson No. 2	73
234	D. C. Stevenson	59	295	Karl Crawford No. 1	73
235	Gray	60	296	Karl Crawford No. 2	73
236	Keener-Durr	60	297	A. C. Fordyce	74
237	Silas Ross	60	298	Elijah Maple	74
238	Mary Reed	60	299	J. P. Hagan	74
239	John Steele	60	300	Josephus Rice	74
240	B. F. Gabler	60	301	Orndorf No. 1	75
241	Dilliner	62	302	S. C. Leighliter	76
242	Chisham	62	303	Robert Ullom	76
243	Asa Sterling	62	304	Elizabeth Sammons	76
244	Sturgiss	62	305	Anderson Hinerman	77
245	Jennie Miller	62	306	Lewis Kuhn	77
246	Stone	62	307	John Moore	77
247	Hathaway	62	308	John Riggle	77
248	Hugh Keenan	62	309	Clara Riggle	77
249	Fordyce	62	310	Rachel Grim	77
250	Rices Landing	62	311	Chas. Bean	77
251	Rices Landing (mill)	62	312	Thomas Thorpe	78
252	Degood No. 2	62	313	Levi Thorpe	78
253	Jacob Crayne	62	314	John Lewis	78
254	Jacob Haver	63	315	M. L. Polen	78
255	Denny	63	316	Anderson	78
256	J. L. Luse	63	317	Benj. Phillips	78
257	Degood No. 1	63	318	A. J. Dye	78
258	Sprowles	63	319	J. L. Riggs	79
259	Robinson	63	320	Wagonroad Run	79
260	Williams	63	321	D. A. McCracken	83, Pl. II
261	Inghram	64, 83	322	S. S. Iams	71, Pl. II
			323	Michael Funk No. 3	Pl. II
			324	Brooks No. 2	Pl. II
			325	Litman	83
			326	John Parkinson	71

TRIANGULATION STATIONS.

The exact location of Greene County with reference to latitude and longitude is determined from certain points the positions of which have been ascertained accurately by triangulation. The survey

of the county is controlled by 11 triangulation stations located within its boundaries and 9 other stations near by.

The locations of the stations within the county are shown on Plate I. by small triangles, but the accompanying sketch (fig. 7) shows the relative positions of all these points. These stations are marked by sandstone or marble posts, 6 by 6 to 12 by 12 inches in cross section and 3 or 4 feet long, set flush with the surface of the ground or projecting from 4 to 12 inches. In the center of the top of each post is cemented a bronze tablet marked "U. S. Geological Survey—Pennsylvania" or (at the West Alexander, Wilson, and Rocklick stations) "U. S. Geological Survey—West Virginia." There are two exceptions—Morley station is marked by a stone post, in the center of the top of which is cemented a copper bolt, and Oak station is a lone signal tree on the highest point of the hill.

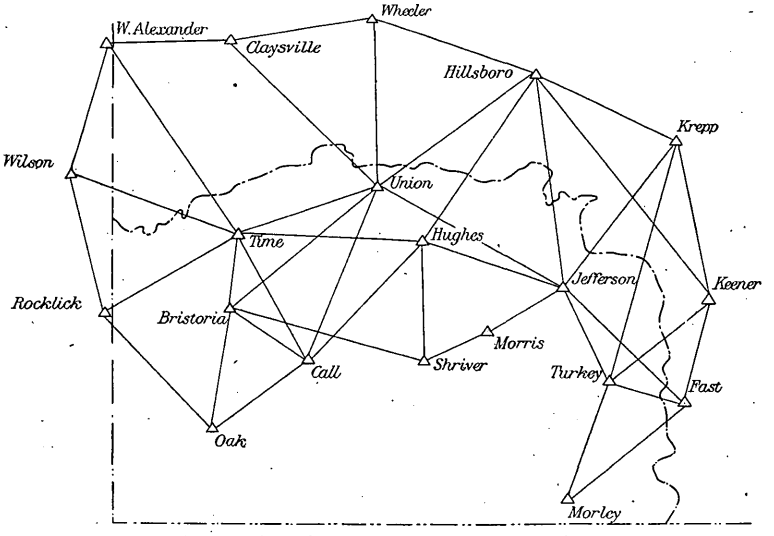


FIG. 7.—Sketch map showing location of triangulation stations on which the survey of Greene County is based.

The following descriptions are from Bulletin No. 181, with corrections:

BRISTORIA, GREENE COUNTY.

On a dome-shaped hill 1½ miles north of Bristoria and 11 miles west of Waynesburg, in a pasture owned by the Iseminger estate, about 500 feet north of a public road.

[Latitude 39° 53′ 32.55″. Longitude 80° 23′ 38.18″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Oak	6	54	26.4	186	53	51.1	4.0377279
Rocklick	76	18	21.5	256	13	07.0	4.0791962
Wilson	130	48	17.3	310	41	33.7	4.2943973
Time	185	30	01.5	5	30	19.2	3.8348950
Union	231	40	06.0	51	46	11.3	4.2357775
Call	301	26	01.0	121	29	33.0	3.9642757

CALL, GREENE COUNTY.

On a cleared hill about 2½ miles southwest of Rogersville, on land owned by Robert Call.

[Latitude 39° 50′ 56.68″. Longitude 80° 18′ 07.61″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Oak	56	45	12.3	236	41	05.3	4.0403119
Bristoria	121	29	33.0	301	26	01.1	3.9642757
Time	148	14	24.8	328	11	16.5	4.1355279
Union	200	05	07.7	20	07	40.7	4.2167757
Hughes	221	22	02.6	41	26	18.6	4.1564204
Shriver	268	59	33.8	89	04	36.7	4.0507482

CLAYSVILLE, WASHINGTON COUNTY.

On a cone-shaped hill 1 mile south of Claysville, on cultivated land belonging to J. Mosier.

Reference marks: Double chestnut tree, south, 72 feet; apple tree, east, 80 feet.

[Latitude 40° 06′ 20.01″. Longitude 80° 23′ 55.46″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Wheeler	257	55	51.0	78	01	54.2	4.1350995

FAST, FAYETTE COUNTY.

About 2 miles southeast of Masontown, on road to Smithfield, 8 feet north of an east-west fence, on land owned by Mr. Fast, who lives about 300 yards south of station.

[Latitude 39° 49′ 29.36″. Longitude 79° 53′ 30.97″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Morley	47	17	02.2	227	11	58.5	4.1871165
Turkey	99	01	56.6	278	58	14.5	3.9215699
Jefferson	129	24	42.4	309	19	08.7	4.2041975
Keener	190	44	15.0	10	45	03.1	3.9804006

HILLSBORO, WASHINGTON COUNTY.

In a rocky pasture, about 1,000 feet north of Scenery Hill cross-roads, along the National Pike, 3 miles northwest of Beallsville, on land owned by Mrs. E. S. Tonebaugh.

[Latitude 40° 05′ 17.67″. Longitude 80° 04′ 15.81″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Krepp	295	07	06.8	115	13	26.6	4.1890430
Jefferson	351	12	54.0	171	14	13.9	4.2860956
Keener	319	14	33.3	139	22	16.0	4.4181154
Hughes	33	02	20.9	212	51	42.6	4.2751190
Union	51	48	48.2	231	42	26.5	4.2531028
Wheeler	108	08	43.9	288	02	07.1	4.1859700

HUGHES, GREENE COUNTY.

On a hill covered with an orchard of small peach trees, about 3½ miles north of Waynesburg, owned by the Hughes estate.

[Latitude 39° 56′ 45.33″. Longitude 80° 11′ 26.53″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Call	41	26	18.6	221	22	02.6	4.1564204
Union	141	03	49.6	321	02	06.5	3 7827879
Hillsboro	212	57	42.6	33	02	20.9	4.2751190
Jefferson	283	56	38.3	104	02	35.8	4.1344974
Morris	322	34	23.6	142	37	23.6	4.0403635
Shriver	350	35	28.6	170	36	15.8	4.0296854

JEFFERSON, GREENE COUNTY.

About 1½ miles southeast of Jefferson, on a high, bald knob owned by Lawrence Kraft.

[Latitude 39° 54′ 58.46″. Longitude 80° 02′ 11.55″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Hillsboro	171	14	13.9	351	12	54.0	4.2860956
Krepp	221	23	32.6	41	28	31.9	4.2228713
Keener	273	01	04.2	93	07	26.3	4.1512351
Fast	309	19	08.7	129	24	42.4	4.2041975
Turkey	334	56	40.0	154	58	31.5	3.9895121
Hughes	104	02	35.8	283	56	38.3	4.1344974
Union	115	15	13.2	295	07	32.4	4.2747311

KEENER, FAYETTE COUNTY.

About 6 miles east of Carmichaels, 1½ miles north of McClellandtown, and 23.3 feet west of a lone locust tree on a bare knob owned by Ben Keener, who lives 300 yards south of station.

Reference mark: A stone post, 36 by 12 by 12 inches, set 34 inches in the ground, in the center of top of which is cemented an aluminum bolt; azimuth from station, 275° 27′; distance, 20 feet.

[Latitude 39° 54′ 33.86″. Longitude 79° 52′ 16.00″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Fast	10	45	03.1	190	44	15.0	3.9804006
Turkey	51	08	33.2	231	04	02.8	4.1097964
Jefferson	93	07	26.3	273	01	04.2	4.1512351
Hillsboro	139	22	16.0	319	14	33.3	4.4181154
Krepp	166	57	58.6	346	56	35.3	4.1346730

KREPP, WASHINGTON COUNTY.

About 1½ miles northwest of Brownsville, on a prominent and well-known bald knob owned by James Nickson.

[Latitude 40° 01′ 44.55″. Longitude 79° 54′ 25.69″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Jefferson	41	28	31.9	221	23	32.6	4.2228714
Hillsboro	115	13	26.6	295	07	06.8	4.1890430
Keener	346	56	35.3	166	57	58.6	4.1346730
Turkey	18	00	10.1	197	57	02.7	4.3515150

MORLEY, GREENE COUNTY.

On a flat, bald ridge owned by D. W. Morley, 1 mile southwest of Bald Hill and one-half mile north of the Pennsylvania-West Virginia State line. There are a few trees under the brow of the hill on the east side.

[Latitude 39° 43′ 50.65″. Longitude 80° 01′ 25.65″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Turkey	194	30	55.5	14	32	17.4	4.0842057
Fast	227	11	58.5	47	17	02.2	4.1871165

MORRIS, GREENE COUNTY.

On land owned by Henry Morris, 5 miles southeast of Waynesburg, at the head of Braden Run in a cleared field 600 feet north of the ridge road and one-fourth mile west of Mr. Morris's house.

[Latitude 39° 52′ 2.67″. Longitude 80° 6′ 47.91″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Shriver	69	27	10.8	249	24	58.1	3.7205630
Hughes	142	37	23.6	322	34	23.6	4.0403635
Jefferson	230	25	41.6	50	28	38.8	3.9301943

OAK, GREENE COUNTY.

On a high, cleared hill 1½ miles west of Nettle Hill, 3 miles south of Higbee and 5½ miles south of Bristoria, on land owned by S. T. Williams.

[Latitude 39° 47′ 41.45″. Longitud 80° 24′ 33.31″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Rocklick	127	39	19.7	307	34	40.8	4.1163332
Bristoria	186	53	51.1	6	54	26.4	4.0377279
Call	236	41	05.3	56	45	12.3	4.0403119

ROCKLICK, MARSHALL COUNTY, W. VA.

On a bare hill one-half mile south of the town of Rocklick, W. Va. A county road passes on the north side of the hill.

[Latitude 39° 52′ 00.15″. Longitude 80° 31′ 48.73″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Wilson	168	13	33.5	348	12	04.9	4.2053434
Time	231	50	19.0	51	55	51.4	4.1943297
Bristoria	256	13	07.0	76	18	21.5	4.0791962
Oak	307	34	40.8	127	39	19.7	4.1163332

SHRIVER, GREENE COUNTY.

On a bald hill 2 miles west of Randolph Church and 3 miles south of Waynesburg, on land owned by William Shriver.

[Latitude 39° 51′ 02.82″. Longitude 80° 108′ 14.90″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Call	89	04	36.7	268	59	33.8	4.0507482
Hughes	170	36	15.8	350	35	28.6	4.0296854
Morris	249	24	58.1	69	27	10.8	3.7205630

TIME, GREENE COUNTY.

In a pasture owned by the Miller estate on a cleared knob 2½ miles north of Graysville and 1 mile west of Time post-office.

[Latitude 39° 57′ 13.23″. Longitude 80° 23′ 10.56″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Bristoria	5	30	19.2	185	30	01.5	3.8348950
Rocklick	51	55	51.4	231	50	19.0	4.1943297
Wilson	111	17	45.4	291	10	43.8	4.2228433
Union	253	14	48.2	73	20	36.0	4.1275671
Call	328	11	10.5	148	14	24.8	4.1355279

TURKEY, GREENE COUNTY.

About 1¼ miles west of Sigsbee and 4 miles south of Carmichaels, on Turkey Knob, in a cultivated field owned by Leroy Hartley.

[Latitude 39° 50′ 11.72″. Longitude 79° 59′ 17.69″.]

To station—	Azimuth.			Back azimuth.			Log. distance.
	°	′	″	°	′	″	*Meters.*
Morley	14	32	17.4	194	30	55.5	4.0842057
Jefferson	154	58	31.5	334	56	40.0	3.9895121
Krepp	197	57	02.7	18	00	10.1	4.3515150
Keener	231	04	02.8	51	08	33.2	4.1097964
Fast	278	58	14.5	99	01	56.6	3.9215699

UNION, GREENE COUNTY.

In a pasture on a prominent hill 7 miles north-northwest of Waynesburg and 2½ miles east of Deerlick.

[Latitude 39° 59′ 18.24″. Longitude 80° 14′ 09.16″.]

To station—	Azimuth.	Back azimuth.	Log. distance.
	° ′ ″	° ′ ″	*Meters.*
Call	20 07 40.7	200 05 0.7	4.2167757
Bristoria	51 46 11.3	231 40 06.0	4.2357775
Time	73 20 36.0	253 14 48.2	4.1275671
Wheeler	178 04 16.4	358 04 01.9	4.2002916
Hillsboro	231 42 26.5	51 48 48.2	4.2531028
Jefferson	295 07 32.4	115 15 13.2	4.2747311
Hughes	321 02 06.5	141 03 49.6	3.7827879

WEST ALEXANDER, OHIO COUNTY, W. VA.

On a hill 1 mile southwest of West Alexander, Pa.

Reference marks: A maple tree 2 feet in diameter bears N. 85° 56′ W., distance, 72.1 feet; a butternut tree 10 inches in diameter bears S. 52° 25′ E., distance, 15 feet.

[Latitude 40° 05′ 48.62″. Longitude 80° 31′ 41.59″.]

To station—	Azimuth.	Back azimuth.	Log. distance.
	° ′ ″	° ′ ″	*Meters.*
Wilson	19 15 19.31	199 13 46.06	4.0179782

WHEELER, WASHINGTON COUNTY.

On a sparsely timbered hill, 3 miles south of Washington, on land of William Courson, who lives at the north base of the hill.

[Latitude 40° 07′ 52.16″. Longitude 80° 14′ 31.71″.]

To station—	Azimuth.	Back azimuth.	Log. distance.
	° ′ ″	° ′ ″	*Meters.*
Claysville	78 01 54.2	257 55 51.0	4.1350995
Hillsboro	288 02 07.1	108 08 43.9	4.1859700
Union	358 04 01.9	178 04 16.4	4.2002916

WILSON, MARSHALL COUNTY, W. VA.

On the farm of G. H. Wilson, 1½ miles northeast of Sand Hill and 2½ miles west of West Union, near the line fence between the lands of Mr. Wilson and Mr. Howard, where the fence crosses the summit of the hill. The Moundsville and Washington pike passes over the north side of the hill.

[Latitude 40° 00′ 29.42″. Longitude 80° 34′ 06.77″.]

To station—	Azimuth.	Back azimuth.	Log. distance.
	° ′ ″	° ′ ″	*Meters.*
Time	291 10 43.8	111 17 45.4	4.2228433
Bristoria	310 41 33.7	130 48 17.3	4.2943973
Rocklick	348 12 04.9	168 13 33.5	4.2053434

BENCH MARKS.

The elevations in the following list are based on and adjusted between bench marks established by spirit leveling. All bench marks are referred to an aluminum tablet in the foundation of the Seventh Avenue Hotel at Pittsburg, marked "738 Pittsburg 1899," the elevation of which is accepted as 738.384 feet above mean sea level.

The leveling was done as follows: On the Waynesburg quadrangle in 1900, under the direction of Frank Sutton, topographer, by J. H. Wetzel, levelman; on the Blacksville quadrangle in 1901, under A. H. Bumstead, topographer, by M. P. Page, levelman; on the Rogersville quadrangle, mostly in 1902, under R. D. Cummin, topographer, by Charles Hartman, jr., levelman; and on the Amity quadrangle, partly in 1901, under A. H. Bumstead, topographer, by Messrs. Page and H. Wood, levelmen; partly in 1902, under R. D. Cummin, topographer, by Charles Hartman, jr., levelman; and partly in1 903, under Mr. Sutton, by Mr. Wetzel. The work on the Claysville quadrangle, was done in 1905, under W. T. Griswold, topographer, by B. J. Green, levelman.

The standard bench marks except that at Mount Morris are stamped "PITTS" or "PITTSBURG" in addition to figures of elevation, which, being taken from unadjusted field values, are in many cases incorrect. For instance, the tablet at Waynesburg court-house is marked "1035" but its actual elevation is 1,034.446 feet above tide. The localities here described are arranged alphabetically by townships.

ALEPPO TOWNSHIP.

	Feet.
Aleppo post-office, or Bridgeport, highway bridge over South Fork Dunkard Fork Wheeling Creek, in southwest abutment; bronze tablet marked "1060 PITTS"	1,059.588
Aleppo, 1.1 miles south of, at forks of roads near Sam King's residence, on ledge of rock; chiseled square	1,134.05
Aleppo 2.3 miles southwest of, near top of ridge, at forks of road to Sugar Grove, Aleppo, and Waynesburg, on ledge of rock; chiseled square	1,462.34
McCracken, 1 mile east of, near forks of roads to Jacksonville and Ryerson station, near sawmill, at entrance to John Lewis's residence, on stone step; chiseled square	999.29
Morford post-office, 1 mile northwest of, between Antill's residence and post-office, on rock near hickory tree; chiseled square	1,500.34
Morford post-office, Jacob McMiller's residence next to, on stone step at entrance; chiseled square	1,394.88

CENTER TOWNSHIP.

Bluff, 0.2 mile north of, in front of A. R. White's residence at bottom of hill, on stone; chiseled square	1,178.81
Bluff, 1.5 miles north of, near corner of fence, in front of schoolhouse, at forks of road, on stone; chiseled square	1,080.88

	Feet.
Hunters Cave, at center of crossroads to Nineveh, Waynesburg, Rogersville, and Graysville; cut in large ledge of rock	1,334.02
Hunters Cave, 0.5 mile north of, at bottom of hill, barn near E. Cutter's residence, on first step of foundation wall; square cut	1,144.47
Rogersville, highway bridge over Tenmile Creek at, southwest abutment, set in capstone; aluminum tablet marked "978 PITTS"	977.337
Rogersville, 1 mile north of, on ledge of rock; chiseled square	1,051.76
Rogersville, 2.5 miles north of, at top of hill, residence of Hiram Ely, on stone step; cut	1,393.86
Rogersville, 1.5 miles east of, on Waynesburg road, bridge over small stream, on stone; chiseled square	965.97
Rogersville, 3 miles east of, opposite R. H. Katz's residence, on Waynesburg road, on ledge of rock; chiseled square	968.47
Rogersville, 1 mile south of, covered bridge over Hargus Creek, on southwest abutment; chiseled square	982.21
Rogersville, 2 miles south of, near schoolhouse, covered bridge over Hargus Creek, on southwest abutment; chiseled square	1,007.70
Rogersville, 3 miles south of, at end of small bridge near Inghram residence, on rock; chiseled square	1,038.03
Rogersville, 4.5 miles south of, at entrance to church, on stone; chiseled square	1,053.75
CUMBERLAND TOWNSHIP.	
Carmichaels, on stone step of entrance to schoolhouse; aluminum tablet marked "1004 PITTSBURG"	1,004.297
Carmichaels, 2 miles west of, covered bridge over Muddy Creek, on southwest wall of; chisel mark	981.76
Carmichaels, 2.5 miles west of, opposite brick and white house, on stone water trough, chisel mark	1,004.94
Khedive, residence of Mrs. Sarah Yoder, in west end of, on foundation stone under bay window; aluminum tablet marked "1013 PITTSBURG"	1,013.255
DUNKARD TOWNSHIP.	
Davistown, middle (wooden) bridge in, in ledge of rocks at end of northeast wing wall; bronze tablet marked "932 PITTSBURG"	932.174
Davistown, 1.5 miles southeast of, iron bridge over Dunkard Creek, or northwest wing wall; chisel mark	871.78
Dilliner, 1 mile north of, bridge over Dunkard Creek, at junction with Monongahela River, west side of south abutment; stone, chisel marked	799.927
Dunkard, 0.5 mile west of, bridge on northwest wing wall; chisel mark	848.8
FRANKLIN TOWNSHIP.	
Waynesburg, court-house, northeast corner of stone veranda; bronze tablet marked "1035 PITTSBURG"	1,034.446
Waynesburg, east end of, covered bridge over Tenmile Creek, on southeast wing wall; chisel mark	934.89
Waynesburg, 2 miles south of, on rock at bridge; chisel mark	968.79
Waynesburg, 5 miles south of, floor of iron bridge; chisel mark	1,037
Waynesburg, 1 mile west of, junction of road to Oak Forest and Sycamore; small spike in telegraph pole	939.78
Waynesburg, 2 miles west of, on Rogersville road, on ledge of rock; chiseled square	956.77
Waynesburg, 3 miles west of, highway bridge on Rogersville road, on southeast abutment; chiseled square	952.78

GILMORE TOWNSHIP.

	Feet.
Ashtree, on stone in front of R. Gray's residence; chiseled square	1,320.19
New Freeport, 2.5 miles east of, 100 feet east of William Phillips's residence, at bend in road, on ledge of rock; chiseled square	1,191.81
Pinebank, 0.5 mile west of, public bridge over Blockhouse Run, on northwest abutment; chiseled square	1,012.97
Pinebank, highway bridge over Toms Run at, in southeast abutment; bronze tablet marked "1006 PITTS"	1,005.454

JACKSON TOWNSHIP.

Bluff, 0.5 mile southwest of, on north side of road near bottom of hill, on ledge of rock; chiseled square	1,222.28
Pinebank, 2.1 miles north of, at forks of road leading to Bluff and Nettle Hill, on ledge of rock; chiseled square	1,079.14
Triumph, 0.8 mile west of, residence of Lindly Roberts, on flat stone at entrance; chiseled square	1,083.63

JEFFERSON TOWNSHIP.

Clarksville, 1 mile south of, covered bridge over Tenmile Creek, northwest wing wall, on coping stone (next to bridge); bronze tablet marked "814 PITTSBURG"	814.167
Jefferson, 0.5 mile north of, covered bridge, on southwest wing wall; chisel mark	851.24

MORRIS TOWNSHIP.

Nineveh, entrance to Van Cleve Hotel, in southeast top of foundation wall; aluminum tablet marked "1023 PITTS"	1,022.180
Nineveh, 0.8 mile north of, near Smith's residence, highway bridge over Browns Fork, on northeast abutment; chiseled square	1,048.01
Nineveh, 2 miles northwest of, near Caldwell's residence, near barn, on ledge of rock; chiseled square	1,168.19
Nineveh, 2.5 miles west of, on top of hill at crossroads to Washington, Waynesburg, Simpson Store, and Nineveh; stone at cut	1,447.58
Nineveh, 3 miles west of, at bottom of hill, north side, on ledge of rock; chiseled square	1,251.38
Nineveh, 0.5 mile southeast of, 300 feet northwest of greenhouse, on ledge of rock; chiseled square	1,019.73
Nineveh, 2 miles southeast of, at Y roads, 6 miles to Rutan, on ledge of rock; chiseled square	988.60
Time, 0.2 mile east of, at forks of road, on ledge of rock; chiseled square	1,153.54
Time, 0.7 mile northwest of Ewing's residence, on large bowlder used as embankment for small run in front of; chiseled square	1,044.38

PERRY TOWNSHIP.

Mount Morris, 150 feet west of mill, in northwest abutment of bridge over Robinson Run, 8 feet from north end of bridge, 10 feet from center of road; bronze tablet stamped "904 GRAFTON"	903.840

RICHHILL TOWNSHIP.

Bradens Mill, 1.6 miles northwest of Video, highway bridge over Big Wheeling Creek, in capstone of southeast abutment; bronze tablet marked "918 PITTS"	917.211
Crabapple, at forks of roads, highway bridge over Crabapple Creek, on abutment; chiseled square	954.85

	Feet.
Crabapple, 1 mile northeast of, near F. M. Braddock's residence, highway bridge over Crabapple Creek, on abutment; chiseled square	986.10
Durbin, iron bridge over Crabapple Creek, on abutment; chiseled square	896.42
Durbin, 1.2 miles south of, at forks of road, near S. Lyon's residence, highway bridge over Wheeling Creek, on abutment; chiseled square	922.72
Eno, on top step of entrance to church at; chiseled square	997.59
Eno, 1 mile west of, on north side of road along Wheeling Creek, on ledge of rock; chiseled square	992.62
Ryerson Station, Dunkard Fork of Wheeling Creek at, highway bridge over, on abutment; chiseled square	931.29
Ryerson Station, 1.6 miles south of, at forks of roads leading to Cameron, Ryerson, and Aleppo, and near Bryan's residence, on stone; chiseled square	958.61
Ryerson Station, 3 miles south of, near Earnest's residence, covered bridge over Dunkard Fork of Wheeling Creek, on abutment; chiseled square	974.93
Simpson Store, 0.5 mile west of; at spring, on ledge of rock; chiseled square	1,013.97
Simpson Store, 3 miles west of, iron bridge over Big Wheeling Creek, on northwest abutment; chisel mark	963.20
Simpson Store, 3.5 miles west of, bridge over Big Wheeling Creek, on northwest abutment; square cut	944.38
Video, 0.5 mile west of, on top of ridge, entrance to Frank D. Headley's residence, on corner of flagging; chiseled square	1,346.99
SPRINGHILL TOWNSHIP.	
Deep Valley, public bridge over Fish Creek at, on northeast abutment; square cut	1,015.81
Deep Valley, 0.5 mile west of, covered bridge over Wagonroad Run, on southwest abutment; chiseled square	1,004.67
Deep Valley, 2 miles west of, 2 miles east of State line, on north side of road near house, on rock under walnut tree; chiseled square	996.20
Morford post-office, 0.6 mile south of, in roadway near entrance to John Miller's residence, on ledge of rock; chiseled square	1,466.46
Morford post-office, 2 miles southeast of, at forks of roads on Wagonroad Run, near residence of John Calwell, on face of rock at bottom of hill; chiseled square	1,094.68
New Freeport, public bridge over Fish Creek at, in southwest abutment; bronze tablet marked "1062 PITTS"	1,062.006
New Freeport, 1 mile east of, at entrance to Hamilton's residence at forks of road, on ledge of rock; chiseled square	1,084.14
New Freeport, 0.5 mile west of, bridge over Herod Run, on top of northeast abutment; paint mark	1,048.53
New Freeport, 1.5 miles west of, public bridge over Laurel Run near Methodist Episcopal Church, on southeast abutment; chiseled square	1,031.17
WASHINGTON TOWNSHIP.	
Ruff Creek, wooden dwelling house of John Breston, northeast corner, in upper foundation stone; bronze tablet marked "999 PITTSBURG"	997.697
WHITELEY TOWNSHIP.	
Newton, on northeast wing wall of iron bridge, 2 coping stones from bridge; bronze tablet marked "1010 PITTSBURG"	1,009.525
Newton, 1.5 miles east of, covered bridge, on northwest wing wall; chisel mark	997.66
Newton, 2 miles east of, iron bridge, southeast wing wall; chisel mark	991.66
Newton, 2.25 miles east of, bridge coping stone; chisel mark	989.74
Newton, 1.5 miles southwest of, covered bridge, on southwest wing wall; chisel mark	1,047.84
Newton, 3 miles west of, near small bridge at road south by schoolhouse; rock, chisel marked	1,084.10

INDEX.

CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Bulletin No. 304.]

The publications of the United States Geological Survey consist of (1) Annual Reports, (2) Monographs, (3) Professional Papers, (4) Bulletins, (5) Mineral Resources, (6) Water-Supply and Irrigation Papers, (7) Topographic Atlas of United States—folios and separate sheets thereof, (8) Geologic Atlas of United States—folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists can be had on application.

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