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UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, DIRECTOR

RECORD OF DEEP WELL DRILLING FOR 1904

BY

M. L. FULLER, E. F. LINES, and A. C. VEATCH

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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
HYDROGRAPHIC BRANCH.
Washington, D. C., February 13, 1905.

SIR: I have the honor to transmit herewith a manuscript entitled "Record of Deep Well Drilling for 1904," prepared by Messrs. M. L. Fuller and E. F. Lines, but including certain material compiled from notes furnished by Mr. A. C. Veatch. The report presents the results of the first six months' work, with a system for the collection of well records and samples, formulated by Mr. Veatch and put in operation under the direction of Mr. Fuller, chief of the eastern section of the division of hydrology, on July 10, 1904. Mr. Veatch was assisted by Mr. Lines until September 15, when the work was relinquished to the latter. The report embodies the records of a large number of wells, for many of which sets of samples are preserved on file, and in addition gives an account of the development of the system and of the methods employed.

The principal aim of the report, as stated in the introduction, is to furnish drillers and present or prospective well owners a basis for future work and to afford geologists and others a more complete knowledge of the rock succession and structure. It is hoped that the report will lead to greater appreciation of the value of records by the driller and will serve to encourage the preservation of samples.

Very respectfully,

F. H. NEWELL, *Chief Engineer.*

Hon. CHARLES D. WALCOTT,
Director United States Geological Survey.

RECORD OF DEEP WELL DRILLING FOR 1904.

By M. L. FULLER, E. F. LINES, and A. C. VEATCH.

INTRODUCTIÓN.

In this report, which is the first of a proposed series of annual publications, are presented the results of the first six months' work by the United States Geological Survey in the systematic collection of well records and samples. Much time having been occupied in organization and preliminary correspondence, the results of only about three months' actual work are included. The report is issued for the purpose of giving to present or prospective well owners and drillers the results of drilling as reported to the Survey, with the object of furnishing them as good a basis as possible for future drilling in the regions discussed, and to afford geologists and others a more complete knowledge of the rock succession and structure.

It is intended that the reports of the series shall present records of contemporaneous drilling rather than the results of past work, a special attempt being made to secure records accompanied by samples. The logs of completed wells, however, will be incorporated when practicable; but as records of such wells are seldom preserved for any length of time, their number will probably decrease in proportion to new wells as the work continues.

All well records received during the year 1904 that were accompanied by complete sets of samples are presented in this report, as are also a considerable number furnished by drillers, contractors, well owners, etc., representing other completed wells. The report does not, however, include all records furnished the Survey, a great number being furnished by oil companies and others interested in the development of oil or mineral lands. Many of these are confidential and can not be published, while others will be compiled and embodied in reports on special regions, which will be published later.

Grateful acknowledgment is made to the following contractors and drillers who, by furnishing records or samples, have assisted the Survey in its endeavor to bring about a better knowledge of the strata penetrated in drilling. The asterisk (*) indicates that records of wells are given in whole or in part in the present report; in the other cases the records are either confidential or are reserved for special reports to be published later.

Principal contractors and drillers furnishing records.

Aggers, William A., Muscogee, Ind. T.
Akin, Mr., Wade avenue, Washington, Pa.
*Akins, E. J., driller for Reece, Heasley & Meals, Hundred, W. Va.
Archer, Kruger, Mississippi.
*Artesian Well and Supply Company, Dyer and Friendship streets, Providence, R. I.
*Barber, Lucien C., Scott, Cortland County, N. Y.
Barnes, R. B., Artesia, N. Mex.
Beach, O. C., Roswell, N. Mex.
*Bean, J. S., R. F. D. 65, Emlenton, Pa.
Birdsong, Mason, Bolton, Miss.
Bishop, Mr., Salt Lake City, Utah.
Black, Frank L., Waynesburg, Pa.
*Black, R. H., 423 John street, Braddock, Pa.
*Bliss, George R., Rye, N. Y.
*Bolles, William M., Franksville, Wis.
Borchers, W. F., 68 East Maiden street, Washington, Pa.
Brigham, W. J., Tunica, Miss.
Broiles, E., Artesia, N. Mex.
*Carman, George W., driller for G. W. Patterson, Stewartstown, Pa.
Carnegie Natural Gas Company, Carnegie Building, Pittsburg, Pa.
Carter Oil Company, Titusville, Pa.
*Champlin, F. A., East Longmeadow, Mass.
Chapman & Sperry, Artesia, N. Mex.
Chartiers Oil Company, Tradesmen's Building, Pittsburg, Pa.
Chesney & McCready, Muscogee, Ind. T.
*Christofferson, E., driller for J. F. McCarthy, Fertile, Minn.
*Cladek, Frank T., West Scott avenue, Rahway, N. J.
*Clifton, R. T., Velasco, Tex.
*Colwell, J. A., West Superior, Wis.
Cook, William J., Muscogee, Ind. T.
Cooper & Warren, Roswell, N. Mex.
*Copley, W. H., 828 Leonard street, Fostoria, Ohio.
*Craig, L. J., Rock Springs, Wyo.
Crane, G. S., Checotah, Ind. T.
*Crist, S. T., and Son, Codorus, York County, Pa.
Cunningham, J. B., Cliftonville, Miss.
*Danis, C. H., Coldspring Harbor, N. Y.
Devonian Oil Company, Pittsburg, Pa.
*Dibble & Ernest, Fullertown, Ohio.
*Dillon, J. B., Bowen, Pike County, Ark.
*Duck, Elmer J., driller for John McCool, New Freeport, Greene County, Pa.
*Dunlap, T. L., driller for J. B. Fishel, New Martinsville, W. Va.
Dunn, J. L., Dunns Station, Washington County, Pa.
Durst, F. A., Bellefourche, S. Dak.
*Eagen, Thomas, Poynette, Wis.
*Egan, James, driller for F. A. Champlin, Mansion House, Springfield, Mass.
Eisman, David, Washington Trust Building, Washington, Pa.
*Elliott, J., Mellville, N. Y.
Endly, W. J., Nowata, Ind. T.
English, A. Z., Muscogee, Ind. T.
*Espy, E., driller for J. F. McCarthy, Atwater, Minn.
*Faust, J. J., South Kaukauna, Wis.

Feigler, C. E., Minter City, Miss.
*Ford, John L., driller for J. A. Sutter, Pass Christian, Miss.
Forest Oil Company, 323 Fourth avenue, Pittsburg, Pa.
Forman, Grant, Muscogee, Ind. T.
*Fowler, Thomas, Corpus Christi, Tex.
Fox, J. A., Roswell, N. Mex.
Franklin Oil Company, Tyro, Kans.
Garner & Swerringen, Artesia, N. Mex.
*Gibson, Alex. T., West Winfield, Herkimer County, N. Y.
Gillespie, R. G., Pittsburg, Pa.
Goldsburg, Albert, Memphis, Tenn.
*Gorder, H. G., Dodgeville, Wis.
*Granberry, P. M., & Co., box 115, Houston, Tex.
*Grant, C. L., 17 Byron street, Providence, R. I.
Grayson, Harry, Washington Trust Building, Washington, Pa.
*Green, Charles L., 1160 Stuart street, Green Bay, Wis.
Greensboro Natural Gas Company, 808 Tradesmen's Building, Pittsburg, Pa.
Guffey & Queen, Pittsburg, Pa.
*Guffy & Galey, Pittsburg, Pa.
*Gunter Brothers, Stuttgart, Ark.
Hale, J. C., Artesia, N. Mex.
*Halterman, George G., Parowan, Utah.
*Hambrecht, H. W., superintendent for L. Wilson Well Company, 225 Dearborn street, Chicago, Ill.
*Hamilton, W. F., Ocala, Fla.
*Hammond, E. D., 120 Sargeant street, Hartford, Conn.
*Harmon, William, 226 East Market street, Tiffin, Ohio.
*Harper, Thomas B., Jenkintown, Pa.
*Harris, N. F., driller for Artesian Well and Supply Company, Providence, R. I.
*Hawk, John I., Selma, Ala.
Heath, E. N., Artesia, N. Mex.
*Heflin, J. O. & Co., 2004 Third avenue, Birmingham, Ala.
Henderson, J. B., McMillan, N. Mex.
*Hills, I. W., Medina, Wis.
*Howard, F., Canandaigua, Lenawee County, Mich.
Hulse, Jesse, Murray, Utah.
*Jameson, William, driller for St. Mary's Drilling Company, Lima, Ohio.
*Jenkins, E. A., Scottsville, N. Y.
Jennings Brothers, Pittsburg, Pa.
*Johnston, R. J., box 528, Burlington, Iowa.
*Jorgensen, H., driller for W. N. Bolles, Franksville, Wis.
Judd, W. E., Farmington, Utah.
Karns, S. E., Beaver, Pa.
Kelly Bros. & Cooper, Beaver, Pa.
Kennedy, W. C. & Co., Pittsburg, Pa.
*Kinney, James, jr., Bellaire, Ohio.
Klinkscale, Mr., Roswell, N. Mex.
*Knaack, Henry M., Station A, R. R. No. 5, Milwaukee, Wis.
*Knauf, M. F., driller for Artesian Well and Supply Company, Providence, R. I.
*Lambie, Robert, Drilling Company, Orrville, Ohio.
Larssen, Peter, Salt Lake City, Utah.
Lawrence Gas Company, Youngstown, Ohio.
*Lee, John H., 1702 Houston avenue, Houston, Tex.
Leonard, John, 63 West Chestnut street, Washington, Pa.

*Liberty Well Company, 7633 Bennett street, Pittsburg, Pa.
Lykins, W. C., Miami, Ind. T.
*Lyle, James, 349 North Main street, Washington, Pa.
*Lynch, Albert, Stamford, Conn.
McCausland, John, 33 West Walnut street, Washington, Pa.
*McDonald, J. J., driller for Smith & Thayer Company, Berlin, N. H.
*McDonald, R. H., driller for C. E. Gesin, Tidioute, Pa.
*McGuckin, J. B., driller for Thomas B. Harper, 5921 Beechwood street, Philadelphia, Pa.
McVay Brothers, Rockyford, Colo.
*Matteson & Zeigler, Bonsteel, S. Dak.
*Maule, Lewis, Copemish, Manistee County, Mich.
*Meloy, E. D., driller for Charles S. Wise, 2544 North Grand avenue, St. Louis, Mo.
*Mentzer, Frank, driller for Artesian Well and Supply Company, Providence, R. I.
*Miller's, W. J., Sons, Genoa Junction, Wis.
Monongahela Natural Gas Company, Oliver Building, Pittsburg, Pa.
Muno, P., McMillan, N. Mex.
Murdock, Baldwin & Co., Union Trust Building, Washington, Pa.
Natural Gas Company of West Virginia, 39 Vandergrift Building, Pittsburg, Pa.
*Nichols, L., driller for J. P. Miller Artesian Well Company, 39 Michigan street, Chicago, Ill.
Nicholson, W. I., Wagoner, Ind. T.
Norbeck & Nicholson, Redfield, S. Dak.
*O'Neill, James, 217 West College street, Albert Lea, Minn.
Oregon Short Line Engineering Department.
*Osborne, W. R., Metuchen, N. J.
*Pannewitz, P. E., Schulenburg, Tex.
Patrick, D. R., Hagerman, N. Mex.
*Pearsall & Co., Utica, Ohio.
People's Gas Company, Tradesmen's Building, Pittsburg, Pa.
Philadelphia Company, Philadelphia Building, Pittsburg, Pa.
*Phillips, A. P., 314 North Main street, Findlay, Ohio.
Phillips, Jake, Springville, Utah.
Pinchin, Job, Salt Lake City, Utah.
Poland, C. E., Hagerman, N. Mex.
Pond, Chester H., Moorhead, Miss.
Prairie Oil and Gas Company, Neodesha, Kans.
Preston, John, 322 Washington Trust Building, Washington, Pa.
*Pursell, F. U., Waukena, Cal.
*Pursell, T. A., Waukena, Tulare County, Cal.
Pyle, P. L., Fort Gibson, Ind. T.
Ratliff, W. E., McMillan, N. Mex.
*Reardon, H. A., driller for F. S. Black, Delmont, Pa.
*Reed, Jefferson J., driller for R. D. Mead & Co., Higbee, Greene County, Pa.
Reese & Heasley, Waynesburg, Pa.
Reeves, Ira L., Muscogee, Ind. T.
*Ridpath & Potter, 587 Bourse Building, Philadelphia, Pa.
*Robbins, S. L., Blaine, Kans.
*Roberson, Elmer A., Box 83, Cheney, Kans.
Ross, Tim, Waynesburg, Pa.
*Roughen, Patrick, 213 Amory street, Fond du Lac, Wis.
*St. Marys Drilling Company, St. Marys, Ohio.
*Sealy, W. F., 27 Seventh street, Fond du Lac, Wis.
*Shanks, Oscar, P. O. Box 485, Alexandria, La.

*Sharpe, J. E., 304 West College street, Albert Lea, Minn.
Shay, John W., 249 Locust avenue, Washington, Pa.
*Shute, C. E., Bath, Me.
Smith, A. B., Muscogee, Ind. T.
Southern Pacific Railroad Engineering Department.
South Penn Oil Company, 323 Fourth avenue, Pittsburg, Pa.
Steele, C. L., Muscogee, Ind. T.
*Steinsiek, H. W., 4321 Prairie avenue, St. Louis, Mo.
Stevenson, J. B., Springville, Utah.
*Stotthoff Brothers, Flemington, N. J.
*Strait, E. C., Prentiss Vale, Pa.
*Sutter, Frank, Pensacola, Fla.
*Sutter, John A., Pass Christian, Miss.
Taylor, D. J., Roswell, N. Mex.
*Taylor, Fred, Grandville, Mich.
*Teeter, W. G., North Salem avenue, Dayton, Ohio.
*Thorne, W. L., & Co., Whitewater, Wis.
*Tomlin, James, Mars, Oreg.
*Tracy, Albert, Orrville, Ohio.
*Trow, Linden C., driller for W. J. Miller's Sons, Genoa Junction, Wis.
Turner, E. F., Leland, Miss.
*Vandervort, E. R., Warrens, Wis.
*Wainright, V., Lake Charles, La.
*Walters, W. P., driller for St. Mary's Drilling Company, Alto, Ind.
*Wankel, Frank, 535 Himrod street, Brooklyn, N. Y.
*Waterman Brothers, Hamorton, Chester County, Pa.
*Watkins & Co., Vancamp, W. Va.
*Weiler Brothers, Box 367, Marietta, Ohio.
Westfal, John, Provo City, Utah.
Westphal, Gus, Salt Lake City, Utah.
White, Elza, Roswell, N. Mex.
Willetts, Elmer E., 186 South Main street, Washington, Pa.
*Winger, Josiah G., Box 135, Grand Valley, Pa.
Yager, Frank, Salt Lake City, Utah.

In addition to the drillers furnishing records and samples, special thanks are due to the owners of many wells, through whose courtesy and by whose orders many of the samples and records were furnished the Survey. The names of the owners are given in the tables of records, those furnishing records being indicated by the letter "O" in the column headed "Authority."

OBJECTS, DEVELOPMENT, AND RESULTS OF THE WORK OF COLLECTING WELL RECORDS AND SAMPLES.

By MYRON L. FULLER.

The information relating to borings must generally be gathered when the well is being sunk or not at all. Many drillers keep records when the work is going on, but in the majority of cases these are soon lost. If the driller continues work in a single locality he soon comes to know perfectly the main points of the succession of the rocks and keeps no records, often even throwing away his earlier ones. In other cases he may remove to other regions, and, having no further personal interest in the original locality, the early records are lost or destroyed. Only the larger operators keep permanent records of their wells. For these reasons the effort is now being made by the Survey to secure the record at the time of drilling and to supplement it wherever possible by actual samples, which will be filed and made permanently accessible for use whenever questions arise regarding the materials encountered.

IMPORTANCE OF ACCURATE WELL RECORDS.

The knowledge of conditions beneath the surface, whether sought by the driller, the mining engineer, or the geologist, must be obtained either from surface observations of rock outcrops or from artificial sections afforded by mine or other shafts, inclines, tunnels, and borings. By systematic observations upon the character of the rocks over extended areas and the determinations of their inclination (dip) and their line of outcrop on level surfaces (strike), the trained observer is able to calculate more or less accurately the thickness of the beds, their depth below the surface, their structure, and to a certain extent their character as regards the occurrence of gas, oil, brine, or fresh water, especially the latter. The thickness and composition of rocks, even of the same bed, are not constant, but undergo changes, often considerable in amount and taking place within short distances. These changes are frequently of great importance in their effect upon the occurrence of the products named. Where the rocks are at the surface the changes can be easily recognized, but when below the surface only

the shaft or drill can determine the occurrence and nature of the changes in question.

The shaft is of immense value in restricted areas, but it is the widely distributed and often deep borings that afford information in regard to the broader features of interest to the driller, to the operator in search of oil, gas, or brines, and to manufacturers and others seeking artesian waters.

The importance of accurate records of borings was early recognized by the more enterprising of the drillers and by certain companies operating in oil and gas, and the success of such drillers and operators has been to a considerable extent due to their recognition of the importance of the precise information afforded by the borings, their insistence that records be kept, and their attention to other similar details, minor in themselves but often sufficiently important in the aggregate to make the difference between failure and success. It is probable that there is now not one successful operator on a large scale who does not require the keeping of at least partial records.

Among the many ways in which well records are of value the following may be mentioned: To the oil and gas driller they furnish information as to (1) the best point for locating the well, (2) the depth of the supposed productive bed, (3) the character of the material to be penetrated, (4) the amount of water which will be encountered, (5) the amount of casing required, and (6) the limit of depth to which it is desirable to drill. To the owners of such wells information as to each of the foregoing points, especially those affecting the cost of the wells, is furnished by the records, in addition to which data relating to still more important factors, namely, those of quantity and quality of supplies, are furnished. In the case of drillers and owners of water wells the same information is supplied, but here the items affecting the cost are of increased importance owing to the lower value of the product, and questions of head, quantity, and quality of supply again come to the fore. To prospective owners records show the results obtained by others and the probabilities of success of new ventures, while to the geologist they are of value in assisting him to a more thorough understanding of the geology, which in turn enables him to more intelligently answer the numerous questions constantly referred to him by drillers, well owners, and others.

A more detailed statement concerning the uses of records is given in the following paragraphs, with the view of presenting their benefits more fully to those drillers and owners, especially the smaller operators, who do not have the facilities of the larger companies for collecting and preserving their own records, but who by furnishing information can assist the Survey to a knowledge of the various regions, and thus enable it in turn to give them the benefit of the results of the studies of its geologists.

VALUE OF WELL RECORDS TO THE DRILLER FOR OIL AND GAS.

The contractor or driller for oil or gas is often called upon to sink wells in regions wholly unfamiliar to him. Among the questions which will arise are the following: (1) What is the depth of the supposed oil- or gas-bearing rock? (2) What is the character of material to be penetrated before reaching it? (3) At what depths, in what amounts, and of what quality can water for the boilers be obtained? (4) What is the depth of water seams which must be cased off? (5) What are the character, depth, and thickness of rock which will require casing to prevent caving, if any? (6) At what depth and in what rock is it advisable to stop drilling in case of failure to strike oil or gas at the expected point? (7) At what depths will minor shows of oil and gas be encountered? In case the contractor or driller is required to select the spot for drilling, another question will arise: (8) At what point is the structure most favorable for the occurrence of oil and gas?

A certain amount of this information can be obtained, as has been pointed out, by observation of the character, dip, and strike of the rocks exposed at the surface. Other data, especially those relating to the occurrence of water, to caving rock, and to the depth at which it is advisable to stop drilling, are best derived from records of borings. These need not, however, be necessarily in the immediate vicinity, for a geologist or a driller with a practical working knowledge of the simpler principles of geology can combine the observations afforded by surface outcrops with records of borings at a distance, and intelligently predict the conditions in the intervening area.

Depth of productive rock.—The depth to the productive rock is of great importance as affecting the success of a well. For a shallow well a relatively light outfit can be used, but for deeper borings heavy and more costly machinery and rigs are required. These, with increased cost of fuel, outfit, casing, and greater difficulty of manipulation, make the cost of a well increase rapidly with depth. The amount of oil or gas which would give a good profit on the investment required for a 1,000-foot well might not be sufficient to warrant the sinking of a 3,000-foot well.

It is apparent, therefore, that as close an estimate of the depth as possible should be made before starting to drill. This may in some cases be determined more or less satisfactorily by observation of the distance of the well from the outcrop of the rock and determination of the direction and amount of the dips at the outcrop and in the area intervening between it and the well, but in many instances the outcrop is several score, if not hundreds, of miles from the well, and there are many irregularities of dip and changes of thickness of the rocks in the intervening area, all of which serve to make computations from surface data difficult and unreliable.

On the other hand, deep drilling has been so extensively conducted in this country, especially in the East, that there are very few regions of any extent that do not have one or more deep borings. These furnish, where the data have been preserved, our best evidence of underground conditions, and, combined with surface observations, form a basis for predicting the materials to be encountered in new borings. Where there are a number of borings they afford accurate data for the calculation of dip, which as determining structure becomes an all-important factor in oil and gas operations. This is an especially important feature in regions where, as in much of Ohio, the rocks are buried by hundreds of feet of drift and are nowhere exposed to view at the surface. Two wells of known elevations and penetrating a bed at known depths are sufficient to establish the dip in such regions with greater accuracy than if outcrops were present and served as a basis for the determination. With distances and the amount and direction of dip known the depth can, as has already been indicated, be readily predicted at a given point. Without borings this would often be impossible.

Character of material.—Of almost as much importance as the depth of a well is the character of the material penetrated. On it depends the nature of the process of drilling employed. In the soft material of the Coastal Plain, as in parts of Alabama, Mississippi, and Louisiana, driving, jet, and rotary processes, either singly or in combination, are used, but none of these are suitable for rock work. If, therefore, a very hard bed is to be penetrated another type of outfit must be provided. The character of the tools and the rig itself must also be adapted to the nature of the material to be penetrated. In rock the rate of drilling varies from a few inches in the harder limestones to over 100 feet a day in certain shales; hence, in contracting for a well, knowledge of the character of the various beds and of their thickness is of the greatest value.

As already intimated, important variations in the character and thickness of the beds may take place underground without there being at the surface any evidence of the changes, and while it is possible to judge, to a certain extent, of the character of the beds beneath the surface from their more or less distant outcrops, by far the most accurate information is that afforded by the borings in the same or adjacent regions.

Water supplies.—When wells are located in valleys, or in thickly settled districts, water for boiler use can usually be obtained from streams or the wells of near-by houses. In many of the oil fields, where the wells are frequently located upon the sides or tops of hills or mountains, the question of boiler supplies is important, and small, separate wells are often drilled for this supply. Beyond the ability of the rock to hold water, as indicated by its texture, little is shown by

the surface outcrop. Nothing as to crevices, joints, local sandy beds, etc., on which so much depends, is indicated. All this can be finally determined only by the drill. In this case a single boring, unless in the immediate vicinity of the proposed new well, will not afford an absolute indication of the conditions, but from a considerable number sunk in the same kind of rock an average is obtained which shows the predominating conditions characterizing the bed. This is especially true of the quality of the water, which will vary greatly in different localities, often without any reference to conditions discoverable at the surface.

Casing off water.—Among the factors affecting the sinking of a well is the occurrence of water in quantities necessitating casing it off. This is of importance in determining the amount of casing necessary and its cost, and in determining the size of the original hole in case it is anticipated that several horizons at some distance from one another, each of which may involve a reduction of the size of the casing, will be encountered. As in the case of the water supplies discussed in the preceding paragraph, the most satisfactory information is that furnished by the records of adjacent wells.

Casing off "cave" rock.—In many of the older wells in the softer rocks, especially in shales, much trouble was experienced by the walls of the hole caving and stopping up the bore. This difficulty will be recalled by those familiar with the history of the old Dunkard Creek field, in southwestern Pennsylvania, where many of the wells sunk without casing were ruined by the caving of the walls. Even now that the caving is easily preventable by proper casing, a knowledge of the depths and thicknesses of troublesome beds is of importance in determining in advance the questions relating to casing and its effect on the cost of the well. This information is best furnished by records, as in the case of the water horizons already discussed.

Limits of depth.—Nothing can be further from the truth than the common fallacy that oil, gas, water, or whatever the driller may be in search of, can be had if the hole is only drilled deep enough. In unaltered porous rocks oil and gas may occur, within certain limits, regardless of depth; but all rocks, of whatever character, if buried deep enough, especially if subjected to the powerful compression incident to the formation of mountains, become altered through the influence of heat and pressure, often into more or less crystalline masses. In such rocks the volatile substances, such as the hydrocarbons, are expelled and it is useless to look in them for deposits of oil or gas. It is also useless to seek for oil in rocks of igneous origin—that is, those which have once been molten—for the conditions of their formation are such as to preclude the formation or retention of oil or similar substances. Nevertheless, wells have not infrequently been

sunk into such rocks in search of oil, but the uselessness of this is apparent to those who have noted the records of similar wells elsewhere, as well as to geologists and others who understand the nature of the rocks. The value of accurate records in indicating the depth at which it is advisable to stop drilling will be manifest in those cases where altered or igneous rocks, as described above, are encountered, and in general the logs of the deeper borings are of great value in showing the conditions to be expected at great depths.

Oil and gas shows.—In drilling, especially where the well is being sunk to a known producing sand, small shows of oil or a little gas are often encountered and passed through without much attention being paid to them. Probably many instances have occurred where valuable flows have been cased off, but one or two examples will suffice. In the region southwest of Olean, N. Y., on the outskirts of the Bradford oil field, the early wells were all sunk to the Bradford sand, at a depth of 1,000 feet or so below the valleys. In some instances shows of oil were noted at a certain depth, but were cased off without it being suspected that a producing sand was present above the Bradford. Later, when the Bradford supplies ran low, it was shown that the sand at the upper oil show could be developed into a producer, now known as the Chipmunk sand. Where accurate records had been preserved, the casing of the old wells was locally removed and both sands drawn upon; but where because of lack of records this could not be done, new wells had to be sunk, at an aggregate cost of many thousands of dollars. Similarly, in the Bellevernon and other gas fields in southwestern Pennsylvania gas flows which would now be of great value were cased off in the old days of high pressure. Where accurate records have been kept, these can be utilized by removing the casing in the old wells, but otherwise new wells must be drilled.

Structure.—It has been many years since the anticlinal theory of oil and gas was proposed. This theory postulated the axis of the anticline or crest of the rock arch as the most favorable point for the occurrence of gas, while oil and salt water should be successively encountered in going outward from the crest. While all anticlines do not afford oil or gas, and while oil is often found under somewhat different conditions, as at the point just above where a steep dip changes to flat (at the top of the rock step, as it were), the general principle involved in the theory has not been affected. On the contrary, almost every district, when closely investigated, is shown to agree with these principles, so that at the present time the problems of rock structure are as important as they ever have been in the history of drilling for oil and gas. In no way can the structure be determined so satisfactorily and with such accuracy as by wells or boring records.

VALUE OF RECORDS TO OWNERS OF OIL AND GAS WELLS.

The statements which have been made in regard to the benefit of accurate records to drillers for oil and gas apply with added force to the owners of wells, for the ultimate cost of the wells must, in nearly every instance, fall upon them rather than upon the drillers or contractors. The structure, as determining the most favorable points for drilling, the depth of the producing rock, the character of the materials to be penetrated, the available water supplies, the casing required to shut off undesirable water and to support "cave" rock, and the supply obtainable are all of the greatest importance in determining the success or failure of a well. As has been pointed out, this information is best afforded by records of adjacent wells, and the operator will practically always make inquiries in regard to adjacent wells before beginning his own. Frequently these wells will be found to have been drilled many years ago and the records lost. It is to prevent such loss and, instead, to make the information permanently available that the work of collecting records and samples has been undertaken by the Survey.

VALUE OF RECORDS TO DRILLERS OR OWNERS OF WATER WELLS.

In the same way that records are of value to oil and gas operators they are of benefit to drillers or owners of water wells. The question of the depth of the water-bearing rock, for instance, is of even greater importance than that of the oil or gas sands, because of the relatively low value of the water as compared with oil or gas. With crude petroleum at $1.50 a barrel a supply of only a few barrels a day will give a profit on the investment required for a well of 2,000 or more feet deep, while many hundred barrels of water are required to make even a much shallower well profitable. Moreover, for many manufacturing uses the supply must reach a certain minimum, representing the amount needed for the processes involved, in order to be of any value whatever, while oil, if present in quantities greater than a mere show, can generally be successfully utilized.

The great importance of obtaining water supplies at a moderate depth will be seen when it is remembered that among the competitors of any manufacturing establishment there will always be some who will be able to obtain abundant supplies of the best quality at almost no cost above that of pumping. In such instances the success or failure of an enterprise may depend on obtaining good water at a slight depth. The character of the material to be penetrated and the amount of casing are prominent items in the cost and, therefore, largely determine the success or failure of a well. Other elements, such as head,

volume, permanency, and quality of the supply, become of great importance, for on them depend the uses to which it may be put.

Upon the head, for instance, depends the height to which the water will rise, thus determining whether or not pumping, with its attendant expense for outfit, fuel, and labor, will be necessary, while the obtaining of water in sufficient volume, or of a certain quality, may, as has been pointed out above, determine the ability of a manufacturer to cope with competitors, or even the very existence of an industry in a given locality. The probability of success can, in many instances, be foretold in advance where records in surrounding regions are available. The importance of this knowledge has been long appreciated by those interested in obtaining supplies for industrial purposes or for the boilers of manufacturing establishments or railroad locomotives.

Wells have for many years been of great importance as a source of water for irrigation at many points in the West, and recently they have been extensively utilized in the cultivation of rice in Louisiana and other States of the Gulf and Atlantic coastal plains. In such regions the information and records afforded by the pioneer wells as to the depth and cost of wells, quantity and quality of water, etc., have likewise proved of much value.

Another important class of people benefited are those interested in the development of mineral waters for bathing, sanitariums, and resorts, or for the purposes of bottling for table or medicinal uses. The depths, quantity, composition, and temperature are all most satisfactorily afforded by records supplemented by the analyses which are usually made soon after the well is completed and which, like the records, are often soon lost.

Records of adjacent wells may, in cases, be of great benefit, especially to owners in furnishing a check on statements as to the occurrence of water horizons, depth to rock, amount of casing, total depth of well, etc., all of which are sometimes misstated when contracts have been let for a specified sum per foot or which have been inaccurately reported because of failure to keep proper records. They also afford a basis of comparison as to conditions with more successful or less successful wells of the locality, and frequently give a clue to the cause of failure or of variations from the normal wells.

In many regions the surface wells gradually fail because of the deforesting of the land or its drainage by ditches, and it may become necessary to sink deep into the rock for a permanent supply. All rocks do not yield water, while in some yielding abundant supplies the water carries too much mineral matter for ordinary use. It is in such regions that records, affording a basis for predicting results, are of special value.

IMPORTANCE OF RECORDS TO GEOLOGISTS.

To the geologist records are of value from both the practical and the scientific standpoints. Problems are submitted almost daily by drillers and by present or prospective well owners in regard to the occurrence of oil, gas, or water. Where he can visit the field he can, as already indicated, work out the general features of structure and character and thickness of beds, and can make certain generalizations as to the occurrence of water and in some cases of oil and gas; but he can not give more precise information without a knowledge of the changes which the beds undergo beneath the surface, and these are best afforded by well sections.

The occurrence of oil and gas is shown, as accurate investigation proceeds, to be more and more dependent upon structure, which term is here used in a broad sense to include both the attitude of the rocks and the changes in extent, thickness, or texture which they may undergo from point to point, and the same holds to an even greater extent in regard to artesian waters. Combining well records with surface observations, the geologist is able to locate the anticlines, synclines, flats, etc., so important in their bearing on the occurrence of oil and gas, to determine similar structures governing the occurrence of artesian waters and regulating their head, to predict the character of the material to be penetrated, to fix the depth of the producing horizon, and in the case of water to estimate the approximate volume to be obtained.

From the scientific standpoint records and samples, especially where the latter include fossils, aid the geologist to a better understanding of the age and succession of the rocks, assist him in the correlation of identical or equivalent beds in remote localities, and enable him to work out the details of structure and history, all of which furnish a basis for conclusions which are of much benefit to the driller or well owner.

WORK OF COLLECTING WELL RECORDS AND SAMPLES.

ORGANIZATION.

EARLY COLLECTION OF RECORDS.

Ever since the organization of the Survey the collection of records as an aid to the study of geology has formed an incidental part of the work of the geologist in the field, but since the beginning of the precise stratigraphic and structural work of recent years the collection of records has become an important part of the Survey's work in certain regions. The vast majority of wells, especially in Pennsylvania, were sunk a number of years ago, but fortunately many records have been preserved. These were carefully collected by the geologists in the individual localities.

PROPOSED SECTION OF OIL AND GAS (1902).

The collection of records finally became so important that it was thought that a section, organized for the purpose of collecting them in connection with a study of the oil and gas fields, might be organized to advantage, and an outline plan for such a section was, at the request of Mr. M. R. Campbell, submitted to the geologist in charge of geology April 28, 1902, by the present writer. The following is an extract from this plan:

In the prosecution of the work of areal mapping, and in the determination of the structure of the areas surveyed by Mr. [M. R.] Campbell and members of his party in Pennsylvania and Indiana, it has become apparent that great importance is to be attached to the information which may be derived from the deep borings for oil and gas.

As has been pointed out by Mr. Campbell, it is generally only in increased details of outcrop, made possible by accurate topographic maps, and more especially in the greater refinement in structural details, that improvement has been made upon the detailed work of the earlier surveys in the region mentioned. Engineers, coal operators, and oil and gas men with whom the geologists have come in contact and who have learned of the nature of the structural work which is now being undertaken, have almost invariably shown a marked interest in what is being accomplished and have fully appreciated its value to them as practical men.

Already many errors, some of them very grave, have been found in the structural work of the Second Survey of Pennsylvania. Supposedly continuous folds have been found in reality to consist of a series of short disconnected ellipsoid domes and canoe-shaped troughs, and marked by frequent irregularities and by noticeable offsets at their terminations. Others have been shown to vary at angles as high as 60° or more from the positions previously determined, and, in fact, everywhere abound in unsuspected relations. The once famous oil fields west and northwest of Bradys Bend on the Allegheny River have previously been thought to have no relation to structure, but have now been proved to have a very close and definite relation to it, a fact that should be of great value in the drilling for the Speechley oil sand which is now going on, and in the drilling of gas wells, which, following the recent revival of activity, are fast becoming of great importance in this and other regions.

The determination of the minor but important details of structure is dependent (1) upon information afforded by mines, (2) upon observation and correlation of natural outcrops, and (3) upon information afforded by deep wells. The first is available only in synclines containing workable coals. The second is of little value in many localities because of the general absence of distinctive characteristics over broad areas and through considerable vertical ranges of the Devonian and Carboniferous rocks, not only in Pennsylvania and Indiana, but in many other of the areas where these rocks occur. In such regions the oil and gas wells have frequently furnished the only reliable data for the determination of the structural details.

The growing disposition on the part of the States to cooperate with the United States Geological Survey makes it somewhat probable that work similar to that now going on in Pennsylvania will at no very distant date be undertaken at other points, where presumably similar conditions will prevail and similar results be expected and required.

The great value of well records in his work in Pennsylvania was fully appreciated by Mr. Campbell, and considerable amounts of time were devoted both by him and by myself to the collection of such records. Some 1,500 were obtained in 1901. It has become apparent, however, that to carry out the collection of records to the

extent desirable, and especially to properly file and catalogue them so as to be readily available, is impracticable with the present force. This, in addition to the advisability of collecting and publishing this information (which seems likely to be of considerable economic value), has led Mr. Campbell to suggest to me that I place before you the question as to the advisability of employing or assigning some geologist or other person who can devote the whole or a large part of his time to the work, and who should be given charge, under your supervision, of the work relating to oil and gas.

Some of the duties that might be expected to devolve, in whole or in part, upon an assistant geologist or geologist in charge of oil and gas are as follows:

1. To consult with other geologists and with hydrographers and topographers with the view of collecting and filing information relating to deep borings for oil and gas obtained by the various field parties of the Survey.

2. To obtain representative records and information as to structure of all pools as far as possible.

3. To collect and file samples of oil- and gas-bearing rocks, together with other characteristic beds encountered, as far as feasible.

4. To gather together published records and all available unpublished records as far as practicable, and to file them in the form of card catalogues which will be available to the members of the Survey at all times.

5. To prepare a bibliography of all oil and gas papers which have appeared in scientific publications and, as far as practicable, those which have appeared in trade journals up to and including 1900.

6. To keep a bibliographic catalogue of all oil and gas papers which have appeared since 1900 in both scientific and trade journals.

7. To review oil and gas periodicals and to keep records of developments and progress.

8. To keep a general index map showing the location of the oil and gas fields throughout the United States.

9. To keep State or county maps or topographic maps of the Survey, where available, to show the details of the various fields and pools of oil and gas.

10. To prepare geologic columnar sections for each pool as far as possible.

11. To prepare digests of structure for each pool as far as possible.

12. To keep a catalogue of all sands and their character and geologic positions as far as known.

13. To prepare correlation tables of the various sands where the information is available.

14. To visit new fields and investigate the geology and determine the structure, running levels where necessary.

15. To visit, collect records, and prepare reports on the oil and gas in quadrangles and districts where it is not practicable for the geologist in charge to give his personal attention to the problem.

16. To furnish other geologists with all information as to stratigraphy, structure, etc., which is afforded by the samples and by the records and other information on file.

17. To answer inquiries of operators, etc., regarding structure and other points relating to oil and gas as far as possible, without divulging confidential information.

18. To publish immediately in trade journals summaries of the geological knowledge of the regions of newly discovered pools.

19. To publish in Survey publications from time to time detailed reports of the development, structure, and general geology of new pools or the extensions of old pools.

20. To prepare statistics on production, etc., for the Mineral Resources, if required.

To summarize, the appointment or assignment of a geologist to take charge of the

oil and gas problems would create a sort of "bureau of information" which would be of much value to both the operator and the geologist.

The gas production is greater now than at any time in the past, and the oil production is holding its ground fairly satisfactorily. It seems likely, therefore, that there will be steady demand for information for some time to come, and it is not unlikely that an "oil and gas division" could be made a division of some importance in the Survey.

ORGANIZATION OF THE "WELL DIVISION."

The lack of available funds made it impossible to take up the plan as a part of the work of the geologic branch at that time, but in November of the same year a memorandum embodying a plan for a proposed "well division" was submitted to the Director by Mr. F. H. Newell. Under this plan it was proposed to organize in the hydrographic branch a division of work devoted to wells and ground waters, which should be under the charge of a geologist designated "chief of the well division," under whom would be two assistant chiefs, one for the eastern part of the country and the other for the western part, including the sixteen reclamation States and Territories. It was expected that each would spend at least four months of the year in the Washington office, so that one geologist would be constantly on duty to attend to administrative work and correspondence. It was proposed to give particular attention to a card catalogue of wells and to the compilation and filing of schedules relating to wells, which should include those drilled for oil and gas as well as for water. The catalogue and other data were to be available to the entire Survey, and the officers of the division were to supply information to drillers and others requesting it. In addition to the regular geologists, it was planned to have an assistant in each State to visit wells, study the stratigraphy, collect general information, and prepare detailed reports on the geology in its relation to the water resources, the results of which were to be published annually in progress reports, or as separate water-supply papers in the case of completed studies.

The memorandum of Mr. Newell was referred to Dr. C. W. Hayes, geologist in charge of geology, who, in a letter to the Director dated November 18, 1902, expressed his agreement with Mr. Newell as to the necessity of such an organized effort to systematically secure the records of wells being drilled for various purposes throughout the country, but questioned the desirability of placing one man in charge of the entire work. Instead, a recommendation was made that two geologists be employed, one to be placed in charge of the eastern section and the other in charge of the western. It was proposed that the general supervision of the work and of the scientific portions relating to water should rest with the hydrographic branch, while the portions relating to geology should be under the similar supervision of the geologic branch.

The letter contained a recommendation that the present writer be assigned to the charge of the eastern section, which assignment was made by the Director on December 23. To Mr. N. H. Darton was assigned the charge of the western section.

WORK OF THE DIVISION OF HYDROLOGY IN 1903.

The designation of "well division" later gave place to that of "division of hydrology," but without change of scope of work. Plans for collecting well records were taken up immediately on the organization of the division. As has been indicated, it was originally intended to include the collection of oil and gas records with those of water, but because of lack of available funds and proper assistance it was necessary to confine attention entirely to water. For use in connection with the collection of well data, forms for mailing to well owners and cards for filing the information were prepared. The form for mailing has been slightly modified from time to time. The form now used is as follows:

SIR: In its study of the water resources of the United States, which this Survey is making with the view of publishing the results for the benefit of the people, an attempt is being made to obtain important facts relating to wells, whether flowing or not. As it is impracticable on account of expense to visit all places, the endeavor is made to extend and complete the information by correspondence. If you will aid in this work by furnishing the data requested in the following list of questions your assistance will be much appreciated. If you can not supply all the data, kindly answer such of the questions as you can, a partial report being much better than none.

The following inquiry blank is on the same form with the above letter:

1. Well is in.....County. The nearest post-office is.....
   Distance of well from post-office..... (Miles.) Direction from post-office.....
   Locate by section if public-land surveys exist: Township....., Range.....,
   Section....., Quarter.....
   If in town, give street and number.....
2. Owner ..... Address.....
3. Driller ..... Address.....
4. Situation of well..... (Hill, slope, plain, valley.) Elevation is.....feet..... (Above or below.) the
   level of ..... (Sea, railroad station, lake, river.)
5. Type of well..... (Dug, driven, bored, or drilled.) Year completed..... Diameter at
   top..... At bottom .....
6. Depth of well..... Does it enter rock?..... If so, at what depth?.....
7. Depth to principal water bed..... Character of
   water bed ..... (Gravel, sand, clay, rock, etc. If rock, state kind.)
8. Were any other water beds or seams found?..... If so, give depth of each.....
9. Give sizes and lengths of casing.....

10. Does water flow at surface without pumping?..... If so, at what height does it now flow?.....
Has it been tested to see how high it will rise?..... If so, to what height?..... What is its pressure?.....
If not flowing, how near surface does it stand when highest?.....
When lowest?.....
11. Is well pumped?..... If so, by what .....
(Suction, deep well, or force pump, steam, gasoline, air-lift, or windmill.)
12. Temperature of water at well mouth..... Month taken.....
Temperature at bottom .....
13. Natural yield, if flowing..... (Gals. per min.) Maximum yield by pumping..... (Gals. per min.)
water is lowered.....feet by pumping. (State number.)
14. Has supply decreased or increased?..... To what due?.....
15. Is flow or clearness of water affected by storms, winds, etc.?..... If so, describe .....
16. Quality of water—hard, soft, salty, alkaline, iron, or sulphur bearing.....
Cost of well..... Of pumps.....
17. Is water used for drinking?..... Washing?..... Cooking?.....
Stock?..... Manufacturing?..... Irrigation?.....
If for manufacturing uses, state nature..... If for irrigation, give crops .....
If used for public supply, give number of buildings and people supplied:
Buildings..... People .....
Is it sold?..... If so, for what purposes?.....
If used for purposes not mentioned, please name.....
18. Describe interesting peculiarities of well, if any, on back of this sheet.....
19. Give record of beds passed through, analysis of water, names of other well owners or drillers on back.
Name of person filling out blank .....

These or similar circulars were distributed in Maine, New Hampshire, Vermont, Rhode Island, Connecticut, New York, Georgia, Florida, Mississippi, Tennessee, Kentucky, Arkansas, Missouri, Iowa, Minnesota, Wisconsin, and Michigan, and a large number of records were obtained, of which about 2,750 were listed in Water-Supply and Irrigation Paper No. 102. The larger part of the records gave little information as to the strata penetrated, although a considerable number of detailed records were obtained from scattered localities and published in the paper mentioned. The circulars described are still largely used to obtain data relating to wells other than records of strata penetrated.

PRESENT ORGANIZATION OF THE WORK.

In the summer of 1903 it became necessary, in order to make fine distinctions in glacial materials on Long Island, New York, where the geology and water resources were under investigation, to collect samples from the wells being drilled on the island. This work of collecting samples was in charge of Mr. A. C. Veatch. The will-

ingness shown by operators and drillers to assist and the value of the material obtained suggested the organization of a similar system for the entire country.

Accordingly, during the fall of 1903, Mr. Veatch drew up an outline of a proposed system for collecting and preserving well samples, which was indorsed by the geologists interested in the keeping of records and samples, with the result that it was decided to take up the work as soon as circumstances should permit, which was at the beginning of the fiscal year 1904–5.

The plan outlined by Mr. Veatch for the collection of well records and samples contained many points in common with that for the proposed "oil and gas section," submitted by the present writer in 1902. (See pp. 28–39.) The principal points of difference are the inclusion of water wells in the present system and the exclusion of oil and gas data, except as they relate to stratigraphy and structure as shown by the well records. The items covered by paragraphs 1, 2, 3, 4, 7, 16, and 17 of the former plan are likewise covered by the present work, while it is hoped that in the future those mentioned in paragraphs 10, 11, and 14 will also be included.

As the plan originated in the division of hydrology the new work was assigned to it, about two-fifths of the expense being borne by the eastern section and the remainder shared equally by the western section of hydrology and the geologic branch. The oversight of the work rests with the chief of the eastern section, but its inauguration was placed in the hands of Mr. Veatch, assisted by Mr. E. F. Lines, by whom it was put into successful operation. On the relinquishment of the work by Mr. Veatch, who wished to take up more purely scientific problems, the prosecution devolved upon Mr. Lines, to whom much of the success of the work is due.

RESULTS.

The results obtained during the six months in which the system for collecting records and samples has been in operation are very gratifying. The practical nature of the plan has appealed to drillers and others interested in wells and has resulted in many offers of cooperation. The plan has likewise been cordially received by the press and favorably commented upon editorially.

In the office the plan has likewise been shown to be eminently practical. The system outlined by Mr. Veatch has now been in operation long enough to thoroughly test its efficiency, and has proved to be simple in operation, economical as to labor, convenient to handle, and effective in its results. A few minor changes have been found desirable, but in all its main features the plan followed is substantially as originally formulated.

The results of the work may be summarized as follows:

Approximate number of persons returning samples, 200.
Number of wells represented by complete sets of samples, 111.
Number of wells represented by incomplete sets of samples, 190.
Total number of samples received, 3,945.
Records received in Survey notebooks, 139.
Records received in other ways, 230.

The scientific results include detailed records from 111 wells. Of these nothing need be said, their character being indicated by the present report.

METHODS OF WORK.

A number of States have, as a part of their work, undertaken a more or less systematic collection of deep-well records. The Second Geological Survey of Pennsylvania especially gave great attention to this feature, employing several men on the work of collecting and tabulating well records, of which several thousand were published. In some cases observers selected by the State survey were stationed at certain important wells to insure the collection of samples and the taking of accurate measurements. A great number of well records have also been independently collected by geologists throughout the country for the information they throw on stratigraphic and other problems, and a considerable number of them have been published, often constituting contributions of great importance to those interested in the occurrence of oil, gas, brines, and potable waters. The present system of the United States Geological Survey is believed to be more extensive and comprehensive than any previously put in operation for the collection of well records and samples, and it has been thought desirable to put on record a description of the plan, for the benefit of those persons or organizations who may desire to conduct similar work in the future.

It being manifestly impossible, because of the great expense involved, to place observers at the various wells, it was necessary to arrange for cooperation on the part of drillers throughout the country. This cooperation could in general be expected only when the drillers should be substantially benefited by the work, and consequently in the development of the plan this point was kept constantly in the foreground. Arrangements were made whereby such questions as the drillers should submit in regard to their work would be promptly attended to, and records interpreted or samples examined on request. In return the driller is requested to furnish written records of his wells and samples of materials penetrated, his assistance to be acknowledged in the reports on well records, issued annually.

GENERAL PLAN AND DETAILS OF WORK.

(FORMULATED BY A. C. VEATCH.)

The plan followed in the collection of well records and samples was developed by Mr. A. C. Veatch, assistant geologist, who also drew up the various forms used in correspondence, field, and office. The work may be summarized as follows:

First step is to obtain the names and addresses of drillers and well owners, who are informed of the advantages of saving samples and records and invited to cooperate. When a driller signifies his willingness to assist, he is supplied with notebooks for keeping the records, and small bags for shipping the samples through the mails free of cost. The receipt of all records or samples is acknowledged. If the original invitation to cooperate is not answered within a reasonable time, a second request is sent, which may be followed by others if necessary. An account is kept, by means of a card file, of letters and bags sent, and the records and samples are likewise systematically filed as received. At the end of each year, or oftener if the conditions demand, a report is to be prepared giving the names of persons cooperating, a summary of the wells reported, and complete records of the more important wells represented by samples or by detailed records.

SOURCES OF ADDRESSES OF DRILLERS AND WELL OWNERS.

One of the first steps in the work was to secure the names of drillers or owners of wells in process of drilling. These were obtained from the following sources: (1) City directories, gazetteers, etc., (2) parties voluntarily offering to cooperate, (3) trade and engineering publications, (4) geologists and others in the field, (5) newspaper clippings.

The city directories and gazetteers of drillers furnished the largest number of addresses, but as all classes of drillers, including many local operators, are there included the percentage volunteering to assist was small. Perhaps the most effective aid was secured through voluntary offers of assistance from drillers in response to a press notice describing the work which the Survey is undertaking in the collection of samples and records and asking for cooperation. This was widely published, often with favorable editorial comment, in engineering, oil, and water journals and in newspapers. A large number of addresses of drillers and owners were also secured from advertisements for bids, news notes on water supplies, etc., in the engineering and trade journals. The journals now consulted are as follows: Engineering News, Fire and Water Engineering, American Magazine of Mining and Investment, Pacific Oil Reporter, Petroleum Gazette, Oil Investors Journal, and the semiweekly Oil City Derrick. A single issue of a weekly magazine may furnish as high as ten or more addresses, and the

cooperation obtained through these addresses, especially through those obtained from advertisements for bids, is especially efficient. The newspapers throughout the country contain a vast amount of information relating to wells, but it has been found that this is not satisfactorily collected by the press-clipping bureaus, and at present little use can be made of it.

Filing of clippings.—The magazines are examined as received and clippings taken of advertisements for bids, news notes, etc. These, together with the clippings received through the press bureaus, are commonly pasted on a 4 by 6 inch card. At the top of this card is space for the name of the State, county, and town. If the clippings are long and require folding, an envelope attached to the face of the card, opening upward, is of much assistance in filing.

The clipping cards are marked with the name of the publication, and the volume, page, and date, after which they are filed by State, county, and locality. The clipping file gives not only addresses, but a comprehensive summary of drilling operations and allied subjects.

PREPARATION OF MAILING LIST.

Each name and address of a driller or well owner is entered on a 4 by 6 inch card, which also serves as a stock card. In addition to the spaces for the name and address there are spaces for recording the position (owner, contractor, foreman, driller, etc.) of the person referred to, the dates on which circular letters inviting cooperation were sent, the addresses to which supplies are sent, the number of notebooks and bags furnished, and the dates on which they were forwarded. The form of this card is shown below.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Name, Position,

Permanent address, First circular sent,

Circulars sent.

Date.	Address.	N. B.	Account of bags sent.

ARRANGEMENTS FOR COOPERATION.

When the addresses are first recorded on the cards, a letter inviting cooperation is sent. The character of the letter varies with the person to whom it is addressed, but one or the other of two forms is commonly used. These are given below, the first being sent to drillers and the second to well owners.

Letter sent to drillers.

SIR: The demand for information regarding wells has become so great that the United States Geological Survey has decided to issue a yearly publication giving briefly an account of the wells bored in the preceding year. This report is to be published as near the beginning of each year as practicable, and will be sent to all who apply for it. It will contain the names and addresses of persons doing well work, and will summarize the work done by them in the preceding year.

In order that no portion of your work may be overlooked in this report, you are requested to inform this office from time to time of the progress of your work and to forward records and samples of the materials penetrated in your wells.

That the foreman of the outfit, or the person visiting the wells, may not be burdened with a great number of bulky bottles or cans and an ever-growing accumulation of samples, small canvas bags have been prepared (one of which is inclosed) in which samples may be transmitted through the mails without the payment of postage. As these samples can be mailed as often as the men visit the post-office, there is no danger that they will accumulate and become burdensome. For the keeping of a log a convenient pocket memorandum book has been prepared and will be sent with the sample bags.

In order to keep in touch with you and your foreman, a card like the inclosed will be mailed at stated intervals. This will not only serve as a reminder, but will save you some clerical labor.

This work should enlist your cooperation for the following reasons:

First. Your name and work will be kept before a class of readers interested in well drilling.

Second. Records of your work will be carefully filed in this office, and will be readily available to you at any time, so that in case your notes are lost they can be duplicated.

Third. You will aid materially in the study of the geological structure of the United States, a knowledge of which can not fail to benefit you as a well driller.

In some cases it will be necessary that the records should be regarded as confidential, and in these cases the information will be carefully guarded, and used only under the conditions which you stipulate.

I shall be glad to hear from you regarding this work and will be grateful to you for any suggestions.

Letter sent to well owners.

SIR: The Survey is making a systematic collection of well records and samples. Such data are of great assistance in the study of many of the problems which the Survey is called upon to investigate, and you are cordially invited to render assistance by sending to this office records and samples from the wells in which you are interested.

The results of this work, except in cases of confidential records, will appear in a yearly publication and in detailed reports of special areas, which will be prepared from time to time, copies of which will be sent to you.

If you will undertake to save samples, please sign and return the inclosed card, which requires no postage. A supply of canvas bags like the one inclosed will then

be sent you, in order that the samples may be transmitted through the mails without the payment of postage.

In some cases it is necessary that records be regarded as confidential, and in these cases the information will be carefully guarded and used only under the conditions which you stipulate.

When the first letter inviting cooperation is sent out the date is entered on the card (p. 29). If a reply is not received in two weeks or a month, it is often desirable to send out a second letter. In order to keep track of this correspondence, projecting metal clips of different colors are used. Thus, if the first circular is sent out on January 1, and it is desired to send a second letter on January 15, the date January 1 is entered on the line opposite "circulars sent," while the clip is placed on the number 15 at the top of the card. As the cards are of uniform size and fit closely into the drawer, all the clips for a given date fall in a single line, and it is easy to select the cards for a particular date without handling those relating to any other date. To assist still further in handling the correspondence, clips of the following colors are used for the different classes of cooperators: Copper for persons such as foremen for large firms saving samples by order of employers or others; white for all other persons saving samples; green for owners not saving samples, and steel-blue for drillers not saving samples.

If a reply is not received to the first letter by the end of two weeks, a second letter is sent, which is commonly as follows:

Second letter sent to drillers and well owners.

SIR: In order that the collection of well samples being made by this office may be as complete as possible, one of the inclosed forms is sent at stated intervals to all persons interested in well drilling.

If you will save samples of well borings for the Geological Survey, please fill out this card, which requires no postage, and return it to this office, when a supply of canvas bags, which will carry the samples through the mail without the payment of postage, will be sent you.

The card should also be filled out if you need additional sample bags or if you are about to move your outfit to a new place.

If a reply to the second letter is not received, the same form is sent again after an interval varying with the individual circumstances. By repetition the letter serves to impress the importance of the work upon persons not responding to the first invitation, with the result that cooperation is sometimes finally secured. The same letter is also sent from time to time to persons saving samples, in order to keep in touch with them, to make sure that the work is not forgotten, and that the necessary supplies are ordered as required.

With the original letter inviting cooperation and with the second letter there are inclosed a sample of the bags used for shipping samples and a franked card on which the recipient can designate the number of notebooks and bags required.

The sample bags are of light but strong canvas and measure 3½ by 5 inches. On them are printed the "penalty frank" and the Survey address. At the top is a string for securely tying in the contents before shipment.

When the card requesting supplies is received the supplies are immediately shipped, together with a notice of shipment.

TAKING OF NOTES AND SAMPLES.

Form of notebook used.—As every effort has been made to assist the driller in keeping notes and saving samples, special notebooks as well as sample bags were devised.

On the front cover of the notebooks now in use[a] is the title, and on the back cover are printed a postal frank and the address of the Survey, so that the book may be returned by mail without wrapping. Experience has shown that the books become much less soiled than was anticipated, little trouble being encountered in this line.

The inside of the front cover contains the following simple directions, prepared by Mr. Veatch:

Suggestions to drillers.

1. Samples should be taken from each bed passed through, and never more than 20 feet apart, even in the same bed.
2. Samples from wells in sands and clays should not be washed, as washed samples of sandy clay show only clean sand and give a wrong idea of the character of the bed.
3. All oyster, clam, or other fossil shells should be placed in the bags with the dirt or sand in which they are found and marked with the depth from which obtained.
4. Samples should be dry before being mailed.
5. A blank label will be found in each bag. After it is filled out it should be folded once to protect the writing.
6. Bags should be tied securely and mailed. They require no postage.
7. In the first two or three samples sent in, the "Location" should be filled out with care; in the succeeding samples so much care need not be taken with location, but the rest of the card should be complete.
8. Note depth and thickness of all water-bearing layers.
9. Note under "Remarks" the quality of the water from each layer, as hard, soft, salty, alkaline, or sulphur bearing.
10. Note height to which water from each layer rises in well, and give flow in gallons per minute.
11. Make frequent use of the "Remarks" column to explain your notes.
12. If you leave the rig, send in your notebook with the name of your successor and a new book will be sent to him.
13. If you do not understand what is wanted, or desire information on any point, write to this office, using one of the envelopes sent with the first shipment of bags. They require no postage.
14. It sometimes happens that unauthorized persons represent themselves as members of the Survey. If you desire to know whether a man is connected with the Survey, ask for his identification card, which is signed by the Secretary of the Interior and the Director of the Geological Survey.

[a] A new edition to be used after January 1 varies in a number of unessential particulars from the form here described.

Names of owners and drillers who furnish records and samples will appear in the annual publication of the Geological Survey on well borings.

The Survey desires to assist and cooperate with owners and drillers in every way possible, and will be glad to answer questions.

To assist the driller in identifying the rocks, in obtaining a correct understanding of simple geologic conditions, and in keeping more intelligent records, a few geologic notes and definitions of the more common types of rocks, based largely on notes by Mr. G. H. Eldridge, are printed on the inside of the back cover and on the page facing it, respectively. These are given below.

Geologic notes.

In a simple classification rocks may be grouped into three divisions: (1) Sedimentary, (2) metamorphic, and (3) igneous.

Sedimentary rocks.—Sedimentary rocks are formed of fragments worn from older rocks by the action of rain, wind, frost, etc. Such materials were carried by water or glaciers until deposited as beds of clay, sand, gravel, marl, etc. Other deposits consist largely of corals, or of shells, such as oysters and clams. When first deposited the materials are loose and unconsolidated, but they become gradually hardened and cemented together, especially when covered by later beds, and form solid rocks.

Metamorphic rocks.—Sedimentary rocks have frequently been subjected to heat and pressure, which has further hardened them, or even produced a crystalline texture. Sediments and igneous rocks so altered are known as metamorphic rocks. Mica-schist and marble are typical examples. They generally retain a bedded or foliated structure.

Igneous rocks.—Igneous rocks have come from the earth's interior in a molten state and have forced their way between other rocks or have overflowed as lava beds at the surface. They are nearly all more or less crystalline in texture.

Resemblance of rocks of different ages.—Rocks of the types indicated above occur the world over, those of one locality often being indistinguishable from those of another. Notwithstanding this, there may be a difference of thousands of years in age and a great variance in conditions of formation. It is not warrantable, therefore, to say that because a rock in California has the same composition as an oil-bearing rock in Ohio it is of the same age and will yield petroleum.

Fossils.—In sedimentary rocks remains of animals and plants are often found. These generally consist of portions or impressions of shells, skeletons, or leaves, and are known as fossils. A bed can frequently be recognized and its age determined by fossils. It is of great importance that all fossils be saved.

Definition of a formation.—A rock or succession of rocks possessing uniformity of character throughout a considerable area is termed a formation, and is given a name, such as Trenton limestone, etc. The importance of identifying these is great, and their identification will be much facilitated by the preservation of samples.

Structure.—When deposited, sedimentary beds are nearly horizontal. Subsequently they have often been thrown into inclined positions or bent into wave-like folds, the arches of which are known as *anticlines* and the troughs as *synclines*. When the beds are further disturbed they may become broken and the different parts displaced or *faulted* from their original position. The slope of the beds is known as the *dip*, and the direction in which they extend or would outcrop on a horizontal surface is known as the *strike*. The directions of strikes and dips are of importance in studying the occurrence of water and oil, and should be recorded whenever possible.

The definitions of rocks are as follows:

In order to assist the driller in keeping records, brief definitions of the more common rock terms are given below.

UNCONSOLIDATED DEPOSITS.

Soil and subsoil.—The weathered upper portions of any rocks.

Till.—An irregular mixture of clay, sand, and bowlders deposited by glaciers.

Alluvium.—Sand, clay, etc., deposited by streams.

Gravel, sand, and clay.—Made up respectively of pebbles, sand grains, and finer particles.

Chalk.—A soft, white earthy substance made up of fine particles of lime.

Marl.—A clayey substance containing much lime.

SEDIMENTARY ROCKS.

Sedimentary rocks are made up of fragments of older rocks. The fragments or grains are usually rounded, a feature which helps to distinguish them from igneous rocks.

Conglomerate.—Consolidated gravel.

Sandstone.—A consolidated sand. It is said to be *massive* if there are few bedding planes, and *shaly* if it splits into plates.

Quartzite.—A sandstone in which the spaces between the grains have filled with a hard cement (silica), forming an excessively hard rock.

Shale.—Consolidated clay; a soft, fine-grained rock which tends to split into thin plates (often improperly called soapstone).

Slate.—Like shale, but harder; splits into thin plates which may or may not coincide with the bedding. The tendency to split is not often recognized in drilling. Example: Roofing slate.

Limestone.—Formed from consolidated marly beds, or from beds of coral, shellfish, etc. It is composed mainly of carbonate of lime, but often contains sand and other impurities, and is often very hard. It can be most readily detected by the bubbling which takes place when it is touched with muriatic acid.

Flint, rock salt, gypsum, coal.—These are too well known to require definition.

Concretions.—Hardened lump-like masses within the rock, and should not be confounded with real bowlders.

METAMORPHIC AND IGNEOUS ROCKS.

These rocks are generally made up of angular crystals, often recognizable by their glistening faces, a feature which is not often possessed by the fragments of sedimentary rocks.

Marble and dolomite.—*Marble* is a cystalline limestone and gives the same reaction with acid as limestone, marl, and chalk. *Dolomite* resembles limestone, but the bubbling with acid takes place only when the acid is hot. In composition it differs from limestone and marble in that it contains carbonate of magnesium.

Soapstone or talc.—Fairly soft and greasy to the touch. It is seldom encountered in drilling, the substance called soapstone usually being a soft shale, although the name is sometimes incorrectly applied to clay or slate.

Schist.—A crystalline rock characterized by thin layers of mica or other mineral.

Gneiss.—A rock intermediate in character between schist and granite.

Granite.—A crystalline rock composed of quartz, feldspar, and other minerals.

Trap.—A very dark crystalline rock of igneous origin.

The first page of the notebook is used for a general record of the well. It is as follows:

Well record on first page of driller's notebook.

Well is located.....miles in a.....direction
from.....post-office, in the
.....¼ of.....¼ of Sec.....Twp.....Range.....
Owner.....
Contractor.....
Drillers.....
Well began....., 190.; completed ....., 190.
Rig used—cable, rotary, jet, or.....
Diameter of well:.....inches from.....ft. to.....ft.;
.....inches from.....ft. to.....ft.
Length of casing.....
Casing perforated or strainer inserted at.....ft.
Main water supply from .....ft.
Well pumps.....gals. per minute from depth of.....ft.
Well flows.....gals. per minute from depth of.....ft.
If flowing, what is the pressure?.....

Fill out for oil and gas wells.
- Pool or district.....
- Well No.....on .....farm.
- Amount of oil obtained.....
- Amount of gas obtained.....
- Name of sand.....

.....
.....
.....
Recorded by.....
Address .....

The notebook contains 7 double pages for the recording of data. It is an adaptation of a form used by Mr. M. R. Campbell for oil records, which in turn followed the general plan of the notebooks of the Second Geological Survey of Pennsylvania and of later surveys and corporations. On each double page are seven columns, headed as follows: "Sample No.," "Rock or material," "Color," "Hard or soft," "From—," "To—," "Remarks."

Taking and forwarding samples.—In taking, preparing, and shipping samples the suggestions in the notebooks are generally followed fairly closely. The samples are commonly taken every 10 feet, or at every change of material, dried on a board or otherwise,

and then placed in the bags. With each sample is included a 2 by 3 inch label, on which the following data are given by the driller: Sample number, location, name of owner, driller, and person sending sample, and the depth at which the sample was obtained.

EXAMINATION AND FILING OF SAMPLES.

Transfer to bottles.—When received at the office the samples are transferred to glass bottles. The bottles now in general use are approximately 2¾ inches long and three-fourths inch in diameter.

Glass jars, measuring 3 by 1¾ inches, with a tin cover screwing on the top, were originally used, but they were found to be larger than necessary in most cases, although they are convenient where fragments are blown out in shooting or where fossils or pebbles are brought up.

Acknowledgment of samples.—When the bags are opened the labels are examined and acknowledgment is made to the persons sending them.

EXAMINATION OF SAMPLES AND FILING OF RECORDS.

Whenever a set of samples from a particular well is complete it may be taken from the temporary files and referred to a geologist for examination and identification. The data thus obtained, together with those afforded by the drillers' notebook, are then compiled on cards. At the top of these cards are spaces for the names of State, county, and town in which the sample was obtained, for the names of the owner and driller of the well and of the person sending the samples, and for the dates of opening and closing the account. Below this space for general information are seven columns, which contain the following headings: "Date," "No.," "Character of strata," "From—," "To—," "Drawer No.," "Date." If the record is long, supplementary cards are used. These are ruled as described above, but at the top there are spaces for only the names of the State, county, and town.

Data of economic value are recorded on a separate card. The various cards, together with clippings, notebooks, etc., relating to the same well are then fastened together by a clip and filed by locality.

STORAGE OF SAMPLES.

Importance of preservation of samples.—Mr. A. C. Veatch urged the general preservation of samples, as descriptions even by the best geologists are seldom as satisfactory as the samples themselves. Because of advances in geologic science and of later and more precise data for discriminating the characters of underground beds, peculiarities which had been entirely overlooked or misinterpreted often become clear as a result of a later examination. Many facts of value,

both to science and to the practical driller, would undoubtedly be lost if the samples were discarded as soon as examined. Of course, certain simple types of sandstones, shales, and limestones can be described with a considerable degree of accuracy, and such samples, together with duplicates from the same bed, can be discarded, but the present policy is to preserve everything that can possibly be of value.

Labeling of sample bottles.—When the samples are transferred to the bottles a label is made out from the field label which accompanies the sample. It is printed on gummed paper, so that it may be easily attached to the bottle, and on it are written the well and sample number, depth, date, location, and name of owner.

Temporary files.—The samples frequently come in one or two at a time, and it is generally desirable to postpone final examination until all those from the same well have been received. As received they are put into bottles, labeled, given well and sample numbers, and put into a case for temporary filing. The object of the temporary files is to afford storage for samples from miscellaneous wells until the sets from the individual wells are complete. The cases are built in units with smooth ends 40 inches long, 32½ inches high, 24 inches deep, and are provided with glass doors to shut out the dust. Each contains 14 drawers in 2 rows of 7 each. Each drawer is 15½ by 20½ inches, inside measurement, and is 2½ inches deep. The guides are so placed that a space of three-fourths of an inch is left between each drawer to allow for the projecting bottles. The drawers are further subdivided by pasteboard partitions, similar to those used in packing eggs, into 108 compartments, each one of which will hold four of the smaller bottles or one of the large jars. The maximum capacity is 432 bottles to a drawer, or about 5,000 to a case. As but few of the larger jars are used, the actual capacity is very near the maximum.

Permanent storage of samples.—After examination, or when a set is complete, if desired the samples are filed in permanent storage cases of the same type as the temporary files. The compactness of the storage system will be appreciated when it is pointed out that over 200,000 samples can be stored in a 10 by 15 foot room. The samples are filed by wells, which are numbered consecutively as the reports are received, the numbers being entered on the record cards, which are filed alphabetically under States and counties.

RECORDS COLLECTED INDEPENDENTLY OF SAMPLES.

The most thoughtful drillers generally keep records of all wells drilled in new fields, but do not attempt to save samples, because of the labor involved in their handling and storage under ordinary conditions. Many of these records, which are often of much value in determining the geologic features of the region, have been, through the

courtesy of drillers and well owners, presented to the Survey. To facilitate the copying and filing of these records the following blank is used. The size of the original is 8 by 10½ inches.

Form used for obtaining well records.

WELL RECORD.

Well is located.....miles in a .....direction from.....post-office in the.....¼ of.....¼ of sec....., twp....., range....., in the State of.....
Owner..... Contractor..... Driller.....
Well begun ....., 190..; completed....., 190..
Rig used: Cable, rotary, jet, or..... Total depth.....
Length of casing:.....ft. Diameter:....in. from.....ft. to.....ft.; ....in. from.....ft. to.....ft.
Water wells. Completed well develops the following water-bearing strata: From.....ft. to.....ft., from.....ft. to.....ft., from.....ft. to..... Main supply from.....ft.
Completed well pumps.....gals. per min. Flows.....gals. per min. Pressure.....
Oil and gas. Pool or district..... Well No.....on.....farm
Well yields ..... Yield first 24 hours..... Initial pressure.....
[Oil or gas.]
Records sent by..... Address.....

LOG OF WELL.

From—	To—	Character of material. (State whether hard or soft, and give color.)	Remarks. (Note especially depths and thickness of all water-bearing strata, height to which water from each layer rises, quality of the water from each, and yield in gallons per minute.)

CONFIDENTIAL RECORDS.

In many instances borings are put down at great expense for the simple purpose of testing for oil, gas, water, or mineral, or of determining the depth, character, and structure of coal, iron, or other mineral deposits. It can not be expected in such cases that the data obtained will be thrown open to others who have gone to no expense in the matter, but who would be only too glad to make use of the information for their own interest. It is almost universally recognized, however, that such information may be safely given to the United States Geological Survey, whose members are rigidly prohibited by law from having any personal or private interest in the lands or mineral wealth of the region under survey. Such informaton will, if desired, be regarded as strictly confidential, and a signed agreement by the Director to that effect will be given if requested. When confidential samples, records, or other information are received they are stamped "Confidential" and the material is securely cared for.

COOPERATION WITH STATE GEOLOGISTS.

In a number of States arrangements for cooperation have been made with State or local geologists. Two sorts of arrangements have been made. In Alabama, Iowa, Michigan, Minnesota, and West Virginia

the local geologists have furnished clippings, names of drillers, notices of wells, and other information or assistance. In Kentucky and Maryland, on the other hand, the State geologists act as the Survey's representatives, collecting the samples and records at the local offices and forwarding them to the Washington office.

PUBLICATIONS.

It is intended to issue annually a report giving the result of the year's work. The present paper is the first of the series and represents the material received during the first six months of the operation of the work. Being the first report, it will differ somewhat from those which are expected to follow, in that an account of the organization and methods are incorporated in addition to the well data. The general plan is to present each year a list of persons cooperating in furnishing samples or records, a summary of the wells reported and the results, and detailed records of wells. It is believed that the success of the work depends largely on making the material immediately available to drillers, well owners, and geologists rather than holding it for complete reports, which can generally be prepared only after many years of work, during which the information would be relatively inaccessible to those outside the Survey. Detailed reports, however, afford comprehensive views of the fields treated, which are not afforded by isolated records, and are to be prepared as opportunity offers.

WELL RECORDS.

By E. F. LINES.

The records which follow were reported in 1904. A summary of all the records received is given in the tables, and detailed reports of the more important wells are given on page 78.

The sources of information are the records in drillers' notebooks and on record forms, letters, drafts of well sections, and samples of borings.

SUMMARY OF WELL DRILLING REPORTED IN 1904.

Abbreviations used in table.

O, owner.
C, contractor.
D, driller.
M, miscellaneous sources of authority other than owner or driller.
L, Survey possesses a log.
S, Survey possesses samples.
– under "Height of water," distance of surface of water below the mouth of the well.
+ in same column, distance water will rise in an open pipe above the mouth of the well.
Under "Diameter" a series of figures indicates different diameters.

Summary of well drilling

ALABAMA.

No.	County.	Location.	T.	R.	S.	Owner.	Contractor.
1	Covington	Andalusia				Frank Sutter	
2	Madison	Hazelgreen, well No. 3				New York and Alabama Oil Co.	
3	Perry	Uniontown, 10 m. S. of				G. B. Johnston	John I. Hawk
4	Tallapoosa	Alexander City, well No. 2.	23	21	27	Alexander City	J. O. Heflin & Co.

ARKANSAS.

5	Arkansas	Dewitt	4 S.	3 W.	33	Mrs. Ella Johnson	Gunter Bros.
6	do	do	5 S.	3 W.	4	Harry Meritt	do
7	do	Stuttgart				Edd Beity	do
8	do	Stuttgart, 15 m. SE. of	4	4	12	Fred Huffman	do
9	do	Stuttgart				G. H. Kline	do
10	Pike	Bowen				J. D. Hewitt	J. B. Dillon

CALIFORNIA.

11	Kern	Button Willow, 4 m. N. of	28	23	25	C. B. Crawford	T. A. Pursell
12	do	Delano, 18 m. W. of	25	22	16	Frederick Cox	F. U. Pursell
a 13	Monterey	Seaside				B. N. Baker	
a 14	San Diego	Point Loma				Katherine Tingley	
15	San Francisco	San Francisco				J. L. Flood	
16	do	do				do	
17	Santa Cruz	Watsonville				City	
18	Tulare	Waukena				Waukena Water Co.	F. U. Pursell

a See detailed record at end of table.

reported in 1904.

ALABAMA.

Driller.	Authority.	Depth.	Diameter.	Depth to principal water or oil supply.	Height of water.	Yield per minute.		Year completed.	Kind of well.	Remarks.	No.
						Flow.	Pump.				
		Ft.	*In.*	*Ft.*		*Gals.*	*Gals.*				
.....	O.	420	....	267	.....	.....	.....	1904	Water .	.....	1
H. B. Conover..	M.	954	....	.....	.....	.....	.....	1904	Oil	No oil; yields some gas. (L. S.)	2
John I. Hawk ..	D.	875	4-3	855	— 40	.....	10	1904	Water .	Water stratum at 775 feet. (L. S.)	3
F. Osgood and J. Otis Heflin.	C.	300	10	260	—240	.....	55	1904	..do	Water stratum at 80 feet. (L. S.)	4

ARKANSAS.

Gunter Bros	C.	96	2	95	.....	.....	8	1904	Water .	Water stratum at 66 feet.	5
.....do	C.	101	2	98	.....	.....	.....	1904	..do	Abundance of water.	6
.....do	C.	95	....	.....	.....	.....	.....	1904	..do	.....	7
.....do	C.	103	2	98	.....	.....	8	1904	..do	.....	8
.....do	C.	100	....	100	.....	.....	.....	1904	..do	.....	9
J. B. Dillon.....	C.	170	....	.....	.....	.....	.....	1904	..do	Strong flow. (L. S.)	10

CALIFORNIA.

T. A. Pursell....	C.	365	10	311 323 346	.....	.....	.....	1904	Water .	Water at 80, 109, 131, 167, 176, 229, 242, and 357 feet. (L. S.)	11
F. U. Pursell....	C.	828	11-10-8-7	755	.....	1,077	.....	1904	..do	Water strata between 484 feet and bottom of well. Sulphur and other minerals.	12
.....	M.	617	....	610	.....	30	.....	1904	..do	Water-bearing beds at 270 and 540 feet. (L.)	13
.....	O.	400	6-5	.....	—253	.....	24	1901	..do	Elevation of mouth of well 256 feet. A. T. (L.)	14
A. L. Lowe	M.	136	....	.....	.....	.....	.....	1904	..do	Abandoned. (L. S.)	15
.....do	M.	166	....	.....	.....	.....	.....	1904	..do	.....do	16
.....	....	150	7	.....	.....	.....	.....	.....	..do	Test well. Produces 400 gallons a minute.	17
F. U. Pursell ...	C.	868	10	470	.....	1,050	.....	1903	..do	.....	18

Summary of well drilling

COLORADO.

No.	County.	Location.	T.	R.	S.	Owner.	Contractor.
19	Denver	Denver	35	68 W.	20	Dr. Albert A. Clough.	
20	Kiowa	Haswell				Missouri Pacific Rwy. Co.	
21	do	Stuart				do	
a22	Otero	Lajunta				Lajunta Oil and Gas Co.	

CONNECTICUT.

23	Fairfield	Noroton				Mrs. Anson Phelps Stokes.	Albert Lynch
24	do	do				Wee Burn Land Co.	do
25	do	Stamford				William Dashiell	do
26	Hartford	Farmington				C. F. Fienemann	E. D. Hammond
27	do	do				William S. Miles	do
28	do	do				H. T. Stenson	do
29	do	do				Gustav Wollenberg.	do
30	do	New Britain				Town of New Britain.	do
31	New Haven	Meriden				J. W. Britney	do

FLORIDA.

32	Franklin	Carrabelle				Carrabelle Oil and Development Co.	W. F. Hamilton.
33	Polk	Bartow				City of Bartow	do
34	St. John	St. Augustine				Hotel Ponce de Leon.	

a See detailed record at end of table.

reported in 1904—Continued.

COLORADO.

Driller.	Authority.	Depth.	Diameter.	Depth to principal water or oil supply.	Height of water.	Yield per minute. Flow.	Yield per minute. Pump.	Year completed.	Kind of well.	Remarks.	No.
		Ft.	*In.*	*Ft.*		*Gals.*	*Gals.*				
T. Carlton Koogle.	M.	260	4	230	− 38	.....	.....	1902	Water .	Yields soft water .	19
.....	M.	54	6⅝	.....	− 45	.....	25	1903	..do	Abandoned on account of decrease in yield. (L.)	20
.....	M.	49	10⅝	.....	− 30	.....	50	1902	..do	(L.)	21
.....	M.	1,703	....	.....	.....	.....	.....	.....	Oil.....	(L. S.)	22

CONNECTICUT.

Albert Lynch ..	C.	494	6–4½	200	− 12	.....	4	1903	Water .	Water-bearing beds at 300 and 350 feet. Water hard.	23
.....do	C.	142	6	120	− 16	.....	20	1904	..do	Yields hard water.	24
George Northrop.	C.	69	6	60	.....	.....	12	1904	..do	.....	25
Delbert Howe ..	C.	40	6	35	.....	.....	.....	1904	..do	Pumps from 20 to 30 gallons per minute. (L.)	26
.....do	C.	50	6	50	.....	.....	25	1904	..do	.....	27
.....do	C.	37	6	.....	.....	.....	50	1904	..do	(L.)	28
.....do	C.	118	6	108	− 40	.....	10	1904	..do	(L. S.)	29
.....do	C.	167	6	.....	.....	.....	2	1904	..do	Water at 75 and 155 feet. (L. S.)	30
.....do	C.	65	6	.....	.....	.....	10	1904	..do	Water at 40, 50, and 60 feet. (L.)	31

FLORIDA.

W. F. Hamilton.	M.	265	....	.....	.....	.....	.....	1904	Oil	Drilling suspended. (L. S.)	32
.....do	M.	725	....	.....	.....	.....	.....	1904	Water .	(L. S.)	33
.....	M.	1,278	....	.....	.....	.....	.....	.....	..do	"Flagler Well." Flow at 468, 1,110, and 1,200 feet, latter "milky with lime." Flow also at 1,225 feet. (L.)	34

Summary of well drilling

GEORGIA.

No.	County.	Location.	T.	R.	S.	Owner.	Contractor.
35	Berrien	Tifton				H. H. Tift	M. H. Junard
36	Burke	Midville				Allen W. Jones	W. H. Brown
37	Lee	Smithville				City	
38	Walker	Chickamauga Park				U. S. Government	
39	do	do				do	

IDAHO.

40	Fremont	Dubois				San Pedro, Los Angeles and Salt Lake Rwy. Co.	L. J. Craig

ILLINOIS.

41	Adams	Payson				Jos. Scarborough	A. J. Clark
a42	Boone	Belvidere				Chicago and Northwestern Rwy.	L. Wilson Well Co.
43	Clark	Dave Lee farm				Hoblitzell & Co.	
44	do	John Newlin farm				do	
45	do	Phillips farm				do	
a46	Dupage	Naperville				Naperville water Works.	L. Wilson Well Co.
a47	Henry	Kewanee	15 N.		32	Kewanee Boiler Co.	J. P. Miller Artesian Well Co.
48	Lake	Libertyville					W. J. Miller's Sons.
49	do	Russell, 5 m. SW. of	46	11	18	Wilson King	W. M. Bolles
50	do	Russell	46	11	22	Estate of George Shea.	do
51	do	Waukegan	45	11	1	W. H. Finch	do
a52	Lasalle	Streator				Streator Bottle and Glass Works.	L. Wilson Well Co.

a See detailed record at end of table.

reported in 1904—Continued.

GEORGIA.

Driller.	Authority.	Depth.	Diameter.	Depth to principal water or oil supply.	Height of water.	Yield per minute. Flow.	Yield per minute. Pump.	Year completed.	Kind of well.	Remarks.	No.
		Ft.	*In.*	*Ft.*		*Gals.*	*Gals.*				
.....	M.	368	8	330	−125	.....	150	1901	Water.	Hard; some sulphur. Temperature 73°.	35
.....	O.	750	5	700	+ 47	75	.....	1901	..do....	Hard; iron and sulphur. Water-bearing beds at 200, 300, and 450 feet. Temperature 68°.	36
O.L.Herrington	M.	900	4-3	.....	+ 18 to + 24	35	.....	1890	..do....	Soft. Water-bearing beds at 350 to 400 feet. Temperature 73°.	37
.....	M.	306	6	305	− 25	.....	106	1904	..do....	Hard. Water at 110 and 290 feet. In dry season water falls to −100 feet.	38
.....	M.	306	10	305	− 25	.....	183	1904	..do....	This well is 10 feet from one above; pumping one lowers the other correspondingly.	39

IDAHO.

.....	C.	615	....	.....	.....	.....	50	1903	Water.	Water-bearing beds began at 375 feet.	40

ILLINOIS.

.....	C.	1,542	5⅝-4⅛	167	−150	.....	13	1904	Water.	Fresh water from 167 to 1,000 feet, brine at 800 and 1,400 feet.	41
H. W. Hambrecht; H. Hemhoff.	D.	1,231	10-8-6⅛	.....	−20	.....	180	1903	..do....	Water-bearing beds at 574, 834, 1,070, and 1,231 feet. (L.)	a42
J. N. Schell.....	O.	360	....	.....	.....	.....	.....	1904	Oil.....	Oil at 360 feet.....	43
.....do.....	O.	354	....	.....	.....	.....	.....	1904	..do....	Oil at 354 feet.....	44
.....do.....	O.	385	....	.....	.....	.....	.....	1904	..do....	Oil at 385 feet.....	45
H. W. Hambrecht; H. Hemhoff.	D.	1,425	12-10-8-6½	.....	.....	.....	140	1904	Water.	Water-bearing beds at 792 and 1,425 feet. (L.)	46
L. Nichols; Wm. Trentlage.	D.	1,073	12-10¼-8⅝-6	954 to 1,073	−350	.....	80	1904	..do....	Coal, 3 feet, at 187 feet; water at 415 feet. (L. S.)	47
.....	C.	179	....	.....	.....	.....	.....	.....	..do....	Water-bearing beds at 11 and 45 feet.	48
W. M. Bolles....	C.	255	4⅛	255	.....	.....	25	1904	..do....	Water stratum at 150 feet.	49
.....do.....	C.	175	4	175	−12	.....	20	1904	..do....	Soft; sulphurous. (L. S.)	50
.....do.....	C.	205	4	205	−59	.....	18	1904	..do....	(L. S.)	51
H. W. Hambrecht; H. Hemhoff.	D.	1,115	8-6	.....	.....	.....	130	1902	..do....	Water-bearing beds at 596, 706, 834, 1,056, and 1,096 feet. (L.)	a52

Summary of well drilling

ILLINOIS—Continued.

No.	County.	Location.	T.	R.	S.	Owner.	Contractor.
53	Lasalle	Streator				Streator Clay Manufacturing Co.	L. Wilson Well Co.
54	McHenry	Hebron				Village of Hebron	W. J. Miller's Sons.
55	do	Richmond	46	8	9	L. B. Covell	do
56	do	do	46	8	9	F. McConnell	do
57	Sangamon	Springfield, 4½ m. N. of.	16 N.	5 W.	10	City	
58	do	do		do		do	
59	do	do		do		do	
60	Will	Crete				C. and E. I. Rwy. Co.	

INDIANA.

61	Dekalb	Garrett				Baltimore and Ohio Rwy. Co.	Harmon Water Supply Co.
a62	Delaware	Albany. Whitehair farm, well No. 1.			24	Brewster Oil Co.	St. Marys Drilling Co.
63	do	Muncie, 4 m. S. of.				Eureka Oil Co	
a64	Jay	Redkey. Hoppis heirs farm, well No. 5.	12	E.	24	Dunkirk and Redkey Oil-Gas Co.	O. O. McCormic.

INDIAN TERRITORY.

65	Cherokee Nation.	Bartlesville					
66	Osage Nation	Pawhuska					

IOWA.

67	Bremer	Frederika				Pioneer Prospecting Oil Co.	L. Wilson Well Co.
c68	Cedar	Tipton				City	
a69	Cherokee	Cherokee	92	40	28	Cherokee State Hospital.	
a70	Des Moines	Burlington				Iowa Soap Co	R. J. Johnston
a71	Scott	Davenport				Independent Malting Co.	L. Wilson Well Co.
72	Woodbury	Sioux City, 3 m. NW, of.				John Bushar	

a See detailed record at end of table.
c See detailed record in report of Iowa Geological Survey, Vol. III, p. 197.

reported in 1904—Continued.

ILLINOIS—Continued.

Driller.	Authority.	Depth.	Diameter.	Depth to principal water or oil supply.	Height of water.	Yield per minute. Flow.	Yield per minute. Pump.	Year completed.	Kind of well.	Remarks.	No.
		Ft.	*In.*	*Ft.*		*Gals.*	*Gals.*				
H. W. Hambrecht; H. Hemhoff.	D.	773	9–7	.....	.....	.....	94	1903	Water.	Coal at 223 feet; fire clay at 236 feet. This clay used for making tile. (L.)	53
.....	C.	269	....	258	−61	.....	80	.....	..do....	Water-bearing stratum 60 to 148 feet. Water muddy. (L.)	54
L. C. and W. E. Trow.	D.	84	5	84	−38	.....	12	1904	..do	(L. S.)	55
.....do	D.	92	5	92	.....	.....	12	1904	..do	(L. S.)	56
.....	M.	46	10	33	−11	.....	350	1904	..do	(L. S.)	57
.....	M.	45	....	30	.....	.....	.....	1904	..do	The 3 wells are 100 feet apart. (L. S.)	58
.....	M.	49	....	35	.....	.....	.....	1904	..do	(L. S.)	59
.....	M.	275	8	275	−25	.....	.....	1904	..do	Hard water at 200 feet.	60

INDIANA.

A. D. Harmon..	C.	266	10	219 to 266	.....	.....	190	1904	Water.	(L. S.).....	61
Wm. Walters; Wm. Jamison.	D.	1,262	8–6¼	.....	.....	.....	.....	1904	Oil	Small amount of oil. (L. S.)	62
H. J. Hughes...	M.	1,243	....	.....	.....	.....	.....	1904	..do	.....	63
Harry Albert; Geo. Albert.	M.	1,385	8–6¼ 2	1,380	.....	.....	b 5	1904	..do	Gas at 960 feet. (L. S.)	64

INDIAN TERRITORY.

.....	M.	1,700	....	.....	.....	.....	.....	.....	.....	Oil at 1,286 feet. (L.)	65
.....	M.	2,000	....	.....	.....	.....	.....	.....	.....	Water at 1,145 feet. Gas pressure at 2,000 feet prevented further drilling. (L.)	66

IOWA.

H. W. Hambrecht; H. Hemhoff.	D.	1,025	8–6⅝	.....	−4	.....	148	1902	Water.	Water-bearing beds at 367, 717, and 883 feet. Well drilled for oil. (L.)	67
W. N. Treichler.	M.	2,699	....	.....	.....	50	.....	.....	..do	(L. S.)	68
O. G. Wilson....	M.	1,120	12–9	1,120	−206	.....	7	1902	..do	Water-bearing beds at 225, 375, 405, 475, and 535 feet. Temperature 60°. Water hard. (L.)	69
R. J. Johnston..	C.	507	5⅝	435	.....	45	.....	1904	..do	(L. S.)	70
H. W. Hambrecht. H. Hemhoff.....	D.	1,300	10–8	1,050	.....	310	.....	1904	..do	Water began to flow at depth of 996 feet. (L.)	71
Jace Carter.....	M.	98	....	90	−50	.....	.....	1904	..do	(L. S.)	72

b Barrels a day.

Summary of well drilling

KANSAS.

No.	County.	Location.	T.	R.	S.	Owner.	Contractor.
73	Allen	Laharpe					
74	Barton	Hoisington				Missouri Pacific Rwy. Co.	
75	Butler	Rosalia					
76	Chautauqua	Hale. J. W. Darbro farm, well No. 1.	32	12	13	Darbro Oil Co	C. F. Noble
77	do	Hewins	35	9	12	Sterling Oil and Gas Co.	Alexander Bros. & Stauffer.
a78	Greeley	Horace				Missouri Pacific Rwy. Co.	
79	Greenwood	Eureka					
a80	do	Neal. Robb farm, well No. 3.	25	12		Raff & Gammon	Kennedy & Son.
81	do	Neal					
82	Montgomery	Independence. (Heckart No. 1).	34	15	1	Yoke & Brown	Patton & Wolford.
a83	do	Independence. (Logan No. 1).	33	15	27	do	do
a84	Neosho	Chanute. S. Smith farm, well No. 22.	27	18	10	I. N. Knapp	
85	do	Rollin (near)	28	19 E.	9	Shaw farmers	
86	Pottawatomie	Onaga	7	11	11		Bennett & Robbins.
87	Reno	Haven, 6 m. S. of	26	4	6	J. F. Eabling	E. A. Roberson
88	Rush	Bison				Missouri Pacific Rwy. Co.	
89	do	McCracken				do	
90	Sedgwick	Andale	26	3 W.	8	M. Lill	E. A. Roberson
91	Woodson	Toronto					

KENTUCKY.

92	Warren	Bowling Green					
93	do	Bowling Green, 6 m. NW. of.				Warren Petroleum Co.	

a See detailed record at end of table.

reported in 1904—Continued.

KANSAS.

Driller.	Authority.	Depth.	Diameter.	Depth to principal water or oil supply.	Height of water.	Yield per minute. Flow.	Yield per minute. Pump.	Year completed.	Kind of well.	Remarks.	No.
		Ft.	*In.*	*Ft.*		*Gals.*	*Gals.*				
.....	M.	1,050	....	.....	.....	.....	.....	.....	.....	.....	73
.....	M.	200	6½–5¾–5¼	184	.....	.....	.....	1900	Water	(L.)	74
.....	M.	2,062	....	.....	.....	.....	.....	.....	Oil.....	Salt water at 733 and 1,350 feet. Water at 1,710 feet. Drilling suspended.	75
W. B. Frost; Lee McClung.	M.	1,106	10–8¼–6¼	.....	.....	.....	.....	1904	..do	Salt water at 365 and 800 feet. Very little oil.	76
.....	M.	1,479	8¼–6¼–4⅞	.....	.....	.....	.....	.....	..do	Salt water at 510, 775, and 1,060 feet. Pay sand 1446–1474. (L.)	77
.....	M.	1,370	10	1,325	−830	.....	30	1901	Water .	Water at 825 and 1,325 feet. Well abandoned. (L.)	78
.....	M.	1,255	....	.....	.....	.....	.....	.....	.....	Brine at 499 feet .	79
.....	O.	940	10–8¼	.....	.....	.....	.....	1904	Oil....	Water-stratum at 882 feet. (L.)	80
.....	M.	875	....	.....	.....	.....	.....	.....	.....	.....	81
C. A. Williams; D. Hurst.	O.	1,041	8¼–3	.....	.....	.....	.....	1904	Gas....	Yield 11,000,000 feet first 24 hours. (L.)	82
C. A. Williams..	O.	1,160	8¼–6¼	.....	.....	.....	.....	1904	..do	Water-bearing beds at 275, 640, and 895 feet. Yield 18,000,000 feet first 24 hours. (L.)	83
Roy Bair.....	M.	752	5	.....	.....	.....	*b*5	1904	Oil	Water at 30, 128, 521 feet. Brine at 385 feet. Oil at 720, 724, 728 feet. (L. S.)	84
.....	M.	652	....	640	.....	.....	*b*5	1904	..do	The oil grades 32°. (L.)	85
Bennett & Robbins.	C.	602	3–2	540	.....	5	.....	1904	.....	Gas and flowing water 533 to 559 feet. (L. S.)	86
E. A. Roberson..	C.	39	12–5	39	.....	.....	52	1904	Water .	(L. S.)	87
.....	M.	294	8¼	282	−55	.....	90	.....	..do	(L.)	88
.....	M.	558	8¼–6⅝	278	.....	.....	20	1901	..do	Water at 278 and 382 feet. Salty. (L.)	89
E. A. Roberson..	C.	52	10–6	50	.....	.....	30	1904	..do	Water at 30 feet. (L.)	90
.....	M.	1,140	....	.....	.....	.....	.....	.....	.....	Oil at bottom.....	91

KENTUCKY.

.....	M.	1,300	....	.....	.....	.....	.....	.....	Oil	(S.).....	92
.....	M.	600	....	.....	.....	.....	.....	.....	..do	.....	93

b Barrels a day.

Summary of well drilling

LOUISIANA.

No.	County.	Location.	T.	R.	S.	Owner.	Contractor.
94	Calcasieu	Edgerley	10	11	22	D. C. Brown	V. Wainright
95	do	Calcasieu				Louisiana Oil Co.	Oscar Shanks
96	Rapides	Pineville				State of Louisiana	do
97	Vermilion	Gueydan, 5 m. SW. of	12	2	15	A. B. Wilkinson	V. Wainright

MAINE.

98	Androscoggin	Lisbon Falls, 16 m. W. of.				Worombo Woolen Mills.	Andrew S. Merrill.
99	Oxford	Rumford Falls				Rumford Falls Light and Water Co.	Chas. Ray
100	Sagadahoc	Small Point				Geo. O. Curtis	Smith & Thayer Co.

MASSACHUSETTS.

101	Hampden	East Longmeadow				Frank Bane	F. A. Champlin
102	do	Springfield				Andrew Kewic	do
103	do	Springfield, 4 m. N. of				E. Perkins	do
104	do	do				Thomas Webb	do
105	Worcester	North Grafton				A. W. Baker	G. W. Patterson
106	do	Shrewsbury				J. E. Dufresne	do
107	do	Worcester				M. H. Cowden	do
108	do	do				Mary E. Stevens	do

MICHIGAN.

109	Berrien	Benton Harbor				Saltzman Mineral Bath Co.	Cartwright & Sherry.
110	Hillsdale	Prattville				Henry Fickley	F. Howard
111	Iosco	East Tawas				Michigan Pipe Co.	
112	Kent	Grand Rapids (Greenwood Cemetery).				City of Grand Rapids.	O. L. Taylor & Son.
113	Luce	Newberry				Superior Chemical Co.	Jas. Kinney, jr.
114	Mason	Fountain				Martin H. Foster	
115	Oakland	Holly				City of Holly	
116	Ontonagon		43	39	7	Leo M. Geismar	
117	Wexford	Bagnall	23	12 W.	4		Lewis Maule

reported in 1904—Continued.

LOUISIANA.

Driller.	Authority.	Depth.	Diameter.	Depth to principal water or oil supply.	Height of water.	Yield per minute.		Year completed.	Kind of well.	Remarks	No.
						Flow.	Pump.				
		Ft.	*In.*	*Ft.*		*Gals.*	*Gals.*				
V. Wainright...	C.	535	10	390	0	225	1,800	1904	Water .	(L. S.).....	94
Oscar Shanks...	C.	2,200	....	1,005	.....	.....	250	1901	.....	Well yields very warm, salty water. (L. S.)	95
.....do	C.	428	....	.....	.....	.....	.....	1904	.....	(L. S.).....	96
V. Wainright...	O.	280	12	150	-5	.....	.....	1904	Water .	Temperature 60°. Water hard.	97

MAINE.

C. E. Shute.....	D.	215	6⅛	63	.....	.....	35	1904	Water .	Hard water at 23 and 75 feet. Temperature 54°. (L. S.)	98
John White; Walter Follett.	M.	60	2¼	20	.....	.....	25	1904	..do	(L. S.).....	99
J. J. McDonald..	D.	100	6	79	.....	.....	2	1904	..do	.....	100

MASSACHUSETTS.

James Egan	D.	75	6	75	.....	.....	2	1904	Water .	.....	101
.....do	D.	275	6-4¼	250	.....	.....	20	1904	..do	(L. S.)	102
.....do	D.	60	6	50	.....	.....	1	1904	..do	.....	103
.....do	D.	59	6	50	.....	.....	2½	1904	..do	.....	104
Geo. W. Carman.	D.	27½	6	25	.....	.....	30	1904	..do	Soft. (L.).....	105
.....do	D.	80	6	58	.....	.....	5	1904	..do	Water at 35 feet. Soft. (L. S.)	106
.....do	D.	48	6	47	.....	.....	5	1904	..do	Water at 28 feet. Soft. (L.)	107
.....do	D.	41	6	.....	.....	.....	.....	1904	..do	Water at 30 and 35 feet. Pumps 6 gallons an hour, (L.)	108

MICHIGAN.

Cartwright & Sherry.	M.	750	8	.....	—30	.....	.....	1904	Water .	Yields abundance of strong mineral water. (L. S.)	109
F. Howard	C.	106	3	105	—44	.....	.....	1904	..do	Iron and sulphur. (L. S.)	110
.....	O.	271	5	.....	.....	.....	.....	1900	Salt....	(L.)	111
Fred Taylor	D.	364	6-5	264	.....	.....	100	1904	Water .	(L. S.)	112
F. F. Copeland .	C.	100	....	.....	.....	20	.....	1904	..do	One of a series of 9 wells. All about same depth and yield. Temperature 42°. (L. S.)	113
Fred Sherer	O.	97	2	97	.....	.....	.....	1904	..do	Water at 32 feet. Hard.	114
.....	M.	184	....	.....	.....	.....	.....	1904	..do	.....	115
J. A. Colwell ...	D.	95	....	.....	.....	.....	.....	1904	..do	No water. (L. S.).	116
Lewis Maule ...	C.	105	2	.....	—97	.....	.....	1904	..do	(L.)	117

Summary of well drilling

MINNESOTA.

No.	County.	Location.	T.	R.	S.	Owner.	Contractor.
118	Freeborn	Albert Lea	102	21	5	John Tennis	J. E. Sharp
119	Kandiyohi	Atwater				City of Atwater	J. F. McCarthy
120	Polk	Fertile				Northern Pacific Rwy. Co.	do
121	Steele	Blooming Prairie				H. Shaw	

MISSISSIPPI.

a122	Hancock	Bay St. Louis				Peerless Oyster Co.	John A. Sutter
123	do	Waveland				Chas. L. Hopkins	do
124	Harrison	Pass Christian, 3 m. E. of.				Misses Miltenberger.	do
125	do	Wortham				Gulf and Ship Island R. R. Co.	do
a126	Jackson	Mosspoint				L. N. Dantzler Lumber Co.	do

MISSOURI.

a127	Randolph	Moberly					A. P. Phillips
128	St. Louis City	St. Louis	46 N.	6 E.		C. D. Garnett	H. W. Steinsiek
a129	do	do				Welle Boultler Baking Co.	C. S. Wise

MONTANA.

130	Flathead	Kintla Lake				Butte Oil Co	
131	Teton	Chief Mountain Lake					

a See detailed record at end of table.

reported in 1904—Continued.

MINNESOTA.

Driller.	Authority.	Depth.	Diameter.	Depth to principal water or oil supply.	Height of water.	Yield per minute.		Year completed.	Kind of well.	Remarks.	No.
						Flow.	Pump.				
		Ft.	*In.*	*Ft.*		*Gals.*	*Gals.*				
J. E. Sharp.....	C.	127	2	115	−104	.....	.....	1904	Water.	Hard water in abundance. (L. S.)	118
E. Espy.....	D.	453	8-6	414	.....	.....	100	1904	..do....	Water strata at 45, 100, and 310 feet. (L. S.)....	119
E. Christofferson.	D.	296	8-6	280	.....	−25	100	1904	..do....	(L. S.).....	120
Jim O'Neil.....	D.	100	2	.....	+ 2	.....	.....	1904	..do....	Water soft	121

MISSISSIPPI.

John L. Ford...	D.	897	3	818	.....	225	.....	1904	Water.	Water at 690 feet, flowed 50 gallons a minute. (L. S.)	122
.....do.....	D.	775	3	700	.....	165	.....	1904	..do....	Water at 350 feet. (L. S.)	123
John Ford.....	C.	747	3	727	.....	225	.....	1904	..do....	Water stratum 628 to 747 feet. (L. S.)	124
Archie Dickson.	C.	590	3	500	.....	100	.....	1904	..do....	Water began to flow at 110 feet. (L. S.)	125
John L. Ford...	D.	790	3	770	.....	135	.....	1904	..do....	(L. S.)	126

MISSOURI.

A. P. Phillips...	C.	2,100	....	.....	.....	.....	.....	1902	Oil.....	Water at 632 feet. Brine at 870 and 1,215 feet. Water rose to −70 feet. (L.)	127
H. W. Steinsiek.	C.	518	5⅛–4½	500	.....	.....	15	1904	Water.	(L. S.)	128
Ed. Meloy..... A. W. Dickinson.	D.	650	8–6	.....	.....	.....	.....	1904	Oil.....	Water at 140 and 185 feet. A showing of oil at 280, 305, 510, and 600 to 650 feet. Dry hole. (L. S.)	129

MONTANA.

.....	M.	1,405	....	.....	.....	.....	.....	1904	Oil.....	.....	130
.....	M.	1,020	....	.....	.....	.....	*b* 30	.....	..do....	Lubricating oil well. Just north of United States boundary line.	131

b Barrels a day.

Summary of well drilling

NEBRASKA.

No.	County.	Location.	T.	R.	S.	Owner.	Contractor.
132	Buffalo	Shelton				Village of Shelton	
133	Dodge	Scribner				Chicago and Northwestern Rwy. Co.	
134	Saunders	Cedar Bluffs				City	
135	Webster	Rosemont					

NEW HAMPSHIRE.

136	Belknap	New Hampton				Hanna M. Walker.	G. W. Patterson.
137	Merrimack	New London				Chas. G. Davis	Artesian well and Supply Co.
138	do	Potter place				Shepard & Gould.	do
139	do	New London				Chas. Shepard	do
140	Sullivan	Burkehaven				Tuxbury Bros	do

NEW JERSEY.

a141	Atlantic	Pleasantville				Water Department, Atlantic City.	Thos. B. Harper.
142	do	do				do	do
143	Cape May	Woodbine				Woodbine Land Co.	Ridpath & Potter.
144	Hudson	Jersey City				Jno. Mehl & Co	P. H. and J. Conlan.
145	Middlesex	Keasbey				Wm. Dunham	W. R. Osborne
146	do	do				Mrs. Jas. A. Noye	do
147	do	Metuchen				Mr. Avery	do
148	do	do				Mr. Berkold	do
149	do	Perth Amboy				Barber Asphalt and Paving Co.	do
150	do	Perth Amboy, 3 m. S. of				Chas. Bloomfield.	do
151	do	Perth Amboy				W. J. Daniels	do
152	do	do				Raritan Coffee Works.	do
153	do	do				Standard Underground Cable Co.	Stotthoff Bros
154	do	Amboy				George Seamans	W. R. Osborne
155	do	do				R. N. and H. Valentine.	do

a See detailed record at end of table.

reported in 1904—Continued.

NEBRASKA.

Driller.	Authority.	Depth.	Diameter.	Depth to principal water or oil supply.	Height of water.	Yield per minute. Flow.	Yield per minute. Pump.	Year completed.	Kind of well.	Remarks.	No.
		Ft.	*In.*	*Ft.*		*Gals.*	*Gals.*				
.....	M.	52½	....	45½	.....	.....	.....	.....	Water .	One of a series of wells. (L.)	132
L. C. Dewitt	D.	78	6	.....	−12	.....	.....	1904	..do	Two wells pump together 10,000 gallons per hour. (L.)	133
W. A. Morris ...	M.	124	8	.....	.....	.....	147	1904	..do	Water-bearing bed at 57½ feet. Water hard.	134
Class Rose.....	M.	409	....	.....	.....	.....	.....	.....	.....	Iron ore at 375 feet. Oil at 379 feet. (L.)	135

NEW HAMPSHIRE.

Geo. W. Carman.	D.	75	6	.....	.....	.....	.....	1904	Water .	No water. Abandoned. (L. S.)	136
N. F. Harris	....	50	8	.....	−25	.....	4	1904	..do	Water soft. Temperature, 47°.	137
.....do	D.	38	6	38	−10	.....	30	.....	..do	Water soft.....	138
.....do	D.	218	8	195	−10	.....	4	1904	..do	Water soft. Temperature, 50°. (L. S.)	139
.....do	D.	70	8	70	−10	.....	5	1904	..do	Water soft. Temperature, 47°.	140

NEW JERSEY.

.....	M.	320	4¼	.....	.....	.....	.....	1903	Water .	Test well. Water at 35, 80, and 138 feet. Not pumped. (L. S.)	141
.....	M.	190	6	136	.....	50	.....	1904	..do	Well No. 2. Water stratum 180 to 190 feet. (L. S.)	142
.....	C.	152½	6–4	125	.....	.....	60	1904	..do	Water at 6, 106, and 140 feet. (L.)	143
.....	M.	1,020	8	.....	−110	.....	125	1898	..do	Water at 780 and 1,000 feet. Soft. Temperature 54°.	144
.....	C.	85	4	85	.....	.....	.....	1904	..do	(L.).....	145
.....	C.	114	4	90	.....	.....	.....	1904	..do	(L.).....	146
.....	M.	32	4	32	.....	.....	.....	1904	..do	(L.).....	147
.....	C.	56	4	56	.....	.....	.....	1904	..do	Water in abundance. (L.)	148
.....	C.	50	6	45	.....	.....	{ 25 / 50 }	1904	..do	Two wells. (L.)..	149
.....	C.	63	....	63	.....	.....	.....	1904	..do	(L.).....	150
.....	C.	52	....	45	.....	.....	.....	1904	..do	(L.).....	151
.....	C.	150	8–4	.....	.....	.....	140	1904	..do	(L.).....	152
.....	C.	153	6	135	−23	70	.....	.....	..do	Well No. 5. Water stratum at 90 feet. (L.)	153
.....	C.	75	4	60	.....	.....	.....	.....	..do	(L.).....	154
.....	C.	50	4	50	.....	.....	.....	1904	..do	.....	155

Summary of well drilling

NEW JERSEY—Continued.

No.	County.	Location.	T.	R.	S.	Owner.	Contractor.
156	Middlesex	Woodbridge				T. F. Dunnigan	W. R. Osborne
a157	Monmouth	Atlantic Highlands				Borough of Atlantic Highlands.	Ambrose Mathews.
158	Union	Cranford				Henry Deyan	F. T. Cladek
159	do	Elizabeth on Railway				John Bedon	do
160	do	Westfield				Bertram E. Ball	do
161	do	do				Charles Peifer	do
162	Warren	Martens Creek				Seitz Brewing Co	Stotthoff Bros

NEW MEXICO.

163	San Miquel	Chapelle				A. T. and S. F. R. R.	C. H. McVay

NEW YORK.

164	Allegany	Ceres McDonald farm, well No. 1.				J. T. Barnes	E. C. Strait
165	Herkimer	Newport				Condensed Milk Co.	Alex. T. Gibson.
166	Madison	Georgetown station				Mutual Milk and Cream Co.	
167	Monroe	North Rush				State Industrial School.	E. A. Jenkins
168	Nassau b	Freeport				City of Freeport	
169	do	Laurelton				E. C. Henderson	E. K. Hutchinson & Son.
170	do	do				do	do
171	do	Oyster Bay (near Mill Neck).				W. R. Peters	
172	Onondaga	Bromley, 8 m. S. of				School district No. 11.	
173	do	Tully				Ovid S. Trail	
a174	do	do				Solway Process Co.	
175	Richmond	Sea Breeze					W. R. Osborne
176	Suffolk	Brentwood				Wm. H. Moffit	
177	do	Cold Spring Harbor				W. Jennings	Hudson Engineering Co
178	do	Pinelawn				A. B. Sobother	
179	Westchester	Harrison, 3 m. N. of				John W. Sterling	George R. Bliss.
180	do	do				do	do

a See detailed record at end of table.
b For additional records of wells on Long Island see Professional Paper No. 44.

reported in 1904—Continued.

NEW JERSEY—Continued.

Driller.	Authority.	Depth.	Diameter.	Depth to principal water or oil supply.	Height of water.	Yield per minute.		Year completed.	Kind of well.	Remarks.	No.
						Flow.	Pump.				
		Ft.	*In.*	*Ft.*		*Gals.*	*Gals.*				
.....	C.	32	....	32	.....	.....	.....	.....	Water .	.....	156
Elias Brower ...	M.	450	4¼	412	.....	20	125	1904	..do	(L. S.).....	157
F. T. Cladek....	C.	121	6	.....	−17	.....	14	1904	..do	.....	158
.....do	C.	67	4½	60	−18	.....	21	1904	..do	(L. S.).....	159
.....do	C.	119	4¼	108	−29	.....	20	1904	..do	(L. S.).....	160
.....do	C.	96	5	90	.....	.....	18	1904	..do	(L. S.).....	161
H. S. Barnett....	C.	140	6	120	−70	.....	20	1904	..do	(L.)	162

NEW MEXICO.

J. Scully, J. Polley, W. Canfield	M.	960	13–8	930	−310	.....	25	1903	Water .	Water-bearing beds at 120 and 380 feet. (L.)	163

NEW YORK.

E. C. Strait, D. Brumbaugh .	C.	1802	8-6¼	.....	.....	.....	.....	1904	Gas....	Oil at 710 and 1,060 feet; gas at 500 and 1,110 feet; yield, 15,000 cubic feet a day. (L. S.)	164
.....	C.	96	....	90	−10	.....	.....	1904	Water .	.....	165
Lawson B. Cuyle	M.	75	....	60	.....	.....	.....	.....	..do	.....	166
E. A. Jenkins...	C.	115	5⅝	.....	− 5	.....	50	1904	..do	.....	167
F. W. Miller....	M.	.....	10	.....	.....	.....	600	1904	..do	Series of wells	168
.....	M.	58	8	.....	−43	.....	.....	.....	..do	Well No. 1. (L. S.).	169
.....	M.	126	6	.....	−42	.....	.....	.....	..do	Well No. 2; 30 feet from No. 1. (L. S.)	170
C. H. Davis.....	D.	72	....	40	.....	.....	.....	1904	..do	Abundance of water. (S.)	171
L. C. Barber....	D.	112	5	.....	.....	.....	7	1904	..do	.....	172
.....do	D.	104	6	.....	.....	.....	7	1904	..do	.....	173
.....	O.	973 to 1,526	.....	.....	.....	.....	.....	1899 to 1900	Brine..	21 wells. Salt beds at depths between 935 and 1,520 feet. (L.)	174
.....	C.	100	....	.....	− 3	.....	25	1904	Water .	Irony. (L.)	175
J. Elliott.....	D.	37	....	.....	−27	.....	.....	1904	..do	.....	176
Frank Wankel..	D.	400	8	280	.....	.....	75	1904	..do	Water at 276 and 303 feet. (L. S.)	177
J. Elliott.....	D.	50	....	.....	−40	.....	.....	1904	..do	.....	178
George R. Bliss.	C.	255	6	250	−29	.....	18	1904	..do	Well No. 1. Water at 50, 85, 205, 230, and 245 feet. (L. S.)	179
.....do	C.	212	6	212	− 4	.....	5	1904	..do	Well No. 2. Water at 160 and 200 feet. (L.)	180

Summary of well drilling

NORTH CAROLINA.

No.	County.	Location.	T.	R.	S.	Owner.	Contractor.
181	Lenoir	Kinston				City of Kinston	

OHIO.

182	Cuyahoga	Cleveland				Hamby Realty Co.	Dibble & Ernest.
183	do	Gates Mill				S. P. Baldwin	do
184	do	do				E. A. Foot	do
185	do	do				Mr. Ginrich	do
186	do	do				F. T. Showls	do
187	do	South Euclid				Mr. Cousins	do
188	do	do				H. Faust	do
189	do	do				Mrs. K. Martins	do
190	do	do				F. McFarland	do
191	do	South Euclid, 3 m. NW. of.				Northern Ohio Squab Co.	do
192	do	South Euclid				R. E. Smith	do
193	Geauga	Auburn				Corwin Hall	do
194	do	Chardon				F. Curtis	do
195	do	do				H. Hadlon	do
196	do	do				Kiser & Winchel	do
197	do	do				William Martins	do
198	do	do				F. Stafford	do
199	do	Ford				W. B. Cleveland	do
200	do	do				do	do
a201	Hancock	Findlay				C. L. Casterline	G. L. Cusac
202	do	Portage Twp. Smith farm. Well No. 8.			31	Bradford Oil Co	
203	Licking	Utica, 7 m. W. of				Central Ohio Natural Gas and Fuel Co.	Pearsall & Co.
204	Mahoning	Youngstown, 2 m. W. of.				W. H. Lewis	
205	do	Youngstown, 3 m. E. of.				do	
206	do	do				do	
207	do	Youngstown, 2 m. N. of.				do	
208	do	Youngstown, 6 m. N. of.				do	
209	Marion	Martel					
210	Montgomery	Dayton				Dayton State Hospital.	Jas. Kinney, jr.

a See detailed record at end of table.

reported in 1904—Continued.

NORTH CAROLINA.

Driller.	Authority.	Depth.	Diameter.	Depth to principal water or oil supply.	Height of water.	Yield per minute. Flow.	Yield per minute. Pump.	Year completed.	Kind of well.	Remarks.	No.
		Ft.	*In.*	*Ft.*		*Gals.*	*Gals.*				
W. C. Martin	M.	310	....	.....	.....	.....	.....	1904	Water.	(L. S.)	181

OHIO.

.....	C.	30 80 85	...	.....	.....	.....	.....	1904	Water.	Three wells. Small yield.	182
E. Prince	....	148	8	.....	.....	.....	3	1904	..do	(L.)	183
.....	C.	59	5⅛	59	.....	.....	4	1904	..do	(L.)	184
.....	C.	169	4	169	− 9	.....	8	1904	..do	Well in old river channel.	185
.....	C.	136	....	.....	−40	.....	6	1904	..do	(L.)	186
E. Prince	C.	87	5⅛	87	.....	.....	2	1904	..do	(L.)	187
E. D. Ernest	C.	123	5⅛	110	.....	.....	8	1904	..do	.....	188
E. Prince	C.	50	5⅛	48	.....	.....	3	1904	..do	.....	189
.....do	C.	22	5⅛	.....	.....	.....	2	1904	..do	.....	190
.....do	C.	67	5⅛	.....	.....	.....	2	1904	..do	.....	191
E. D. Ernest	C.	121	5⅛	120	−15	.....	24	1904	..do	(L. S.)	192
.....	C.	40	5⅛	.....	.....	.....	2	1904	..do	.....	193
.....	C.	39	5⅛	.....	.....	.....	2	1904	..do	.....	194
.....	C.	186	5⅛ 4¼	.....	.....	.....	.....	1903	..do	All quicksand below 40 feet.	195
.....	C.	75	4¼	.....	.....	.....	6	1904	..do	Soft.	196
George Waite	C.	64	4¼	64	.....	.....	5	1904	..do	.....	197
.....	C.	38	5⅛	.....	.....	.....	2	1904	..do	.....	198
.....	C.	260	7 5⅛ 4¼	.....	.....	.....	.....	1903	..do	Water-bearing beds at 85 and 260 feet.	199
.....	C.	103	5⅛	100	.....	.....	8	1903	..do	.....	200
O. P. Fike; C. Hill	M.	1,158	6¼	.....	.....	.....	.....	1904	Gas....	Water at 50 and 60 feet; brine at 540 feet; small amount of gas; well abandoned. (L. S.)	201
O. P. Fike	M.	1,414	....	.....	.....	.....	.....	1904	Oil	Oil, 19 feet in Trenton; second pay, 34 feet in. (L. S.)	202
.....	C.	2,133	6½	.....	.....	.....	.....	1904	Gas....	Yield, 2,500,000 feet first 24 hours.	203
W. S. Emery	O.	140	4½	138	.....	.....	8	1904	Water.	Hard; small quantity of iron. (L.)	204
.....do	O.	120	6¼	115	.....	.....	5	1904	..do	(L.)	205
.....do	O.	65	4½	62	.....	.....	4	1904	..do	(L.)	206
.....do	O.	203	8¼	190	−60	.....	20	1904	..do	Soft. (L.)	207
.....do	O.	251	5⅝	240	−10	.....	100	1904	..do	(L.)	208
G. W. Ward	....	474	....	450	.....	.....	.....	.....	..do	(L.)	209
.....	C.	105	10	.....	−10	.....	250	1900	..do	Well No. 1	210

Summary of well drilling

OHIO—Continued.

No.	County.	Location.	T.	R.	S.	Owner.	Contractor.
211	Montgomery	Dayton				Dayton State Hospital.	Jas. Kinney, jr.
212	do	do	2	6	29	A. Makley	W. G. Teeter
213	do	Miamisburg				Village of Miamisburg.	
214	Seneca	Fostoria				F. E. England	W. H. Copley
215	do	do				do	do
216	do	do				Mrs. Flickinger	do
217	Summit	Near N. end of Summit Lake.				Water Works Co	Jas. Kinney, jr.
218	do	do				do	do
219	do	Barberton				Pittsburg Valve and Fittings Co.	do
220	do	Boston				Harry Dayton	Dibble & Ernest.
221	Trumbull	Cortland. (Hadsell well.)					
222	Wayne	Orrville				Cyclone Drilling Machine Co.	R. Lambie Drilling Co.
223	do	Orrville				John Jenny	
a224	Wood	Portage. Mrs. L. Dienst farm, well No. 2.	4	11 E.	6	G. F. Munn & Son.	Frank Clough

OREGON.

225	Clatsop	Fort Stevens	8 N.	10 W.	5–6	United States	
226	Multnomah	Portland				Sisters of Good Shepherd.	
227	Sherman	Monkland				D. McLachlan	

PENNSYLVANIA.

228	Allegheny	Braddock				Braddock Water Works.	R. H. Black
229	do	do				William Sherwin	do
230	do	Bunola				Mr. Stewart	do
231	do	Duquesne				Carnegie Steel Co.	do
232	do	Homestead				do	do

a See detailed record at end of table.

reported in 1904—Continued.

OHIO—Continued.

Driller.	Authority.	Depth.	Diameter.	Depth to principal water or oil supply.	Height of water.	Yield per minute. Flow.	Yield per minute. Pump.	Year completed.	Kind of well.	Remarks.	No.
		Ft.	*In.*	*Ft.*		*Gals.*	*Gals.*				
.....	C.	.....	....	.....	.....	.....	.....	1900	Water .	Wells Nos. 2 and 3. Wells 500 feet apart, each yields 60 to 70 gallons a minute.	211
W. G. Teeter....	C.	176	5⅝	40	.....	.....	⅛	1904	..do	.....	212
J. A. Yinglin ...	M.	50	8	20	−20	.....	450	1904	..do	Water soft. Temperature 46°.	213
W. H. Copley...	C.	81	4¼	79	.....	.....	.....	1904	..do	.....	214
.....do	C.	57	4¼	57	.....	.....	.....	1904	..do	.....	215
.....do	C.	45	4¼	44	.....	.....	.....	1904	..do	(L.)	216
.....	M.	125	....	23	.....	.....	188	1904	..do	Well No. 1. (L.)..	217
.....	M.	150	....	50	.....	.....	301	1904	..do	Well No. 2. (L.)..	218
O. D. Thomas...	C.	85	8	47	−20	.....	200	1904	..do	(L. S.)	219
.....	C.	70	5⅛	.....	.....	.....	4	1904	..do	.....	220
.....	M.	3,710	....	.....	.....	.....	.....	.....	..do	Little oil, gas, and salt water at 2,995 feet. Top of salt at 3,239 feet.	221
R. Lambie.....	D.	604	4½	.....	.....	.....	.....	1904	..do	Brine at 237 and 588 feet. No oil or gas. (L. S.)	222
Albert Tracy ...	D.	193	3	160	−12	.....	60	1904	..do	.....	223
Frank Clough; Evidence Kirk	O.	1,262	8¼ / 6¼	1,102	.....	.....	*b* 5	1904	Oil.....	(L. S.)	224

OREGON.

Charles Palmberg.	M.	80	6	80	−7	.....	40	1904	Water .	Water-bearing beds all the way. Water slightly irony. Temperature 52°.	225
S. Clifford.....	D.	140	....	130	.....	.....	.....	1904	..do	.....	226
James Tomlin ..	D.	195	....	.....	.....	.....	.....	1904	..do	.....	227

PENNSYLVANIA.

.....	C.	67	16	.....	−38	750	.....	1904	Water .	Test hole. (L.) ..	228
James Hoffman.	C.	102	5⅛	92	−55	.....	22	1904	..do	Water-bearing bed at 51 feet. Water soft. (L.)	229
.....	C.	90	....	66	.....	.....	.....	.....	..do	(L.)	230
Joseph Hufman.	C.	131	8¼	120	−38	.....	.....	1904	..do	Water-bearing beds at 69, 87, and 95 feet.	231
.....	C.	87	....	.....	.....	.....	.....	.....	..do	No. 1 test hole. (L.)	232

b Barrels a day.

Summary of well drilling

PENNSYLVANIA—Continued.

No.	County.	Location.	T.	R.	S.	Owner.	Contractor.
233	Allegheny	Homestead				Carnegie Steel Co.	R. H. Black
234	do	do				Homestead Water Works.	do
235	do	do				City of Homestead	
236	do	Pittsburg				H. S. Leighton	R. H. Black
237	do	Wilkinsburg				Texter Lumber Co.	Liberty Well Co.
238	Butler	Renfrew. Wallace farm, well No. 2.				John Humphrey & Co.	Gibson & Bovard.
239	Chester	East Downingtown				Northwood Cemetery Co.	Waterman Bros.
240	Clearfield	Dubois					J. S. Bean
241	Forest	Delight, N. P. Wheeler farm, well No. 32.				Forest Gas Co	C. E. Gesin
242	Greene	Higbee, F. B. Morris farm, well No. 1.				South Penn Oil Co.	R. D. Mead & Co.
a243	do	Higbee, L. C. Grim farm, well No. 6.				do	do
a244	do	Morris Twp., John Lewis farm, well No. 1.				Venture Oil Co	F. S. Black
245	do	Spring Hill Twp				Hope Gas Co	John McCool
246	do	Spring Hill Twp. Perry Pethel No. 1.					
247	Lawrence	Robinson Crossing				Hughes Well	
248	Montgomery	Port Kennedy				Michel Eret	Thomas B. Harper.
249	Warren	Deerfield Twp., Dallas Brooks farm, well No. 1.				Josiah G. Winger & Co.	Josiah G. Winger.
250	do	Deerfield Twp., Dell Thomas farm, well No. 1.				Stanton Oil Co	do

a See detailed record at end of table.

reported in 1904—Continued.

PENNSYLVANIA—Continued.

Driller.	Authority.	Depth.	Diameter.	Depth to principal water or oil supply.	Height of water.	Yield per minute. Flow.	Yield per minute. Pump.	Year completed.	Kind of well.	Remarks.	No.
		Ft.	*In.*	*Ft.*		*Gals.*	*Gals.*				
.....	C.	85	....	.....	.....	.....	.....	.....	Water .	No. 2 test hole. (L.)	233
.....	C.	70	....	.....	−23	.....	.....	.....	..do	Test well. (L.) ..	234
.....	M.	70	12	.....	.....	.....	.....	.....	..do	Series of 16 wells. (L.)	235
.....	C.	58	8–5⅝	.....	.....	.....	.....	1904	..do	Water-bearing beds at 40 and 52 feet. (L.)	236
E. S. Kahl.....	D.	126	....	.....	.....	.....	*b* 300	1904	..do	Water-bearing bed at 71 feet. (L.)	237
Bovard & Snider.	O.	1,780	8¼–6¼	.....	1,750	.....	*b* 11	1904	Oil	Water-bearing beds at 170 and 600 feet. (L. S.)	238
.....	C.	82	5⅝	71	.....	.....	6	1904	Water .	Water at 37 feet.	239
J. S. Bean.....	C.	3,006	....	.....	.....	.....	.....	1902	Oil	Fresh water at 110 feet; salt water at 620 and 1,430 feet. Dry hole. (L. S.)	240
R. H. McDonald; William Gesin.	D.	1,225	8–5⅝	80	.....	(*c*)	.....	1904	Gas....	Hard water at 80 feet.. (L. S.)	241
Jim George; W. Oslimbaugh.	M.	3,337	10–8–6–5	.....	.....	.....	.....	1904	Oil	Pittsburg coal at 1,022 feet; brine at 1,862 feet. Dry hole. (L.)	242
J. J. Reed; William Moriarty.	D.	3,076	13–10–8–6–5	2,969	.....	.....	*b* 10	1904	..do	Pittsburg coal at 927 feet. (L.)	243
H. A. Reardon; F. Bell.	D.	2,965	13–10–8–6	.....	.....	.....	.....	1904	Gas....	Pittsburg coal at 935 feet; gas at 2,940 feet. (L.)	244
John Noels; E. J. Duck.	D.	3,434	10–8¼–6⅝–5	.....	.....	.....	.....	1904	..do	Gas at 3,369 feet. Pressure, 900 pounds. (L.)	245
Elmer Duck....	D.	3,234	10–8¼–6⅝–5	.....	.....	.....	.....	.....	..do	Pittsburg coal at 996 feet; gas at 3,183 and 3,228 feet. (L.)	246
.....	M.	3,830	8–6½	.....	.....	.....	.....	1904	.....	Water and oil at 240 feet; gas at 500, 575, and 825 feet. Abandoned.	247
J. B. McGuckin .	D.	581	8	530	.....	.....	130	1904	Water .	Water at 90 and 500 feet. Water hard. (L. S.)	248
Jay O. Winger..	O.	831	8–5⅝	565	.....	.....	*b* 13	1887	Oil	Oil, gas, and salt water at 565 and 775 feet. Well abandoned. (L.)	249
.....do.....	C.	765	8–5⅝	728	.....	.....	*b* ¾	1896	..do	Showing of oil at 245 and 485 feet. Well pumped but a short time. (L.)	250

b Barrels a day. *c* 10,000 cubic feet a day.

Summary of well drilling

PENNSYLVANIA—Continued.

No.	County.	Location.	T.	R.	S.	Owner.	Contractor.
251	Warren	Deerfield Twp., John Holden farm, well No. 1.				Winger & Nichol.	Josiah G. Winger.
252	do	Deerfield Twp., Philadelphia tract, well No. 1.				do	do
253	do	Deerfield Twp., Reno land, well No. 5.				Stanton Oil Co.	do
a254	do	Eldred Twp., Adams farm, well No. 11.				do	do
255	do	Eldred Twp., Adams farm, well No. 19.				do	do
256	do	Eldred Twp., M. Cartright farm, well No. 1.				do	do
a257	do	Eldred Twp., M. Cartright farm, well No. 2.				do	do
258	do	Eldred Twp., M. Cartright farm, well No. 3.				do	do
259	do	Eldred Twp., James Cochran farm, well No. 1.				Devonian Oil Co.	do
260	do	Eldred Twp., Ellis farm, well No. 6.				Stanton Oil Co.	do
261	do	Eldred Twp., Ellis farm, well No. 11.				do	do
262	do	Eldred Twp., Lamarie Lot, well No. 4.				do	E. Meely
263	do	Eldred Twp., Lamarie Lot, well No. 16.				do	Josiah G. Winger.
264	do	Eldred Twp., Lot No. 147, well No. 1.				Pardee estate.	do
265	do	Eldred Twp., Philadelphia tract, well No. 1.				Tait & Paterson	do
a266	do	Eldred Twp., Philadelphia tract, well No. 2.				do	do

a See detailed record at end of table.

reported in 1904—Continued.

PENNSYLVANIA—Continued.

Driller.	Authority.	Depth.	Diameter.	Depth to principal water or oil supply.	Height of water.	Yield per minute. Flow.	Yield per minute. Pump.	Year completed.	Kind of well.	Remarks.	No.
		Ft.	*In.*	*Ft.*		*Gals.*	*Gals.*				
Jay O. Winger..	C.	837	8-5⅛	813	.....	.....	b 1	1898	Oil	Fresh water at 100 feet; salt water at 305 feet; oil and salt water at 560 feet; gas at 807 feet. (L.)	251
J. G. and J. O. Winger.	C.	677	8-6¼	406	.....	.....	b ½	1898	..do	Salt water at 170 feet. (L.)	252
J. O. Winger...	C.	621	8-5⅛	.....	.....	.....	.....	1889	..do	Fresh water at 50 feet; oil, gas, and salt water at 315 feet; salt water at 576 feet; rose 200 feet. Abandoned. (L.)	253
J. O. and J. J. Winger.	C.	817	8-5⅛	740	.....	.....	b 20	1900	..do	Salt water at 750 feet. (L.)	254
Jay O. Winger..	C.	826	8-5⅛	797	.....	.....	b 20	1904	..do	Fresh water at 275 feet; oil and gas at 758 feet. (L.)	255
J. G. and J. O. Winger.	C.	499	8-5⅛	482	.....	.....	b 5	1894	..do	Fresh water stratum at 435 feet. Salt water at 465 feet. (L.)	256
.....do.....	C.	477	8-5⅛	449	.....	.....	b 65	1894	..do	Now (1904) producing about 2 barrels a day. (L.)	257a
J. G. Winger; W. D. Putnam.	C.	437	5⅛	408	.....	.....	b 8	1895	..do	Water and gas sands end and oil sands begin at 397 feet. (L.)	258
J. G. and J. O. Winger.	C.	1,250	8¼-6¼	.....	.....	.....	.....	1898	..do	No trace of oil or gas. (L.)	259
Josiah G. Winger.	C.	421	8-5⅛	389	.....	.....	b 6	1895	..do	Salt water at 358 feet. (L.)	260
J. G. and J. O. Winger.	C.	424	8-5⅛	428	.....	.....	b 10	1902	..do	Fresh water, 50 to 187 feet, salt water, 187 to 213 feet. (L.)	261
.....	M.	728	8-5⅛	.....	.....	.....	b 15	1899	..do	(L. S.).....	262
.....	C.	802	16-8-5⅛	.....	.....	.....	.....	1904	..do	Showings of oil at 495 and 740 feet. Abandoned. (L. S.)	263
J. O. and J. J. Winger.	C.	510	8-5⅛	.....	.....	.....	.....	1900	..do	Oil, gas, and salt water at 226 feet; salt water at 460; rose 200 feet. Abandoned. (L.)	264
Jay O. Winger; Charles Arters.	C.	352	5⅛	.....	.....	.....	b 32	1891	..do	Drilled in 1884 by Stewart Bros., and produced 2 barrels a day. Cleaned and reclaimed in 1891.	265
Charles Arters..	C.	375	8-5⅛	334	.....	.....	b 32	1891	..do	Fresh water at 100 feet; salt water at 150 feet. (L.)	266

b Barrels a day.

Summary of well drilling

PENNSYLVANIA—Continued.

No.	County.	Location.	T.	R.	S.	Owner.	Contractor.
267	Warren	Eldred Twp., Philadelphia tract, well No. 3.				Tait & Paterson	Josiah G. Winger.
268	do	Eldred Twp., Philadelphia tract, well No. 4.				do	do
269	do	Eldred Twp., Philadelphia tract, well No. 5.				do	do
270	do	Eldred Twp., Philadelphia tract, well No. 6.				do	do
271	do	Eldred Twp., Philadelphia tract, well No. 7.				do	do
272	do	Eldred Twp., Philadelphia tract, well No. 8.				do	do
273	do	Eldred Twp., W. D. Pierce farm, well No. 1.				Devonian Oil Co	do
274	do	Eldred Twp., Reno lot, well No. 6.				Stanton Oil Co	do
275	do	Eldred Twp., Reno lot, well No. 10.				do	do
276	do	Eldred Twp., Reno lot, well No. 11.				do	do
277	do	Eldred Twp., Sayers farm, well No. 18.				Rock Oil Co	J. P. Eaton
a278	do	Eldred Twp., Sayers farm, well No. 19.				do	do
a279	do	Eldred Twp., Smith farm, well No. 4.				Stanton Oil Co	Josiah G. Winger.
280	do	Eldred Twp., E. F. Thomas farm, well No. 1.				E. Thomas and T. Grant.	do
281	do	Eldred Twp., Wade farm, well No. 1.				Stanton Oil Co	do

a See detailed record at end of table.

reported in 1904—Continued.

PENNSYLVANIA—Continued.

Driller.	Authority.	Depth.	Diameter.	Depth to principal water or oil supply.	Height of water.	Yield per minute.		Year completed.	Kind of well.	Remarks	No.
						Flow.	Pump.				
		Ft.	*In.*	*Ft.*		*Gals.*	*Gals.*				
{Charles Arters; J. O. Winger.	C.	420	8–5⅛	383	.....	.....	26	1891	Oil.....	Fresh water at 152 feet; gas at 371 feet. (L.)	267
.....do.....	C.	360	8–5⅛	310	.....	.....	*b* 4	1891	..do....	Fresh water 20 to 184 feet; rises nearly to surface. (L.)	268
.....do.....	C.	461	8–5⅛	420	.....	.....	*b* 35	1891	..do....	Oil and water rose 200 feet in well. (L.)	269
.....do.....	C.	420	8–5⅛	377	.....	.....	*b* 20	1891	..do....	Now (1904) producing about 1 barrel a day. (L.)	270
J. G. and J. O. Winger.	C.	420	8–5⅛	384	.....	.....	*b* 7	1891	..do....	Proved small well. (L.)	271
.....do.....	C.	333	8–5⅛	290	.....	.....	*b* 22	.....	..do....	Yield retarded by large quantity of salt water present. In this pool (Newton) oil and salt water vary proportionately. (L.)	272
.....do.....	C.	618	6¼	.....	.....	.....	.....	1898	..do....	Oil and gas at 354 feet. Casing torn by torpedo. Well abandoned. (L.)	273
{Josiah G. Winger; W. D. Putnam.	C.	484	8–5⅛	519	.....	.....	*b* 5	1894	..do....	Much salt water at 512 feet. (L.)	274
J. G. and J. O. Winger.	C.	554	8–5⅛	.....	.....	.....	*b* 10	1899	..do....	Showing of oil not sufficient to warrant torpedoing the well. (L.)	275
Jay O. Winger..	C.	615	8–5⅛	587	.....	.....	*b* 5	1904	..do....	Small showing of oil, gas, and salt water at 313 feet. (L. S.)	276
{Harry Eaton; Orany Proper.	D.	544	8–6¼	514	.....	.....	*b* 15	1904	..do....	Well yields 3 barrels of salt water to 1 of oil. (L. S.)	277
{H. J. Eaton; O. Proper; H. G. Peck.	D.	520	8–6¼	490	.....	.....	*b* 12	1904	..do....	Amount of salt water small. (L. S.)	*c*278
Jay O. Winger..	C.	632	8–5⅛	505	.....	.....	*b* 12	1904	..do....	Fresh-water sand 140 to 220 feet. Showing of oil at 335 feet. (L. S.)	*c*279
.....do.....	C.	690	8–5⅛	.....	.....	.....	.....	1901	..do....	Salt water at 425 feet. Showings of oil at 641 and 666 feet. Well abandoned. (L.)	280
Oliver Kelly....	C.	754	8	.....	.....	.....	.....	1889	..do....	Fresh water 40 to 224 feet. Slight traces of oil and gas at 712 feet. Well abandoned. (L.)	281

b Barrels a day.

Summary of well drilling

PENNSYLVANIA—Continued.

No.	County.	Location.	T.	R.	S.	Owner.	Contractor.
282	Warren	Eldred Twp., Henry Wheeler farm, well No. 1.				Stanton Oil Co.	Josiah G. Winger.
283	do	Spring Creek Twp., Frank Hellyer farm, well No. 1.				Devonian Oil Co.	do
a284	do	Southwest Twp., Sturges farm, well No. 25.				Cogswell, Thurston & Co.	B. P. McCool
a285	Washington	Thomas. Speer heirs' farm, well No. 7.				Liberty Oil and Gas Co.	Lyle & McCloy
286	York	Nashville				William Sprenkel	S. T. Crist

RHODE ISLAND.

287	Kent	Warwick				Nelson W. Aldrich	
288	Newport	Sakonnet				Edwin W. Winter	
289	Providence	Woonsocket				Alsace Worsted Co.	Artesian Well Supply Co.
290	do	do				Rev. George T. Mahoney.	C. L. Grant

SOUTH DAKOTA.

291	Gregory	Bonesteel				C. & N. W. Rwy. Co.	Matteson & Zeigler.
292	Hyde	Highmore, 8 m. NW. of.	114	71	29	Mitchell Cattle Co.	Norbeck & Nicholson.

TENNESSEE.

293	Hamilton	Chattanooga				Chattanooga Medicine Co.	

a See detailed record at end of table.

reported in 1904—Continued.

PENNSYLVANIA—Continued.

Driller.	Authority.	Depth.	Diameter.	Depth to principal water or oil supply.	Height of water.	Yield per minute. Flow.	Yield per minute. Pump.	Year completed.	Kind of well.	Remarks.	No.
		Ft.	*In.*	*Ft.*		*Gals.*	*Gals.*				
Jay O. Winger..	C.	497	8-5⅝	434	.....	.....	*b* ¾	1895	Oil.....	Salt water at 442 feet rose 150 feet. Oil at 465 feet. (L.)	282
J. G. and J. O. Winger.	C.	484	8-5⅝	.....	.....	.....	.....	1898	..do	Fresh water flowed 10 gallons a minute at 198 feet. Showing of oil and gas at 224 and 463 feet. Yield 5 gallons first day. Abandoned. (L.)	283
B. P. McCool, E. Hare.	C.	789	8¼-5⅝	760	.....	.....	*b* 5	1904	..do	Fresh water at 55 feet. (L. S.)	284
McCloy & Rowlee.	D.	2,275	13-10-8-6⅝	2,252	.....	.....	*b* 15	1904	..do	Water at 80 and 1,082 feet. Pittsburg coal at 336 feet. Gas at 1,285 feet. (L.S.)	285
S. T. Crist	C.	120	6	90	.....	.....	10	1904	Water .	(L.).....	286

RHODE ISLAND.

.....	M.	502	8	.....	−10	.....	120	1900	Water .	Water rather hard	287
.....	M.	66	6	50	−30	.....	¼	1904	..do	Water soft.....	288
Frank Mentzer, M. F. Knauf.	D.	240	10-8	240	.....	.....	20	1904	..do ...	(L. S.)	289
J. F. Matthews.	C.	102	6	44	.....	.....	17	1904	..do	(L. S.)	290

SOUTH DAKOTA.

Matteson & Zeigler.	C.	393	5½	.....	.....	.....	.....	1904	.....	Test hole. Water stratum 30 to 50 feet. (L. S.)	291
.....	M.	1,397	2	1,397	.....	137	.....	1902	.....	Water at 1,232 feet. Very soft. Temperature 81°.	292

TENNESSEE.

.....	O.	250	6	155	−100	.....	.....	.....	Water .	Water at 250 feet. "Abundant supply" of soft water. (S.)	293

b Barrels a day.

Summary of well drilling

TEXAS.

No.	County.	Location.	T.	R.	S.	Owner.	Contractor.
294	Bexar	Fort Sam Houston					
295	Brazoria	Sandy Point				L. B. Shephard	P. M. Granberry.
296	do	Velasco, 3½ m. SW. of				Mr. Bryan	
297	Denton	Denton				College Addition Waterand Power Co.	
298	El Paso	El Paso, 40 m. N. of				Albert M. Coe	
299	do	El Paso, 25 m. N. of				J. F. Mahill and Wiley N. Coe.	
300	Hardin	Batson, Parafine Oil Co., well No. 7.				Texas Drilling Co.	Texas Drilling Co.
a301	Harris	Houston				Houston Water Co.	Gust. Warnecke.
a302	do	Humble, L. W. Long farm, well No. 1.				P. M. Granberry and others.	P. M. Granberry.
303	do	Humble, 8 m. E. of				Dan E. Kennedy	do
304	do	Humble, 6½ m. E. of				do	do
305	Jefferson	Beaumont, 17½ m. SW. of. (Bingham farm.)				Sun Co	Sun Co
306	Montgomery	Wilburton				I. & G. N. Rwy	
307	Nacogdoches	Nacogdoches, 13 m. SE. of.				J. M. Thresher	
308	Nueces	Coldris, 3 m. S. of				Robert Driscoll	
309	do	do				do	
310	Tyler	Kountze, 15 m. NW. of. (Reliance No. 2.)				Sun Co	Sun Co
311	Wilson	Sutherland Springs, Lee farm, well No. 1.				American Mineral Co.	American Mineral Co.

a See detailed record at end of table.

reported in 1904—Continued.

TEXAS.

Driller.	Authority.	Depth.	Diameter.	Depth to principal water or oil supply.	Height of water.	Yield per minute. Flow.	Yield per minute. Pump.	Year completed.	Kind of well.	Remarks.	No.
		Ft.	*In.*	*Ft.*		*Gals.*	*Gals.*				
.....	M.	726	....	705	−5	.....	200	1901	Water .	Water-bearing beds at 351 and 398 feet. Water at 398 feet salt. (L. S.)	294
.....	C.	1,500	....	.....	.....	.....	.....	1904	Oil.....	Prospect well. Artesian water stratum 1,000 to 1,100 feet.	295
R. T. Clifton....	D.	742	....	.....	.....	.....	.....	1904	..do....	Abandoned at 742 feet. (L. S.)	296
Luther Myers ..	M.	592	6–4	520	.....	.....	12	1904	Water .	(L. S.)	297
James Sewell...	M.	160	5–6	45	.....	.....	.....	1898	..do....	"Abundant supply" of soft water.	298
.....do	M.	350	6	335	.....	.....	.....	1904	..do....	Soft water	299
Joseph Dronot..	M.	885	4	.....	.....	.....	*b*50	1904	Oil.....	(L. S.)	300
A. Warnecke ...	O.	2,025	8–6 4	.....	.....	.....	.....	1904	Water .	Gas at 1,600 feet. One of a series of wells which yield from 1,000 to 800,000 gallons a day each. (L. S.)	301
W. A. Young....	C.	990	11⅝ –6	950	.....	.....	*b* 100	1904	Oil.....	Gas present in increasing amounts below 600 feet. (L. S.)	302
.....	C.	1,500	....	.....	.....	.....	.....	1904	..do....	Prospect well; no oil. Little gas at 600 feet. Water-bearing beds 600 to 650 feet and 1,150 to 1,200 feet.	303
.....	C.	1,000	6–2½	.....	.....	.....	.....	1904	..do....	Prospect hole. Found neither oil nor gas.	304
James W. Clark.	D.	1,515	6–4	.....	.....	.....	.....	1904	..do....	Water at 220 and 260 feet. Gas at 240 and 400 feet. Dry hole. (L.)	305
J. H. Lee	D.	917	....	892	.....	.....	*b* 50	1904	..do....	.....	306
.....	O.	435	6	.....	.....	.....	.....	1904	..do....	Water at 68 and 393 feet. Oil at 212, 312, 328, and 360 to 428 feet. Lost on account of water. (L. S.)	307
Thomas Fowler.	D.	590	5⅓– 4¼	.....	.....	80	.....	.....	Water .	Well No. 4. (L.).	308
.....do	D.	625	5⅓– 4¼	.....	.....	150	.....	.....	..do....	Well No. 5. (L.).	309
James W. Clark.	O.	1,737	6–4	.....	.....	.....	.....	1904	Oil	Dry hole. (L.)...	310
Hamrick; Pannewitz; Donohue.	D.	1,500	....	.....	.....	.....	.....	1904	..do....	Flowing water and gas strata at 14, 71, 419, 973, 1,056, and 1,352 feet. Traces of oil at 415, 628, 775, and 1,352 feet. Dry hole. (L.)	311

b Barrels a day.

Summary of well drilling

UTAH.

No.	County.	Location.	T.	R.	S.	Owner.	Contractor.
312	Beaver	Beaver				W. Shepherd	
313	Boxelder	Brigham	9	3	14	W. O. Knudson	
314	Davise	Farmington				Guffy & Galey	Guffy & Galey
315	Iron	Lund				San Pedro, Los Angeles and Salt Lake R. R. Co.	L. J. Craig

VIRGINIA.

316	Henrico	Richmond				Lewis Ginter	

WASHINGTON.

317	King	Ballard				City of Ballard	

WEST VIRGINIA.

a318	Kanawha	Forks of Little Sandy. O. Simmons farm, well No. 1.				Lehigh Oil Co	Weiler Bros
319	Ohio	Wheeling				News Publishing Co.	Jas. Kinney, jr.
a320	Ritchie	Harrisville, F. D. Hawkins, No. 1.				Octo Oil Co	B. W. Publes
321	Tyler	Van Camp				Lincoln District	Watkins & Co
322	Wetzel	Folsom. John Robison farm, well No. 17.				South Penn Oil Co.	W. S. Burton
a323	do	Hundred. J. Murphy farm, well No. 1.				Syndicate Oil Co	Reese, Heasley & Meals.
324	do	Keough				Hope Natural Gas Co.	John P. Fishel
325	do	Keough. J. V. Higgins farm, well No. 1799.				Philadelphia Co	do

a See detailed record at end of table.
c See detailed record in paper on "Oil and Asphalt Prospects in Salt Lake Basin," by J. M. Boutwell: Contributions to Economic Geology, 1904.

reported in 1904—Continued.

UTAH.

Driller.	Authority.	Depth.	Diameter.	Depth to principal water or oil supply.	Height of water.	Yield per minute. Flow.	Yield per minute. Pump.	Year completed.	Kind of well.	Remarks.	No.
		Ft.	*In.*	*Ft.*		*Gals.*	*Gals.*				
Geo. G. Halterman.	D.	330	....	.....	.....	.....	.....	1904	Water	Not flowing	312
.....	M.	30	9	22	−22	.....	300	1904	..do	Dug well 9 feet in diameter.	313
.....	O.	2,000	....	.....	.....	.....	.....	.....	Oil	Dry. Well did not reach bed rock.	314
.....	C.	584	12–10–8-6	573	.....	.....	50	.....	Water .	Salt water at 12 feet. (L.)	315

VIRGINIA.

.....	M.	445	....	410	.....	.....	.....	.....	Water .	A little water at 102 feet. (L.)	316

WASHINGTON.

G. P. James	M.	245	....	.....	.....	.....	.....	1904	Water .	.....	317

WEST VIRGINIA.

J. G. and G. J. Weiler.	D.	1,700	13–10–8-6⅝	.....	.....	(*d*)	.....	1904	Gas	Fresh water at 60 and 155 feet. Hole flowed full of salt water 940 to 990 feet. Gas at 928 feet. (L. S.)	318
.....	C.	250	....	.....	.....	.....	.....	1904	Water .	(L. S.)	319
.....	O.	1,875	....	.....	.....	*b* 12	.....	1904	Oil	(L. S)	320
.....	C.	36	6	35	−13	.....	.....	1904	Water .	Soft.....	321
H. A. Reardon..	D.	3,560	10–8–6-5	.....	.....	.....	*b* 100	1902	Oil	Pittsburg coal at 1,435 feet. Salt water at 2,225 and 2,735 feet. Oil at 3,512 and 3,542 feet. Deepest producing well known. (L.)	322
E. J. Akins; A. Wild.	D.	3,236	13–10–8¼–6⅝	.....	.....	(*d*)	.....	1904	Gas	Pittsburg coal at 1,852 feet. Gas at 1,995, 2,145, and 3,000 feet. Yield. (L.S.)	323
T. L. Dunlap; C. L. King.	D.	2,635	13–10–8-6	.....	.....	.....	.....	1902	..do	Water at 60 feet. Pittsburg coal at 530 feet. Gas at 1,675, 1,885, and 2,615 feet. Rock pressure of gas at 1,675 feet, 800 pounds. (L.)	324
.....do	D.	3,200	10–8–6⅝	.....	.....	.....	.....	1904	..do	Pittsburg coal at 1,095 feet. Gas at 1,866 and 2,460 feet. Salt water at 1,935 feet. Dry hole. (L.)	325

b Barrels a day. *d* 500,000 cubic feet a day.

Summary of well drilling

WEST VIRGINIA—Continued.

No.	County.	Location.	T.	R.	S.	Owner.	Contractor.
326	Wetzel	Van Camp				J. G. Eddy	Watkins & Co.
327	do	do				Magnolia district.	do
328	do	do				J. M. Van Camp	do
329	do	do				Z. S. Watkins	do
330	do	do				Watkins & Co	do

WISCONSIN.

331	Brown	Askeaton	21	20	30	Cheese factory	J. J. Faust
332	do	do	21	20	28	John Hart	do
333	do	Mills Center				Jef. Kimbs	
334	Columbia	Arlington				David Bullen	
335	Fond du Lac	Eden Twp			33	Academy of St. Mary.	P. Roughen
336	do	Fond du Lac				M. Obrin	do
337	do	do				Charles Olem	do
338	do	Waupun					W. F. Sealy
339	Grant	Castlerock	7 N.	1 W.	14		H. G. Gorder
340	Iowa	Highland	7	1	17		do
341	Juneau	Mather				Appleton Cranberry Co.	E. R. Vandervort.
342	Outagamie	Dale	21	15	30	Conrad Giebel	I. W. Hills
343	do	Greenville	22	17	19	Charles H. Fischer	do
344	do	Hortonville	22	16	36	W. Fischer	do
345	do	do	22	16	13	Anthony Wallace	do
346	do	Medina	21	15 E.	14	M. Bottrell	do
347	do	do	21	15	26	Sam Rupple	do
348	do	Shiocton	43	16	36	John Laird	do
349	do	South Kaukauna					
350	Racine	Corliss	3	22	9	T. F. Cooney	W. M. Bolles
351	do	Franksville	4	22 E.	28	F. Kittenhoffen	do
352	Vernon	Valley	14	2 W.	26	Frank Winchel	
353	Walworth	Whitewater. (City waterworks.)				C. E. Gray	W. L. Thorne & Co.
354	Waukesha	Elm Grove	7	20	35	C. K. Reichert	Peter Bauer
355	Winnebago	Larsen	20	16 E.	21	John Lemke	I. W. Hills
356	do	do	20	16 E.	21	Fred Ziehm	do
357	do	Winneconne	19	15	2	George Barber	do

WYOMING.

358	Sweetwater	Rock Springs, 6 m. S. of.	18	104 W.	20	Belgo American Drilling Co.	

reported in 1904—Continued.

WEST VIRGINIA—Continued.

Driller.	Authority.	Depth.	Diameter.	Depth to principal water or oil supply.	Height of water.	Yield per minute.		Year completed.	Kind of well.	Remarks.	No.
						Flow.	Pump.				
		Ft.	*In.*	*Ft.*		*Gals.*	*Gals.*				
.....	C.	137	6	.....	−97	.....	.....	1904	Water.	Soft water at 70, 126, and 137 feet.	326
.....	C.	41	5⅝	36	− 8	.....	.....	1904	..do	Soft water	327
.....	C.	31	6	27	−10	.....	.....	1904	..do	.....do	328
.....	C.	60	6	55	−20	.....	.....	1904	..do	.....do	329
.....	C.	32	6	22	−10	.....	.....	1904	..do	.....do	330
					WISCONSIN.						
M. G. Faust	C.	534	4½	512	−75	.....	7	1904	Water.	(L. S.)	331
.....do	C.	117	4½	110	.....	.....	10	1904	..do	.....	332
Chas. L. Green ..	D.	315	....	.....	.....	.....	.....	1904	..do	(L. S.)	333
Thos. Eagen	D.	155	....	.....	.....	.....	.....	1904	..do	(L. S.)	334
P. Roughen	C.	97	5	75	.....	.....	.....	1904	..do	.....	335
.....do	C.	95	5	93	.....	.....	12	1904	..do	(L.)	336
.....do	C.	228	5	227	.....	.....	15	1904	..do	(L. S.)	337
.....	C.	800	6–5	.....	.....	.....	.....	1887	..do	(L. S.)	338
H. G. Gorder	C.	162	7⅛	130	.....	.....	5	1904	..do	(L. S.)	339
.....do	C.	260	6¼	.....	.....	.....	.....	1904	..do	Stratum at 240 feet yields sulphur water.	340
E. R. Vandervort.	C.	179	6	.....	.....	.....	.....	1904	..do	(L. S.)	341
J. Yahuke and F. Sweet.	C.	35	4	35	.....	.....	.....	1904	..do	"Good stream of water."	342
G. H. Fischer and F. Sweet.	C.	117	4	116	− 5	.....	.....	1904	..do	(L. S.)	343
.....do	C.	41	4	35	.....	.....	.....	1904	..do	(L.)	344
.....do	C.	105	4	100	.....	.....	.....	1904	..do	.....	345
F. Sweet	C.	23	4	.....	.....	.....	.....	1904	..do	.....	346
R. Haase and Wescott.	C.	87	....	70	.....	.....	.....	.....	..do	.....	347
G. H. Fischer and M. Hills.	C.	150	4	150	.....	.....	.....	1904	..do	.....	348
J. J. Faust	D.	300	4½	.....	−60	.....	3	1904	..do	(S.)	349
H. Jorgensen ...	D.	94	4	.....	.....	.....	15	1904	..do	(L. S.)	350
.....do	D.	98	4	98	.....	.....	25	1904	..do	(L. S.)	351
B. I. Baley & Son	M.	280	6–5½	230	.....	.....	3	1904	..do	(L. S.)	352
W. L. Thorne & Co.	C.	252	6	200	.....	30	250	1904	..do	Water at 71 feet, rose to −2 feet. (L. S.)	353
H. M. Knaack ..	D.	190	6	170	.....	20	.....	1904	..do	Water from 170 to 190 feet.	354
J. Yahnke	C.	38	4	28	.....	.....	.....	1904	..do	Pumps small stream.	355
John Yahnke and F. Sweet.	C.	114	4	107	−60	.....	.....	1904	..do	(L.)	356
J. Yahnke and M. Hills.	C.	98	4	.....	.....	.....	.....	1904	..do	.....	357
					WYOMING.						
L. J. Craig	D.	2,400	13	.....	.....	.....	.....	1904	Oil	Water-bearing bed at 30 and 90 feet. Small showing of oil at 625 feet.	358

DETAILED RECORDS.

The detailed reports which follow were selected because they give definite stratigraphic information or information of importance in drilling adjoining wells. While only such records were chosen as appeared to have been kept with care, the Survey does not guarantee their accuracy. Descriptions are given substantially as presented in the original records, although the compiler has taken the liberty to make some changes in nomenclature, such as substituting shale for "soapstone," and to make other modifications in favor of uniformity and conciseness. When the samples suggest an interpretation radically different from the one in the driller's log, both are given, with the former in parentheses. Other interpolations made on the authority of the compiler are also bracketed.

13. Well near Seaside, Monterey County, Cal.

[Authority, B. N. Baker, owner.]

	Feet.
Surface soil	0– 10
Water sand	10– 40
Quicksand	40– 60
Gray sand	60–120
Adobe clay	120–136
Blue clay	136–148
Sandy shale	148–155
Hard shale	155–156
Blue shale	156–173
"Chalk rock"	173–183
Blue shale	183–240
Hard shale	240–241
Blue shale	241–253
Yellow clay and sand	253–263
Cobblestone, gravel, and water	263–270
Water sand	270–303
Blue shale	303–315
"Chalk rock"	315–338
Sandy shale	338–425
Blue clay	425–441
Sand and shale	441–468
Blue clay	468–490
Sand and shale	490–513
Yellow clay	513–518
White sand, carrying some water	518–540
Yellow clay	540–560
Blue shale	560–581
Sand and gravel	581–610
Hard shale; shell	610–617

Last entry is probably incorrect. Water was struck at 610 feet, after piercing shell and going with drill into water sand; flow, 30 gallons a minute.

14. Well on Pueblo Lot 146, Point Loma, San Diego County, Cal.

[Begun August 18, 1900; completed March 18, 1901. Authority, Katherine Tingley, owner.]

[Elevation of mouth of well, 255.88 feet above high tide.]

	Feet.
Surface clay	0– 3
"Hardpan"	3– 8
Sandy clay	8– 30
Water-bearing sand	30– 40
Sandy shale and dry sand	40– 60
Sandy shale	60–100
Sand	100–106
Dark-blue shale	106–190
Water-bearing sand	190–192
Dark-blue shale	192–200
Water-bearing sand	200–202
Dark-blue shale	202–260
Whitish clay	260–261
Coal	261–262
"Ore"	262–265
Water-bearing sand, good water	265–271
Dark-blue shale	271–298
Water-bearing sand	298–300
Dark-blue shale	300–320
White quartz, gold colors from panning	320–321
Blue granite, gold colors from panning	321–323
Light-blue shale	323–350
Alternate shale and sand	350–360
Light-blue shale	360–370
Water-bearing sand	370–372
Light-blue shale	372–388
Water-bearing gravel and sand	388–390
Shale, gravel, and clay	390–400

Point Loma is an isolated cretaceous summit, according to the State Mining Bureau, and the above log shows the geologic column of its undisturbed strata. Diameter of well, 6 inches, 0 to 40 feet; 5 inches, 40 to 400 feet. Water level, 253 feet below surface, or 2.88 feet above high tide. Estimated yield, 35,000 gallons daily if all water-bearing strata are used.

22. Well at Lajunta, Otero County, Colo.

[Samples furnished by La Junta Oil and Gas Company.]

	Feet.
Clay	800–1,080
Sandstone and limestone	1,230–1,290
Light-red sandstone and limestone	1,300–1,500
Dark-red sandstone—limy	1,500–1,535
White sandstone	1,535–1,600
Red sandstone	1,600–1,612
Red sandstone and gray limestone	1,612–1,660
Red sandstone and limestone	1,660–1,703

42. Well at Belvidere, Boone County, Ill.

[Begun April 9, 1903; completed May 23, 1903. Authority, H. W. Hambrecht, driller.]

	Feet.	
Quicksand	0 –	40
Fine gravel	40 –	90
Coarse gravel	90 –	122.5
Gray limestone	122.5–	355
St. Peter's sandstone, coarse and honeycombed, water-bearing	355 –	574
Red marl and limestone	574 –	608
Brown limestone	608 –	643
Brown shale	643 –	718
Sandstone—water of good quality	718 –	834
Red marl	834 –	854
Blue shale	854 –	984
White sandstone, honeycombed rock, water-bearing	984 –	1,070
Blue shale	1,070 –	1,168
Postdam sandstone, soft water	1,168 –	1,231

Well ended in blue shale. Total depth, 1,231 feet. Ten-inch drive-pipe, 0 to 125 feet; diameter of hole 8 inches from 125 to 608 feet; 6½ inches from 608 to 1,231 feet.

46. Well at Naperville, Dupage County, Ill.

[Begun August 31, 1903; completed January 19, 1904. Authority, H. W. Hambrecht, driller.]

	Feet.	
Black soil	0–	4
Sand and gravel	4–	10
Blue shale	10–	18
Loose rolling rock	18–	21
White limestone	21–	237
Blue shale	237–	320
White limestone	320–	646
St. Peter's sandstone; water, hard and soft in streaks	646–	792
Blue shale	792–	836
Brown limestone	836–	950
Blue shale	950–	1,152
Gray limestone—water-bearing rock full of crevices	1,152–	1,425

Ten-inch drive pipe from 0 to 117.5 feet; diameter of hole, 8 inches from 117.5 to 836 feet; 6¼ inches from 836 to 1,425 feet.

47. Well in SE. ¼ of NW. ¼ sec. 32, T. 15 N. (1½ miles west of Kewanee), Henry County, Ill.

[Begun September 9, 1904, completed November 21, 1904. Record and samples furnished by L. Nichols, driller. Geologic divisions made by E. O. Ulrich.]

	Feet.	
Yellow clay	0 –	10
Yellow clay, sandy	10 –	20
Lower Pennsylvania coal measures:		
Blue sandy clay	20 –	36
Soft drab shale	36 –	85
Coal	85 –	86.5
Soft drab shale	86.5–	92.5
Hard gray sandstone	92.5–	93.5
Soft drab shale	93.5–	172
Coal and shale	172 –	184
Coal	184 –	187

	Feet.		
Lower Pennsylvania coal measures—Continued.			
Soft dark shale	187	–	202
Hard dark sandstone	202	–	202.5
Soft gray shale mixed with lime	202.5	–	238
Soft black shale; with pyrite 282–301	238	–	308
Gray sandy shale	308	–	322
Gray sandy limestone	322	–	352
Devonian and Silurian limestone:			
Hard gray limestone	352	–	650
Light-blue limestone	650	–	670
White limestone	670	–	730
Gray limestone	730	–	760
Maquoketa:			
Light-green shale	760	–	833
Hard gray limestone	833	–	850
Hard light-green shale	850	–	915
Hard brown shale	915	–	940
Hard drab shale	940	–	949
Galena limestone:			
Dark-brown limestone	949	–	970
Gray limestone	970	–	1,030
Brown and white limestone	1,030	–	1,050
Brown limestone	1,050	–	1,073

Rig used, pole tools. Diameter of well, 12 inches 0 to 174 feet; 10½ inches 174 to 352 feet; 8⅝ inches 352 to 954 feet; 6 inches from 954 to 1,073 feet. Hole practically dry to 475 feet, where water rose to within 300 feet of mouth of well. Water fresh, no great amount. Main supply from 954 to 1,073 feet. Well pumps 80 gallons a minute.

52. Well at Streator, Lasalle County, Ill.

[Begun September 5, 1902; completed November 15, 1902. Authority, H. W. Hambrecht, driller.]

	Feet.		
Yellow clay	0	–	5
Shale	5	–	8
Coal	9	–	13.5
Shale	13.5	–	15
Brick and tile clay	15	–	20
Blue shale	20	–	90
Blue and brown shale	90	–	95
Coal, good quality	95	–	99.5
Blue shale	99.5	–	172.5
Brown and blue shale	172.5	–	185
Coal, best	185	–	187
Brick and tile clay	187	–	195
White limestone	195	–	385
St. Peter's sandstone; water in lower part not good	385	–	596
Blue shale	596	–	620
Brown limestone; very good water	620	–	706
Madison sandstone; slightly salty water	706	–	834
Brown limestone; soft water	834	–	1,056
Sandstone; water	1,056	–	1,096
Limestone	1,096	–	1,115

Eight-inch pipe from 0 to 195 feet; 6-inch pipe from 0 to 620 feet; 6-inch hole from 620 to 1,115 feet.

62. Well No. 1, on G. S. Whitehair farm, in SE. ¼ of SE. ¼ sec. 24 (4 miles SE. of Albany), Delaware County, Ind.

[Begun October 11, 1904, completed October 31, 1904. Authority, William Jameson, driller.]

	Feet.	
Soft black soil	0–	10
Hard dark limestone	10–	45
Soft red shale	45–	60
Gray limestone of varying hardness	60–	200
Soft shale (calcareous)	200–	220
Hard blue limestone	220–	260
Soft light shale	260–	280
Hard dark limestone and shale	280–	300
Hard blue limestone	300–	340
Soft light shale	340–	500
Soft brown shale	500–	600
Soft light shale	600–	700
Soft dark shale	700–	800
Soft brown shale	800–	950
Trenton limestone	950–	1,260

Some gas at top of Trenton. Well finished at 1,262 feet with little show for oil. Shot with 200 quarts of glycerine. Diameter of well, 8 inches from 65 to 340 feet; 6¼ inches from 340 to 1,262 feet. Casing inserted at 340 feet. Principal water-bearing strata between 30 and 320 feet.

64. Well No. 5, on the Hoppis heirs' farm, in sec. 24, T. 12 E. (one-half mile east of Redkey), Jay County, Ind.

[Begun October 10, 1904, completed November 5, 1904. Authority, Bert Gilbert, driller.]

	Feet.	
Soft brown clay	0–	40
Soft blue clay	0–	100
Hard yellow limestone	100–	120
Hard gray limestone	120–	180
Soft gray shale, "brake"	180–	240
Hard gray limestone	240–	260
Soft gray shale, "brake"	260–	300
Hard gray limestone	300–	320
Soft gray shale (brownish, 800–840)	320–	960
Trenton limestone; gas, pay 960–980; oil sand, 1,360–1,385	960–	1,385

Principal water stratum in limestone at depth of 153 feet. Amount of oil obtained, 5 barrels.

69. Well at Cherokee State Hospital, in sec. 28, T. 92, R. 40 (1½ miles NW. of Cherokee), Cherokee County, Iowa.

[Completed February 24, 1902. Authority, Cherokee State Hospital.]

	Feet.	
Loam	0–	4
Yellow clay	4–	60
Blue clay	60–	240
Quicksand; water	240–	255
Gravel; water	255–	260
Quicksand; water	260–	270
Blue clay	270–	355

	Feet.
Sandstone; water	355– 375
Shale	375– 385
Pink shale	385– 400
Gravel; water	400– 405
Gray shale	405– 410
Red shale	410– 430
Gray limestone; water between 430 and 435	430– 450
Gray shale	450– 470
Gray limestone; water between 470 and 475	470– 480
Shale	480– 490
Limestone	490– 505
Sandstone	505– 510
Shale	510– 525
Sandstone; water	525– 535
Limestone; water rose 30 feet from crevice in rock between 725 and 735 feet	535– 965
Shale	965–1,015
Sandstone; at 1,075 feet water rose 970 feet	1,015–1,095
Shale	1,095–1,100
Gypsum	1,100–1,120

Diameter of well, 12 and 9 inches; 6-inch pump casing 500 feet down. Depth of principal source of water, 1,120 feet. Water rises to within 206 feet of mouth of well. Yield, 100,000 gallons in twenty-four hours.

70. Well at Burlington, Des Moines County, Iowa.

[Begun August 22, 1904; completed October 12, 1904. Authority, R. J. Johnston, driller.]

	Feet.
Artificial filling	0– 10
Yellow clay	10– 20
Blue clay	20– 60
Sand	60– 66
Blue clay	66– 72
Soft limestone	72– 75
Soft gray shale	75– 85
Soft blue shale	85–154
Soft black shale	154–160
Gray shale	160–190
Soft dark shale	190–260
Soft gray shale	260–280
Hard blue limestone	280–305
Hard gray limestone	305–325
Soft gray shale (limestone)	325–335
Hard gray limestone	335–355
Hard red "granite" (limestone containing pyrite)	355–400
Soft blue limestone	400–410
Soft red limestone	410–425
White "magnesia" (clayey limestone)	425–435
Soft "water rock" (no samples below 430)	435–507

Rig used, Keystone driller. Diameter, 5⅝ inches from 0 to 507 feet. Length of casing, 76 feet. Main water supply from 435 to 507 feet. Flows 45 gallons per minute. Pressure, 16½ pounds.

71. Well at Davenport, Scott County, Iowa.

[Begun March 10; completed July 8, 1904. Authority, H. W. Hambrecht, driller.]

	Feet.	
Surface sand	0–	24
Blue shale	24–	89
Black shale	89–	90
Blue shale	90–	110
Loose rock	110–	113
Brown limestone	113–	270
Blue shale	270–	275
Limestone	275–	418
White shale	418–	644
Brown limestone; flow from crevice, about 80 gallons a minute	644–	970
Blue shale	970–	996
Sandstone, St. Peter's; flow increased to 210 gallons a minute	996–1,	050
Brown limestone; flow increased to 310 gallons a minute	1, 050–1,	300

Ten-inch casing from 0 to 110 feet, 8-inch casing from 0 to 120 feet, 8-inch hole from 120 to 1,300 feet.

78. Well at Horace (4 miles east of the Kansas-Colorado State line), Greeley County, Kans.

[Begun February 19, 1901; completed November 26, 1901. Authority, E. Fisher, engineer B. & B.]

	Feet.	
Cemented gravel mixed with clay and lime	0–	55
Clay, gravel, and lime mixed	55–	100
Gray shale	100–	550
White limestone	550–	620
Brown shale; water at 825 rose 400 feet	620–1,	050
Sandstone, more or less broken; top of first Dakota	1, 050–1,	095
Gray sandstone	1, 095–1,	110
Reddish brown sandstone, broken, very much so, 1,130–1,148	1, 110–1,	148
Sandstone; bottom of first Dakota	1, 148–1,	160
Shale	1, 160–1,	250
Reddish brown sandstone, more or less broken; second Dakota water rose 800 feet from 1,325 feet	1, 250–1,	325
Shale	1, 325–1,	370

Water obtained from Dakota sandstone. In pumping the well for several months the water which originally stood at a level of about 830 feet below the ground line was lowered gradually to about 1,000 feet below the ground line, and the difficulty in pumping the limited amount of water (about 30 gallons a minute) was so great that the well was abandoned.

80. Well No. 3 on the Robb farm, SE. ¼ of SE. ¼ of T. 25, R. 12 (near Neal), Greenwood County, Kans.

[Begun October 8, 1904; completed November 12, 1904. Authority, F. R. Gammon, owner.]

	Feet.	
Soil and clay	0–	20
Gravel	20–	30
Blue clay	30–	60
Limestone	60–	80
Blue shale	80–	103
Limestone	103–	126
Blue shale	126–	141

	Feet.
Red shale	141–154
Blue shale	154–171
Limestone	171–187
Shale	187–234
Limestone	234–238
Shale	238–285
Sandy shale	285–308
Blue shale	308–345
Limestone	345–348
Shale	348–350
Limestone	350–363
Sandstone; water	363–381
Shale	381–386
Blue shale; 8¼ inch casing	386–505
Limestone	505–550
Soft limestone; had to put in water to drill	550–560
Limestone; 15 feet soft	560–596
Hard limestone	596–645
Limestone	645–655
Blue shale	655–675
Limestone	675–685
Sandy shale	685–700
Blue shale	700–792
Very hard limestone	792–812
Blue shale	812–842
Limestone; water	842–882
Sandstone	882–902
Limestone; strong odor of oil	902–920
Black shale	920–927
Limestone	927–932
Oil sand	932

83. Well No. 1, on the Logan farm, W. ½ SW. ¼ sec. 27, T. 33, R. 15 (9 miles south of Independence), Montgomery County, Kans.

[Begun April 25, 1904; completed May 13, 1904. Authority, A. J. Yoke, owner.]

	Feet.
Surface soil	0– 15
Shale and lime shell	15–120
Limestone	120–135
Dark shale	135–140
Gritty shale	140–165
Limestone	165–175
Shale (limy)	175–220
Limestone	220–260
Sandstone; water and gas	260–275
Shale	275–330
Limestone	330–335
Shale (limy)	335–465
Limestone	465–495
Shale (limy)	495–525
Limestone	525–535
Shale	535–540
Limestone	540–555

	Feet.
Shale	555– 585
Sandstone; water	585– 640
Gritty shale	640– 680
Limestone	680– 705
Black shale	705– 710
Shale (limy)	710– 725
Gray sand; oil	725– 730
Gritty shale	730– 740
Gray sand	740– 760
Black shale	760– 783
"Big lime"	783– 818
Black shale	818– 825
Limestone	825– 853
Shale, gas and water	853– 855
Limestone	855– 875
Black shale	875– 885
Sandstone; water	885– 895
Shale (limy)	895– 955
Dark shale	955– 965
Gritty shale (limy)	960– 990
Shale	990–1,005
Shale (limy)	1,005–1,080
Dark limestone	1,080–1,115
Sand; gas	1,115–1,118
Hard gritty shale	1,118–1,142
Sandstone; gas	1,142–1,160

Yield first twenty-four hours, 18,000,000 feet; initial pressure, 480 pounds. Forty-one feet of 8¼-inch casing, 950 feet of 6¼-inch casing.

84. Well No. 22, on the S. Smith farm, SE. ¼ of SE. ¼ sec. 10, T. 27, R. 18 (2 miles NE. of Chanute), Neosho County, Kans.

[Begun November 9; completed November 27, 1904. Authority, J. F. Allen, field manager for I. N. Knapp.]

	Feet.
Surface soil	0– 20
Brown gravel; fresh water	20– 30
Hard gray limestone	30– 56
Sandstone	56– 61
Hard gray limestone	61– 65
Soft gray shale	65– 70
Hard gray limestone	70– 75
Soft gray sandstone	75– 80
Soft gray limestone	80–115
Soft gray shale (limy)	115–125
Soft gray limestone; 4 barrels water an hour at 128 feet	125–130
Hard gray limestone	130–142
Soft gray shale (limy)	142–320
Soft light-gray limestone	320–335
Soft gray shale (limy)	335–370
Gray sandstone; salt water and gas; hole filled up 200 feet	370–385
Soft gray shale (limy)	385–400
Soft gray limestone	400–420
Shale	420–428

	Feet.
Hard gray limestone	428–458
Soft gray shale (limy)	458–490
Hard gray limestone	490–513
Hard black shale (limy); water, 40 barrels an hour	513–521
Hard gray limestone	521–528
Soft gray shale (limy)	528–715
Soft gray shale (sandy); top of sand, showing of oil	715–720
Soft gray sandstone and shale (limy)	720–728
Sandstone; oil sand, 22 feet of pay at bottom	728–752

Yield, 4 or 5 barrels a day. Length of casing, 623 feet; diameter, 5 inches.

122. Well 1 mile north of Bay St. Louis, Hancock County, Miss.

[Begun October 29; completed November 20, 1904. Authority, John L. Ford, driller.]

	Feet.
Blue sandy clay	0– 10
White sand	10– 60
Yellow sand	60– 95
White sand and gravel	95–145
Green clay	145–160
Gray sand	160–220
Green clay	220–350
Gray sand	350–370
Green clay	370–650
Water sand; flows 50 gallons a minute	650–690
Blue clay	690–818
Water sand; flows 225 gallons a minute	818–897

Diameter of well, 3 inches.

126. Well 1½ miles northwest of Moss Point, Jackson County, Miss.

[Begun October 3, 1904; completed October 12, 1904. Authority, John L. Ford, driller.]

	Feet.
Hard yellow clay (sandy)	0– 20
Yellow sand	20– 35
Clay (sandy, variegated)	35– 50
Sand (fine white)	50–100
Sand (coarse, white)	100–140
Clay (sandy)	140–210
Sand (fine white)	210–220
Clay	220–370
Sand (fine, white)	370–390
Clay	390–710
Sand (fine gray)	710–790
Clay	790

Main water supply, 770 to 790 feet. Yield, 135 gallons per minute.

127. Well at Moberly, Randolph County, Mo.

[Authority, A. P. Phillips, driller and manager.]

	Feet.
Clay and quicksand	0–115
Blue sandstone	115–127
Blue and white sandstone	127–132
Gray sandstone	132–137
Blue flint	137–146

	Feet.
Blue and white flint	146–154
Yellow flint	154–160
Yellow sandstone	160–170
Hard white sandstone	170–178
Gray sandstone	178–186
Gray sandstone and white flint	186–191
Yellow sandstone	191–202
Hard white flint	202–210
Yellow flint	210–218
Blue flint	218–226
Yellow flint	226–230
Blue and white flint	230–250
White flint	250–260
Blue flint	260–263
White and brown flint	263–266
Brown flint	266–269
White sandstone	269–272
Blue sandstone	272–275
Blue and white sandstone	275–278
White sandstone	278–281
Light-gray sandstone	281–289
Light-brown sandstone	289–290
Dark-brown sandstone	290–320
Gray sandstone	320–345
White sandstone	345–355
White and yellow sandstone	355–380
Gray sandstone	380–430
Dark-gray sandstone	430–447
Green shale	447–450
Dark coarse sandstone	450–460
Dark-gray sandstone	460–470
Gray sandstone	470–480
Green shale and gray sandstone	480–490
Light and dark sandstone	490–510
Dark-gray sandstone	510–520
Black sandstone	520–560
Brown sandstone	560–570
Dark-gray sandstone	570–580
Gray sandstone	580–590
White limestone	590–600
Dark-gray sandstone	600–607
Green shale	607–612
Gray sandstone	612–632
White gravel, like glass sand; great quantity of good water	632–685
Gray sandstone	685–693
Green sandstone	693–705
White and gray sandstone	705–709
Gray sandstone	709–722
Brown sandstone	722–772
Light-brown sandstone	772–802
Gray sandstone	802–832
Brown sandstone	832–840
Light-brown sandstone	840–850

	Feet.
Clear white water sand; salt water at 870 feet	850– 870
Light-gray sandstone	870– 960
Brown sandstone	960–1,020
Dark-brown sandstone	1,020–1,045
Fine brown sandstone	1,045–1,100
Black and brown sandstone	1,100–1,115
Light-gray sandstone	1,115–1,150
Gray sandstone	1,150–1,170
White and gray sandstone; magnesia water at 1,180 feet	1,170–1,190
Yellow and white sandstone	1,190–1,200
Dark-gray sandstone	1,200–1,210
Black and white sandstone	1,210–1,215
Gray sandstone; very salty water at 1,215 feet	1,215–1,220
Blue and white flint	1,220–1,225
Crevice and pebbles	1,225–1,230
Blue and gray sandstone	1,230–1,240
Fine white sandstone	1,240–1,260
White flint	1,260–1,290
Blue and gray sandstone	1,290–1,300
Dark-gray sandstone	1,300–1,330
Gray sandstone	1,330–1,440
Yellow and white sandstone	1,440–1,450
Blue sandstone	1,450–1,460
Fine white sandstone	1,460–1,480
Black and white sandstone	1,480–1,500
Brown sandstone	1,500–1,560
Dark-red sandstone	1,560–1,600
Light-brown sandstone	1,600–1,660
Gray sandstone	1,660–1,690
Brown sandstone	1,690–1,705
Black and white sandstone	1,705–1,965
Dark-gray sandstone	1,965–2,000
Gray sandstone	2,000–2,100
Gray shale	2,100

Main water supply at 632 feet. Water rose to within 70 feet of mouth of well.

129. Well on northwest corner of Vandeventer and Forrest Park Boulevard, St. Louis, Mo.

[Begun October 26, completed December 7, 1904. Authority, E. D. Meloy, driller.]

	Feet.
Filled ground	0– 20
Soft gray clay	20– 40
Sand and gravel	40– 60
Hard gray limestone (shaly); a little water	60– 80
Soft brown limestone	80–100
Hard brown limestone	100–120
Soft gray limestone; water 140–160 and 185–210	120–240
Soft gray shale	240–260
Hard gray limestone	260–265
Soft gray limestone and shale	265–280
Gray limestone; showing of oil 280–290 and 305–325	280–460
Very hard gray limestone and chert	460–470
Hard gray limestone	470–485
Soft gray shale	485–490

	Feet.
Hard gray limestone	490–510
Soft dark-red shale; showing of oil	510–530
Hard gray limestone	530–565
Hard gray limestone and shale; bad caves	565–600
Soft black shale; a little oil	600–620
Soft brown limestone, Trenton; a little oil	620–650

"From 490 to 600 feet is probably Kinderhook, from 600 to 620 feet is probably Devonian Ohio shale."—E. O. Ulrich.

Well yields a small amount of gas.

141. Well 1½ miles northeast of Pleasantville, Atlantic County, N. J.

[Begun January 27, 1903, completed January 31, 1903. Authority, E. E. Lanpher, assistant civil engineer, Atlantic City water department.]

Elevation of mouth of well, 10 feet A. T.	Feet.
Yellow sand and gravel	0– 18
Gravel mixed with clay	18– 23
Soft blue clay	23– 29
Yellow sand and wood	29– 35
White sand; water-bearing	35– 55
Yellow sand and gravel; water-bearing	55–100
Hard light-gray clay and gravel	100–120
Soft gray sand and clay	120–138
Red and white sand; water flowed over casing 2 feet above ground	138–158
Coarse and fine gray sand	158–230
Soft gray sand and clay	230–240
Coarse gray sand	240–250
Soft greenish-gray marl and sand, growing harder toward bottom of bed	250–310
Hard gray clay	310–320

Well discontinued at 320 feet in a rather soft gray sandy clay, and casing withdrawn. Rig used, jet. This was a 4½-inch test well at the Absecon Pumping Station of the water department of Atlantic City. The location is the same as that of the United States Meteorological Station, Pleasantville, N. J. The well was never pumped. Within one-fourth mile of this test well are eleven 10-inch and one 4½-inch wells, yielding about 4,000,000 gallons a day and sunk to about —95 elevation, and one 18-inch well yielding about 700,000 gallons a day, sunk to about —190 elevation. All these wells belong to the water department of Atlantic City and are pumped by compressed air.

157. Well one-half mile west of Atlantic Highlands, Monmouth County, N. J.

[Begun October 1, 1904, completed November 1, 1904. Authority, F. E. Price, superintendent, Atlantic Highlands Waterworks.]

	Feet.
Red sand and clay	0– 8
Bluish sand and marl	8– 16
Gray sand	16– 30
Yellowish sand and wood	30– 40
Light-gray sand; wood between 137 and 157 feet	40–157
Marl (dark gray)	157–244
Marl (fine gray micaceous sand)	244–272
Dark-gray sand	272–292
Marl (dark gray)	292–346

	Feet.
Sand and clay (white and greenish)	346–365
Sandy clay (fine light-gray micaceous sand)	365–392
Gray sand	392–452

Rig used, jet. Diameter of well, 4½ inches. Length of casing, 412 feet. Strainer inserted at 412 feet. Well flows 20 gallons a minute and yields 125 gallons by pumping.

174. Well No. 1, Group B, Solway Process Company, Tully, Onondaga County, N. Y.

[Produced brine October 30, 1890. Authority, Solway Process Company.]

	Feet.
Elevation of floor line, 509 feet A. T. (Syracuse datum.)	
Drift	0– 12
Hamilton:	
Soft gray shale	12– 192
Blue shale	192– 252
Bluish-gray shale	252– 302
Gray shale	302– 352
Soft gray shale	352– 422
Very soft gray shale	422– 610
Blue shale	610– 680
Onondaga or Corniferous limestone	680– 750
Oriskany sandstone	750– 770
Salina or Lower Helderberg?:	
Blue-black magnesian limestone	770– 795
Gray gypseous limestone	795– 885
Blue-black limestone	885– 895
Salina:	
Gray magnesian limestone	895–1,025
Gray gypseous shale	1,025–1,090
Greenish limestone	1,090–1,135
Black gypseous shale	1,135–1,175
Salt	1,175–1,493
Shale at 1,493.	

201. Well in South Lima district, Findlay, Hancock County, Ohio.

[Begun October 10, 1904, completed October 23, 1904. Authority, J. E. Finnerty.]

	Feet.
Surface soil	0– 25
Hard gray limestone; good drinking water between 34 and 50 feet, and black sulphurous water between 50 and 60 feet	25–165
Dark-blue shale	165–170
Dark-blue limestone	170–175
Hard gray limestone	175–180
Soft gray shale	180–185
Hard light-gray and brown limestone	185–235
Hard dark-gray shale	235–245
Hard light-brown limestone	245–260
Soft light-blue shale	260–310
Soft red shale	310–355
Soft blue shale	355–540
Hard blue limestone	540–560
Hard blue shale	560–600
Soft blue shale	600–950

	Feet.
Soft brown shale	950–1,040
Soft black shale—harder last 15 feet	1,040–1,115
Trenton limestone	1,115–1,158

Twenty-five feet 8¼-inch drive pipe. Diameter of well, 6¼ inches from 25 to 1,158 feet. Length of casing, 310 feet to top of red Medina shale. After casing was seated and found tight, drillers made from 115 to 130 feet a tour, and no water was found until well was finished and shot with 100 quarts of glycerine. After the shot there was more salt water than could be pumped, so the well was plugged and casing pulled. Well was drilled for gas. Small amount obtained.

224. Well No. 2 on Mrs. L. Dienst farm, SW. ¼ SW. ¼ sec. 6, T. 4, R. 11 E. (one-fourth mile east of Portage) Wood County, Ohio.

[Begun November 1, completed November 19, 1904. Samples furnished by G. F. Munn, owner.]

	Feet.
Surface soil	0– 20
Gray limestone	20– 200
Blue shale	200– 220
Gray limestone	220– 260
Brownish limestone and pyrite	260– 280
Blue shale	280– 340
Dark red shale	340– 360
Sample missing	360– 380
Blue shale	380– 780
Black shale	780– 920
Brownish gray limestone	920– 940
Reddish shale	940– 960
Gray limestone	960–1,040
Black shale; oil sand at 1,102 feet	1,040–1,120
Brownish-gray limestone with pyrite at 1,180 feet	1,120–1,262

Diameter of well, 8¼ inches from 0 to 300 feet, 6¼ inches from 300 to 1,262 feet. Length of casing, 300 feet. Well was shot with 120 quarts of glycerine. Amount of oil obtained, 5 barrels a day. Gas pressure, 50 pounds.

243. Well No. 6 on the L. C. Grimm farm, 1¾ miles northeast of Higbee, Greene County, Pa.

[Begun June 6, completed August 15, 1904. Authority, J. J. Reed, driller.]

	Feet.
Pittsburg coal	920– 927
Big Dunkard sand	1,422–1,517
Gas sand	1,705–1,760
Salt sand	1,770–1,960
Big lime	2,026–2,100
Big Injun sand	2,115–2,345
Thirty-foot sand	2,745–2,805
Fifty-foot sand	2,855–2,910
Gordon sand	2,969–2,994
Shale	2,994–3,005
Fourth sand	3,005–3,076

Yield of oil: 10 barrels.

244. Well No. 1 on the John Lewis farm, Morris Township, Greene County, Pa.

[Begun October 13, completed December 15, 1904. Authority, H. A. Reardon, driller.]

	Feet.
Soft yellow clay	0– 16
Soft black shale	16– 180
Soft white sandstone	180– 195
Soft black shale	195– 300
Hard white limestone	300– 400
Soft black shale	400– 550
Hard white sandstone	550– 575
Soft black shale	575– 600
Hard white sandstone	600– 635
Coal, Waynesburg	635– 640
Hard white limestone	640– 835
Coal, Mapletown	835– 840
Hard white limestone	840– 935
Coal, Pittsburg—cable measurement	935– 945
Hard white limestone	945–1,045
Soft red shale	1,045–1,100
Hard white limestone	1,100–1,200
Soft black shale	1,200–1,335
Hard white sandstone—Little Dunkard sand	1,335–1,350
Soft black shale	1,350–1,450
Hard white sandstone—Big Dunkard sand	1,450–1,510
Soft white shale	1,510, 1,560
Hard white sandstone	1,560–1,585
Soft black shale	1,585–1,685
Soft porous white sandstone—Gas sand	1,685–1,770
Soft black shale	1,770–1,802
Hard white sandstone—Salt sand	1,802–1,910
Soft black shale	1,910–2,080
Hard white limestone—Big lime	2,080–2,135
Hard white sandstone—Big Injun	2,135–2,385
Soft white shale	2,385–2,705
Hard white sandstone—Thirty-foot sand	2,705–2,735
Soft black shale	2,735–2,850
Hard white sandstone—Fifty-foot sand	2,850–2,900
Soft white shale	2,900–2,930
Hard white sandstone—Gordon sand—gas at 2,940	2,930–2,965

Well produces gas. Diameter of casing, 13 inches from 0 to 16 feet, 10 inches from 16 to 200 feet, 8 inches from 200 to 1,590 feet, 6 inches from 1,595 to 2,145 feet.

254. Well No. 11 on the Adams farm in the Grand Valley oil field, 2 miles east of Grand Valley, Eldred Township, Warren County, Pa.

[Begun July 25, completed August 11, 1900. Authority, Josiah G. Winger, contractor.]

	Feet.
Soft yellow subsoil; conductor hole 16 inches in diameter	0– 22
Soft shale and sandstone with little change in the beds; end of 8-inch hole.	22–308
Soft black shale	308–550
Soft light-gray sandstone; Second sand; no showing of oil, no salt water	550–580
Soft blue shale	580–733

	Feet.
Hard reddish-brown sand; Third sand. This stratum overlies the oil stratum	733–740
Hard light-gray sandstone; oil and gas	740–750
Hard white sandstone; salt water in small quantity	750–775
Soft light-gray sandstone; Second pay or Newton sand	775–785
Hard black shale	785–817

This well compares favorably with many others drilled on this good stretch of territory. Thickness of the Third Sand varies from 45 to 60 feet. Wells are producing from 15 to 20 barrels a month that were drilled thirty-three years ago and have been pumped steadily ever since. This lease is known as the "Dunderdale" lease. It includes the Dunderdale farm, Adams, Grandon, and Reno land. A well designated in Carl's Geology as the "Atlas" well was drilled within half a mile of this property in 1865 (1867?). No paying wells have been found near the "Atlas," which produced 15 barrels a day; 1,800 in all.

Diameter of well, 5⅝ inches from 0 to 308 feet; length of casing, 308 feet.

257. Well No. 2 on the M. Cartwright farm, Newton Pool, 2½ miles northeast of Grand Valley, in Eldred Township, Warren County, Pa.

[Completed September 7, 1894. Authority, Josiah G. Winger, contractor.]

	Feet.
Clay subsoil; conductor hole 16 inches in diameter	0– 12
Shale and sandstone; end of 8-inch hole and end of casing. This section includes first bed of shale, fresh-water sand, second bed of shale, and salt-water sand. The last sand in the 8-inch hole is the Second sand "gravel bed." The gravel bed is 10 feet thick and contains oil and salt water	12–275
Soft black shale; a shell 80 or 90 feet above the Third sand is scarcely perceptible in this field, but farther southwest is 20 feet thick and oil-bearing	275–404
Hard coarse white sandstone; Third sand. This sandstone is flooded with sweet water, which rose 300 feet in the well	404–430
Hard black shale, separating sweet from salt water strata	430–433
Hard pebbly white sandstone; salt water in large quantities	433–447
Medium hard gray pebbly sandstone—"Gas sand"	447–449
Soft light gray, coarse-grained sandstone; pay stratum of the Third Sand.	449–462
Hard black shale	462–477.5

In this well the sand is the best yet found. The well is the best producer in the Newton Pool. It produced in the first twenty-four hours and for several succeeding days 65 barrels of oil. The well flowed through the gas pipe and pumped through the tubing. When the well was a year old it was producing 13 barrels a day. It is now (December, 1904) producing 2 barrels a day.

Diameter, 5⅝ inches from 0 to 275 feet. Length of casing, 275 feet. Initial pressure, 85 pounds.

266. Well No. 2 on the Philadelphia tract, Gilson Pool, 3 miles west of Grand Valley, Eldred Township, Warren County, Pa.

[Completed February, 1891 Authority, Josiah G. Winger, contractor.]

	Feet.
Subsoil; conductor hole 16 inches in diameter	0– 18
Hard sandy shale (limy)	18–100
Soft gray sandstone, water	100–135

	Feet.
Soft black shale	135–150
Hard gray sandstone; first stratum of First sand	150–160
Soft black shale	160–170
Soft gray sandstone; second stratum of First sand; salt water cased off	170–185
Soft blue shale; end of 8-inch hole and end of 5⅝-inch casing	185–200
Soft black shale	200–223
Hard white sandstone, pebbly; Second sand. This 11 feet of sand overlies the oil stratum. It is separated from the lower stratum by a layer of shale 6 inches thick	223–334
Soft white sandstone, pebbly. This 21 feet of oil sand is very coarse, full of pebbles, and easy to drill. Oil, gas, and salt water in this lower stratum of the Second sand	334–355
Black shale; "gravel bed" from 661 to 671 feet	355–375.5

This is the best Second sand pool in this oil field. The sand is very porous. One well of the pool has a record of over 6,000 barrels of oil in its first year. The best wells found in the pool are located on the Theodore Gilson farm, on the Spring Creek and Titusville public road. The pool was developed by Stewart Brothers and later by Tait & Patterson. Yield for the first twenty-four hours, 32 barrels of high-grade oil.

278. Well No. 19, on the Sayers farm, three-fourths mile southeast of Grand Valley, Eldred Township, Warren County, Pa.

[Begun November 14; completed November 22, 1904. Authority, Josiah G. Winger.]

	Feet.
Soft brownish yellow clay	0– 20
Soft brownish yellow quicksand and blue clay	20– 80
Soft blue clay and gravel	80–100
Soft gray sandy clay and gravel	100–120
Hard blue sandstone	120–140
Soft variegated sandstone; 5 feet of First sand at 155 feet	140–180
Hard black shale	180–300
Hard gray sandy shale	300–315
Soft blue shale	315–340
Hard blue shale	340–400
Hard blue sandy shale	400–420
Hard gray shale and sandstone	420–440
Hard gray conglomerate; Third sand; oil in first 10 feet	440–460
Hard white sandstone; salt-water sand	460–485
Gray sandstone; gas sand	485–490
Soft white sandstone; oil sand, the lower stratum of Third sand	490–500
Hard shale	500–520

The quantity of salt water is small, on account of the remarkably fine texture of the salt-water stratum. The sand in a well drilled for the Stanton Oil Company in 1890, only 80 feet distant from this one, was much coarser than this, and the salt water was so plentiful that the company abandoned the well.

Diameter of well, 8 inches from 0 to 310 feet, 8-inch drive pipe from 0 to 140 feet, 6½-inch casing from 140 to 310 feet. Before the 6½-inch casing was placed fresh water rose to within 60 feet of the mouth of the well. Yield of oil the first twenty-four hours, 12 barrels.

279. Well No. 4 on the Smith farm, 2½ miles east of Grand Valley, Eldred Township, Warren County, Pa.

[Begun October 11; completed October 29, 1904. Authority, Josiah G. Winger, contractor.]

	Feet.
Soft yellow subsoil	0– 17
Soft gray shale	17– 60
Gray sandy shale; Mountain sand	60–100
Hard gray sandstone; water sand between 160 and 220 feet	100–220
Soft gray shale	220–235
Hard gray and black sandy shale	235–315
Hard gray, fine-grained sandstone; the "Cap"	315–335
Gray sandstone; oil and gas in small quantities	335–355
Light gray sandstone and shale	355–376
Soft gray and white conglomerate	376–387
Gray sandy shale	387–420
Gray shale	420–460
Soft black shale	460–520
Gray fine sandstone; top of Third sand at 570, but irregular, here represented by a mixture of shale and dark-colored sandstone	520–590
Soft gray sandstone; "Gas sand," inferior quality, no gas found	590–598
Soft light-gray sandstone	598–605
Soft white sandstone; oil sand. One gallon of oil was washed from the sediment from this 5 feet of drillings	605–610
Soft black shale	610–632

The well stood thirty-six hours before it was torpedoed, and had accumulated 5 gallons of oil. Forty-five minutes after torpedo was exploded oil rose in the well to a height of 130 feet. The well produced 12 barrels of good oil the first twenty-four hours.

In this pool the last stratum of the Third sand is pay, and is designated "Newton sand." Farther south the first stratum is oil bearing, and is designated "Grand Valley sand." In a few wells, from 3 to 6 miles south, pay is found in both the upper and lower strata of the Third sand.

Diameter of well, 8 inches from 0 to 235 feet, 5⅝ inches from 235 to 632½ feet. Length of casing, 235 feet.

284. Well No. 25 on the Sturges farm, 4 miles south of Grand Valley, southwest township, Warren County, Pa.

[Begun October 3; completed October 14, 1904. Authority, P. B. McCool, driller.]

	Feet.
Soil; shell at 32 feet	0– 40
Soft shale; soft water at 55 feet; shell 60–80 (sandstone 100–120)	40–240
Hard gray sandstone; Mountain sand	240–280
Gray shale and shells	280–440
Gray sand shells; first oil at 460	440–500
Gray sandstone; First sand	500–545
Soft gray shale, shelly from 620 to 690	545–690
Gray sand shells; Second sand	690–753
Hard gray sandstone; Third sand	753–774
Soft gray shale	774–789

Diameter of well, 8¼ inches from 0 to 285 feet; 5⅝ inches from 285 to 789 feet; length of casing, 285 feet; amount of oil obtained, 5 barrels a day.

285. Well No. 7 on the Speer heirs farm, 1½ miles north of Thomas, Washington County, Pa.

[Begun October 20; completed December 20, 1904. Authority, James Lyle, contractor.]

	Feet.
Soil	0– 20
Hard gray limestone	100– 150
Hard gray limestone, shaly	150– 200
Soft dark-gray shale	200– 250
Soft light-gray shale	250– 330
Pittsburg coal	330– 336
Hard gray limestone	336– 380
Hard gray shale	380– 450
Soft red shale	450– 500
Soft gray shale	500– 550
Soft red shale	550– 600
Soft greenish shale	600– 750
Hard gray sandy shale with some lime	750– 800
Soft blue sandy limestone	800– 850
Hard light-gray sandstone	850– 900
Soft light-gray sandstone	900– 950
Soft dark-gray shale	950–1,000
Dark-gray shale, sandy	1,000–1,082
Coal; fresh water	1,082–1,087
Soft light-gray sandy shale	1,087–1,200
Soft light-gray sandstone	1,200–1,250
Soft white sandstone; gas at 1,285 feet	1,250–1,325
Soft dark-gray shale	1,325–1,400
Hard gray sandstone	1,400–1,500
Hard light-gray sandstone	1,500–1,710
Soft gray shale	1,710–1,930
Hard gray shale	1,930–1,990
Hard gray shaly sandstone	1,990–2,050
Light-gray sandstone	2,050–2,100
Soft light-gray sandy shale	2,100–2,180
Soft light-gray sandstone	2,180–2,243
Blue shale and white sandstone	2,243–2,246
Hard gray sandstone; oil sand; steel-line measurement	2,246–2,252
Soft gray sandstone; pay, oil and a little water	2,252–2,255
Hard white sandstone	2,255–2,275

Diameter of well, 13 inches from 0 to 340 feet, 10 inches from 340 to 696 feet, 8 inches from 696 to 1,547 feet, 6⅝ inches from 1,547 to 2,275 feet. Yield, 15 barrels a day.

301. Well 1¼ miles west of Houston, Harris County, Tex.

[Begun December, 1903; completed February, 1904. Authority, J. Crummy, civil engineer, Houston Water Company.]

	Feet.
Reddish sand	0– 30
Soft gray clay	30– 44
Soft red sand and rock	44– 74
Hard red clay	74– 89
Sand and gravel	89– 93
Hard white clay	93–137
Red sand	137–210

	Feet.
Red clay and gravel; hard drilling	210– 290
Whitish sand and gravel; hard drilling	290– 316
Reddish clay and gravel; hard drilling	316– 356
Red sand; hard drilling	356– 393
White clay and gravel	393– 456
Light-gray sand	456– 496
Clay and gravel	496– 514
Light-gray sand	514– 526
Gravel	526– 532
Whitish clay	532– 570
Very hard rock	570– 571
White sand and gravel	571– 585
Reddish clay	585– 600
Porous rock	600– 602
White clay	602– 608
Sand and gravel	608– 618
Clay	618– 658
White gravel and clay	658– 668
Sand	668– 678
Porous whitish clay and rock	678– 687
White sand	687– 705
Clay and gravel; hard drilling	705– 745
Whitish sand	745– 756
White clay	756– 772
Sand	772– 810
Clay	810– 815
Sand	815– 835
White clay	835– 895
White sand	895– 940
Reddish clay	940–1,134
Hard rock	1,134–1,137
Light-gray sand	1,137–1,179
Clay	1,179–1,236
Whitish sand	1,236–1,314
Hard rock	1,314–1,315
Clay	1,315–1,354
Sand	1,354–1,368
Clay	1,368–1,430
White sand and gravel	1,430–1,470
Hard clay and rock	1,470–1,600
Hard rock; gas	1,600–1,605
Clay	1,605–1,895
Sand	1,895–1,907
Red clay	1,907–2,025

Diameter of well, 8 inches from 0 to 779 feet, 6 inches from 479 to 1,219 feet, and 4 inches from 1,219 to 1,225 feet.

The Houston Water Company has 3 wells in stratum between 137 and 200 feet, 6 between 290 and 316, 5 between 456 and 496, 2 between 571 and 585, 1 between 602 and 618, 5 between 687 and 705, 6 between 772 and 810, 4 between 895 and 940, 4 between 1,137 and 1,139, and 3 between 1,236 and 1,314 feet. All the wells are located within half a mile radius. They have a closed pressure at the surface of from 1 to 18 pounds and flow from 1,000 to 8,000 gallons a day each.

302. Well No. 1 on the L. W. Long farm, Humble (17 miles north of Houston), Harris County, Tex.

[Begun September 17, completed December 22, 1904. Authority, P. M. Granberry, owner.]

	Feet.
Soft gray sand	30– 40
Hard gray clay	40– 60
Hard bluish sand	60–215
Hard gray sand and clay	215–310
Hard blue sand and clay	310–400
Coarse gray sand	400–470
Fine gray sand	470–495
Hard blue clay	495–508
Hard blue sand and clay mixed	508–572
Hard blue clay	572–645
Hard blue sand and clay in alternate layers	645–710
Hard blue shale	710–950
Mixed rock and sand (limy)	950–990

Marsh gas between 215 and 508 feet. Considerable gas between 645 and 670 feet and a little between 670 and 790 feet. Some oil and much gas between 790 and 950 feet. Oil between 951 and 990 feet. Yield, 100 barrels first twenty-four hours; gravity, 28° Baum.

Diameter of well, 11⅝ inches from 0 to 310 feet, 6 inches from 310 to 950 feet. Strainer inserted at 951 feet.

318. Well No. 1 on the O. Simmons farm, three-fourths mile southwest of forks of Little Sandy, Elk Township, Kanawha County, W. Va.

[Begun September 24, completed November 24, 1904. Authority, J. G. Weiler, driller.]

	Feet.
Surface soil	0– 22
Sand (sandy clay or shale)	22– 40
Shale	40– 60
Sandstone; fresh water rose to within 20 feet of surface	60– 70
Soft red shale	70– 76
Soft gray sandstone	76–124
Hard white shale (greenish)	124–155
Light-gray sandstone; fresh water rose to within 10 feet of the surface	155–170
Hard light-gray shale	170–178
Hard light-gray limestone (sandstone)	178–184
Hard light-gray sandstone	184–227
Hard gray shale	227–233
Hard light-gray sandstone	233–300
Hard light-gray shale	300–306
Hard white sandstone	306–318
Black shale, shelly	318–410
Coal	410–412
Black shale, shelly; water cased off at 425 feet	412–452
Hard white sandstone	452–547
Black shale, shelly	547–685
Hard white sandstone	685–730
Black shale, shelly	730–740
Hard white sandstone	740–790
Black shale, shelly	790–857

	Feet.
Hard white sandstone; top of Salt Sand; gas between 928 and 935; estimated yield 500,000 feet in twenty-four hours	857– 935
Soft white sandstone; salt water; steel line measurement	935– 942
Soft white sandstone; hole filled with flowing water	942– 965
Hard white sandstone	965– 990
Hard white sandstone (brown); well stopped flowing	990–1,010
Hard gray and brown sandstone	1,010–1,143
Hard black shale	1,143–1,145
Hard white sandstone	1,145–1,195
Hard dark-gray limestone; Bastard	1,195–1,210
Hard white sandstone	1,210–1,329
Soft white shale (blue)	1,329–1,345
Hard white sandstone; Maxton and Cairo oil sand	1,345–1,365
Hard white sandstone; bottom of Salt sand	1,365–1,402
Black shale, shelly; pencil slate	1,402–1,405
Hard gray limestone, "Big lime"	1,405–1,510
Hard gray limestone; should be Keener sand, was hard and limy	1,510–1,554
Soft gray sandstone, "Big Injun sand"	1,554–1,615
Black shale, shelly	1,615–1,700

The gas in the Salt sand was drowned out by salt water at 1,010 feet. Well dry, casing pulled.

There was no distinction between Keener and Big Injun sands as there should be. Shale brake between Keener and Big Injun sand.

Diameter of casing 10 inches from 0 to 40 feet, 8 inches from 40 to 425 feet, 6⅝ inches from 425 to 1,345 feet.

320. F. D. Hawkins No. 1, Harrisville, Ritchie County, W. Va.

[Authority, W. F. Graham.]

	Feet.
Limestone	190–202
Coal and shale	202–208
Limestone and pyrite	208–220
Gritty limestone	220–250
Red limestone (brown shale)	258–266
Gray limestone	266–274
Gray shale	274–290
Shale, coal and pyrite	290–298
Gray sandstone	298–306
Limestone (sandstone)	306–314
Gray shale	314–322
Limestone (limestone and shale)	322–351
Gray sandstone	351–358
Limestone (sandstone)	358–365
Sandstone	365–384
Red rock, "Little Red"	384–408
Limestone (shale)	408–422
Shale	422–446
Gritty limestone (gray sandstone, limy)	446–467
Shale	467–482
Limestone (shale)	482–489
Shale	489–497
Limestone (sandstone and shale)	497–608
Red rock, "Big Red"	608–664

	Feet.
Sandstone; pyrite	664– 670
Limestone (gray sandy shale, limy)	670– 781
Shale	781– 805
Limestone; pyrite between 813 and 821 (shale between 821 and 852)	805– 852
Shale	852– 867
Limestone (shale)	867– 873
Shale and pyrite	873– 879
Limestone (shale)	879– 885
Shale	885– 892
Limestone (shale)	892– 916
Shale	916– 930
Limestone (shale)	930– 986
Sandstone (red shale)	986– 992
Shale	992–1,006
Limestone (shale)	1,006–1,018
Shale	1,018–1,032
Limestone (shale)	1,032–1,045
Sandstone; Dunkard Sand	1,045–1,155
Shale (coal at 1,219)	1,155–1,219
Sandstone	1,219–1,225
Shale	1,225–1,241
Sandstone; Second Cow Run sand	1,241–1,285
Coal	1,285–1,300
Sandstone	1,300–1,312
Shale	1,312–1,328
Sandstone	1,328–1,340
Shale	1,340–1,348
Limestone (shale)	1,348–1,354
Shale	1,354–1,378
Limestone (shale)	1,378–1,385
Shale; shells from 1,408 to 1,414 feet	1,385–1,438
Sandstone; Gas sand	1,438–1,463
Shale	1,463–1,575
Sandstone; Salt sand	1,575–1,614
Shale	1,614–1,662
Shells; Maxton	1,662–1,669
Limestone	1,669–1,696
Shale; Cairo	1,696–1,699
Limestone, "Big lime;" top of Keener at 1,752 feet, very small showing of gas. Very small showing of light yellow oil between 1,782 and 1,788 feet. Steel line measurements at 1,762 and 1,770 feet	1,699–1,807
Sandstone and shale; brake	1,807–1,813
Sandstone, "Big Injun;" pay, gas and oil, 1,856–1,862 feet. Steel line measurement taken at 1,868 feet	1,813–1,873
Shale	1,873–1,875

Shot with 10 quarts of glycerine and produced 12 barrels flowing.

Dr. George H. Ashley made the following report to Mr. W. F. Graham regarding the geological formations encountered in this well:

"The well appears to have started at about the horizon of the Washington coal. The coal noted at 298 feet is about at the horizon of the Uniontown. The sandstone at 467 feet may be the Sewickley sandstone. The horizon of the Pittsburg coal probably comes at a depth of between 500 and 550 feet. The sandstone between 1,045 and 1,155 feet is probably the Mahoning or 'Cow Run' sandstone.

The coal at 1,219 may be the Lower Freeport or one of the Kittanning coals. The coal at 1,300 may be the Lower Kittanning or Clarion coal. Sandstone and shale from 1,438 to 1,496 is probably Pottsville, including the Salt sand at the horizon assigned by Mr. Graham. The lower part of the section has probably been correctly referred by Mr. Graham, unless it be in the case of the Keener sand, which he has correlated with the Siliceous limestone at 1,752 feet. The existence of a considerable thickness of limestone below would indicate that this occurs in the Big Lime (Greenbrier limestone), and that the Keener occurs in the upper part of the Big Injun immediately below 1,807 feet."

323. Well No. 1 on the J. Murphy farm, 2 miles east of Hundred, Wetzel County, W. Va.

[Begun July 25, completed September 24, 1904. Authority, E. J. Akins, driller.]

	Feet.	
Alluvium	0–	13
Hard limestone	13–	40
Soft shale	40–	60
Limestone and shale; 200 barrels a day of fresh water, slightly sulphurous, caseoff at 115 feet.	60–	352
Coal	352–	355
Shale and soft limestone	355–	425
Coarse white sandstone	425–	445
Soft black shale	445–	480
Coarse white sandstone	480–	500
Fairview or Waynesburg coal	500–	505
Coarse white sandstone. These layers of sandstone are soft but wear the bit out of gage	505–	580
Hard limestone; does not wear the bits	580–	640
Harder limestone; breaks heads of bits	640–	740
Coal; Mapletown	740–	745
Hard limestone	745–	750
Shale	750–	790
Hard limestone	790–	825
Soft chalky limestone	825–	844
Coal; Pittsburg	844–	852
Limestone and shale	852–	870
Gritty limestone	870–	890
Lime shells and shale	890–	960
Soft pink rock	960–	980
Red and white cave rock	980–	1,234
Sandstone; Little Dunkard sand	1,234–	1,275
Soft shale	1,275–	1,312
Sandstone; Big Dunkard sand	1,312–	1,348
Shoft shale	1,348–	1,400
Sandstone; Lower Dunkard sand	1,400–	1,475
Coal (black shale)	1,475–	1,480
Sandstone; "Gas" sand	1,480–	1,610
Shale	1,610–	1,650
Sandstone; Salt sand, dry in this well	1,650–	1,890
Shale	1,890–	1,980
Sandstone; Maxton sand, generally called "Little lime." This sand produces paying oil wells of 100 barrels a day within 1 mile of this well. This well yields about 250,000 feet of gas a day from the pay between 1,995 and 2,005 feet	1,980–	2,030
Shale and lime shells	2,030–	2,044

	Feet.
Limestone; Big lime	2,044–2,145
Sandstone; Big Injun sand; some gas between 2,145 and 2,155 feet. The well will yield about 200,000 feet a day from this pay	2,145–2,343
Shale with limestone and sand shells	2,343–2,900
Sandstone; Fifty-foot sand	2,900–2,970
Shale	2,970–2,988
Sandstone; Gordon Stray sand	2,988–3,008
Shale; brake	3,008–3,009
Sandstone; Gordon sand; a little gas, about 50,000 feet a day, between 3,000 and 3,020 feet	3,009–3,040
Shale	3,040–3,055
Sandstone; Fourth sand; this is the sand the well was drilled for. A well flowed 50 barrels an hour 1,000 feet from this well. This one, however, is dry	3,055–3,075
Shale and shells	3,075–3,100
Shale	3,100–3,236.5

The Fourth sand formation and also the Bayard Sand were missing in this well.

Diameter of casing 10 inches from 0 to 115 feet, 8 inches from 115 to 1,234 feet, 6 inches from 1,234 to 2,132 feet.

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