

SYSTEMATIC WATER FLOOD MAY REVIVE OLDER ILLINOIS FIELDS

Recent Developments Discussed by Engineer Of State Survey

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Will water power revive our oil sands? To answer this question evidence of natural floods on the McClosky, an artificial flood at Carlyle and accidental floods at Allendale will be presented.

McClosky

Figure 1 shows all McClosky production in Lawrence county. This simple kind of a drawing is used because ordinary contour maps often are confusing. In the early days, and old-time prospector when at the postoffice, had the good luck to find a structure map of the area, with lots on the ball. He then turned on a terrific high, opening a new field with an enormous well and claimed that he did it all on geology. Imagine his embarrassment when the postmaster showed him that his contour map was a weather forecast!

In these days anything about the McClosky is news—because it is the producing horizon of Clay City and Noble, and the history of the old field may repeat itself in the new, as history has a way of doing. What then are McClosky characteristics? Figure 1 shows that production is spotted, even on favorable structure. It is also true that wells of great initial production are surrounded by sharply declining production due to abrupt reductions in permeability. Part of the oil is water driven. Since the new field is under thousand feet more head, McClosky water characteristics will be intensified and with wide-open withdrawal of oil and gas, the faster water penetration may shorten the lives of basin wells.

Floods in Four Areas

McClosky floods have been discovered in the Applegate, McClosky, Murphy and St. Francisville areas. For each of them contours have been drawn on fluid levels of equal height. A comparison of contours, from higher to lower, shows the direction of water movement. These areas of different levels are illustrated on the drawings by concentric bands.

A great deal of information, especially on their great productions, is available from Survey publications on the Applegate and McClosky floods. An unusual characteristic of the Murphy area is that many big wells declined and were abandoned before the water-push had time to reach them. The St. Francisville flood is only an infant, but has already greatly increased production. The area was proved to be McClosky lime by its favorable reaction to acid, and suggests tests with acid, in small quantities, to differentiate between any true sand, and McClosky lime, by the absence or presence of carbon dioxide in the casing-head gas of the tested wells. Identification of the St. Francisville as McClosky and therefore 250 feet higher than previously believed to be the case, gives considerable structural significance to the area. In three cases out of four, water invaded from high on structure was directed there by greater permeability.

Flood characteristics of the McClosky are these: Water travels fast, oil production is always benefited. Only part of the area has been flooded. Therefore, the obvious deductions are (1) that the remaining McClosky should be intentionally flooded; (2) that this can be done without new drilling, by using alternate wells for flooding and pumping; and (3) that recoveries, if at all like natural floods, will amount to millions. Repressuring with gas or air should also be tried. Surplus gas, in the new field, should be returned to the formation.

Carlyle

An applied flood is being developed by the Ohio Oil Company which is intended ultimately to cover the whole Carlyle pool of eight hundred acres (fig. 2). The structure, an outline of the producing area, and the wells are shown. The field has produced 3,500 barrels of oil to the acre and the wells have an average age of 25 years. Considerable water has been produced with the oil. The average initial production of 50 barrels per well has declined to one. The average sand thickness is 17 feet. The developed field has 190 wells, of which about half are still pumping. Experimental air re-

pressuring has been tried. The wells are now being gas-pumped to increase the scanty gas supply, oil engines replacing gas engines for power. Such was the situation when flooding began.

A half million barrels of water have been pumped in, under pressures up to five hundred pounds, plus a static head of a thousand feet. The greatest input is about a thousand barrels a day.

Water distribution in the sand is proportional to the size of the circle around each input well. Each circle indicates the total amount pumped into that particular well. The sand, at 15 per cent. porosity, would have 2½ feet of voids and each circle represents the area of the top of a cylinder, 2½ feet high, which would accommodate the total water-input. The large circle indicates the top of a cylinder that would contain all the water pumped into the whole property, and the smallness of this circle, compared to the total area of sand, explains the slowness of results.

A comparison of fluid levels in 1933 and 1937 shows that there has been an average rise of fifteen feet and a similar comparison of pumping time shows a 25 per cent. increase. This operation, covering considerable time, has returned only 600 barrels of water per acre into a sand from which has been taken out 3,500 barrels of oil.

Allendale

Figure 3 shows the most significant happening in the old Illinois field, floods on the Biehl sand at Allendale. The map shows the field, its structure and wells. The discovery well was completed in 1912 and by 1926, 200 wells had been drilled, followed by an equal number up to now. Three hundred are still pumping. These wells have an average age of fourteen years and an average production of 2,500 barrels to the acre. The average initial production of 70 barrels a day had declined to two barrels. The average thickness of the sand is 29 feet, which yields little salt water. It is almost gasless and is gas-pumped to increase the fuel supply, but in most cases the power is obtained from oil engines. Repressuring has been tried on two properties with good results. Such is the picture of Allendale when flooding began.

Conditions at Allendale illustrate

how water, when it breaks through the pipe which cases off the water sand, rises in the well to an average height of 1,200 feet and floods the Biehl sand under an average pressure of nearly 600 pounds. The volume of water entering the Biehl sand is, of course, unknown.

Permeability Control

The direction of the water movement from well to well is shown on the sections through the sands, and demonstrates that permeability, not structure, is the controlling factor. The Biehl varies in thickness, but the flood often chooses the direction of thinking rather than thickening sand. Many floods go faster up structure than down. The average rate of travel is one location in three months, about the same as observed in the McClosky at the beginning of water invasion.

To date, no flooding well has influenced the oil production of more than a single pumping well, except on the Jake Smith and Alice Biehl leases. There a deliberate flooding program has been adopted, and several flooding wells are being used to move oil to each producing well from several directions simultaneously.

Figure 4 is a set of graphs showing the oil production resulting from six floods. They illustrate four conditions:—(1) flood production increasing; (2) flood production past its peak and declining because the pumping well is making an increasing amount of water; (3) flood production declining because the motive power has been shut off by plugging the water well; and (4) flood production reaching its peak and declining to nothing, because the pumping well has been abandoned.

These graphs show productions totalling over 58,000 barrels with three curves still going up and only one back to normal, but even under these conditions, there is an increase of more than 6,000 barrels each for the nine wells. If the whole field of 300 wells was flooded, with alternate flooding and pumping wells, and the same rate of increase held good, the field would produce a million barrels of oil. This does not take into consideration the oil recovered from water drives which would operate on every pumping well from its other

three sides.

Uncontrolled Water

The grave fault of Allendale flooding is uncontrolled water. In the flooded-out well shown on the graph the oil came down dip into the pumping well too fast to be pumped out. An advantage is that, like the McClosky, the sand is so permeable that new drilling is unnecessary, resulting in the most profitable of all flooding programs.

Water is available from the nearby Wabash river and in parts of the field from inexhaustible water-bearing gravel beds. All operators in the field are sold on water flooding for a final clean-up. Experience has shown the great necessity for a systematic program of controlling flooding for the whole field.

Will water revive our oil sands? Illinois is a water-power field. Accidental floods have been uniformly successful. Natural floods are everywhere welcomed. A few years ago Bradford water-flooders, unable to expand longer on their home grounds, hunted for and found

flooding territory in Kansas and Oklahoma. The very trains that carried them through Illinois rumbled over today's greatest oil play! Perhaps that's just the lesson needed to direct attention of operators to today's greatest flood play. When Noah heard rumors of a flood, he did something about it!

ATLANTIC'S NET INCOME HIGHER

Philadelphia, Jan. 25.—The Atlantic Refining company and subsidiary companies report a profit of \$9,942,000 for the year 1937, which compares with a profit of \$7,348,000 for the year 1936. Both figures are after interest, depreciation, taxes, etc. Provision of \$3,200 has been made for surtax on undistributed profits for the year 1937. After provision for dividends on preferred stock, the profit per share on common stock was \$3.51 for 1937 as compared with \$2.59 for 1936.

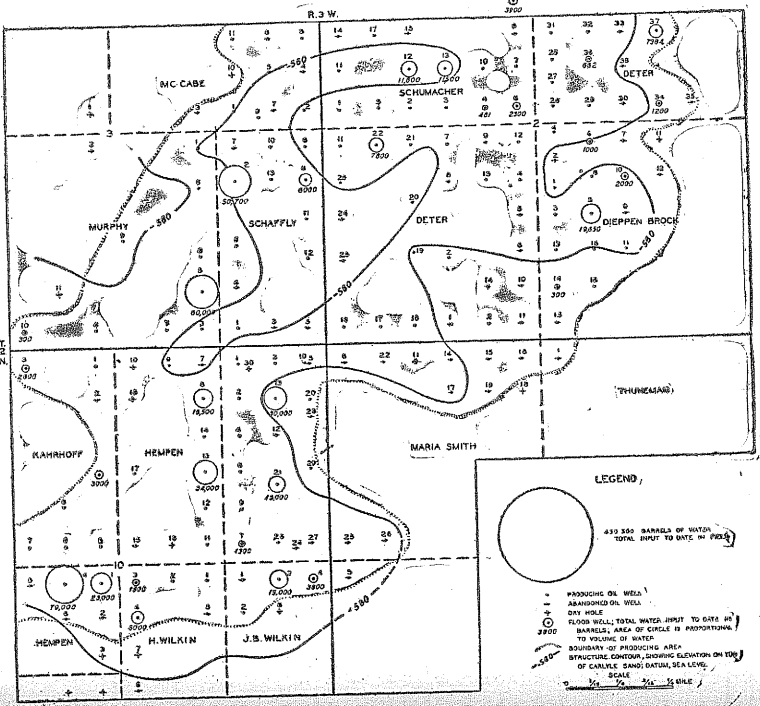


Figure 2. Applied flood at Carlyle pool, showing comparison of flooded areas to total area.

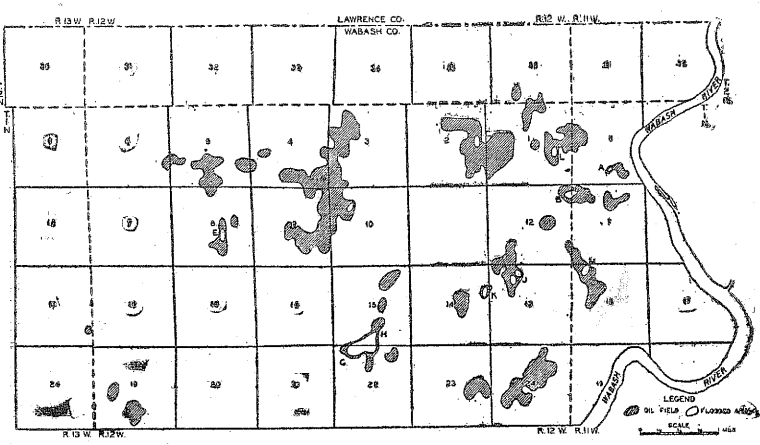


Figure 3. Map showing occurrence of Biehl sand and floods at Allendale.

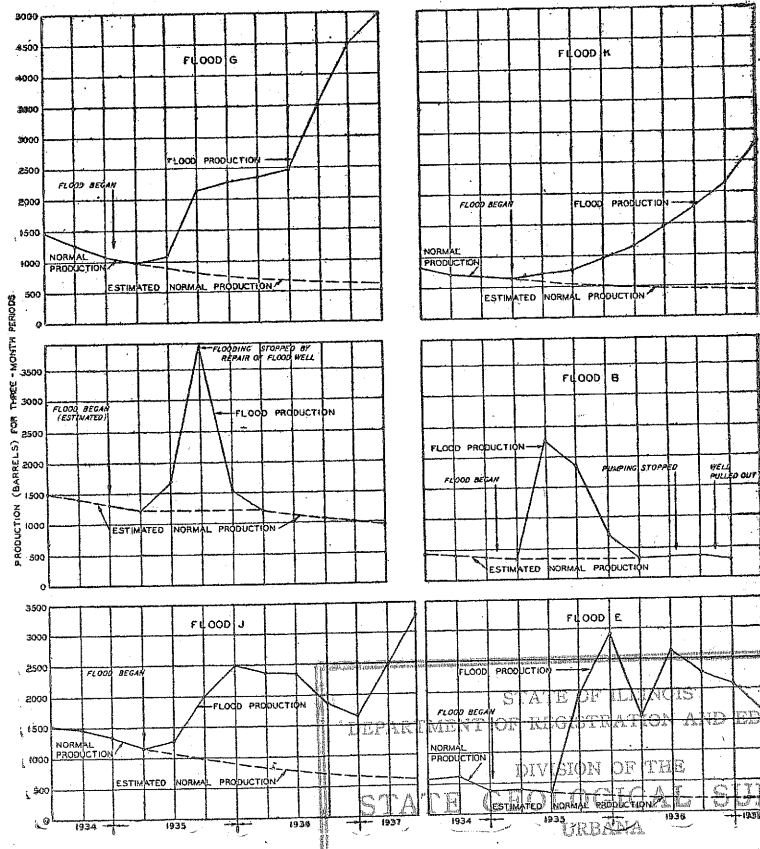


Figure 4. Graphs showing flood production. (See Figure 3).

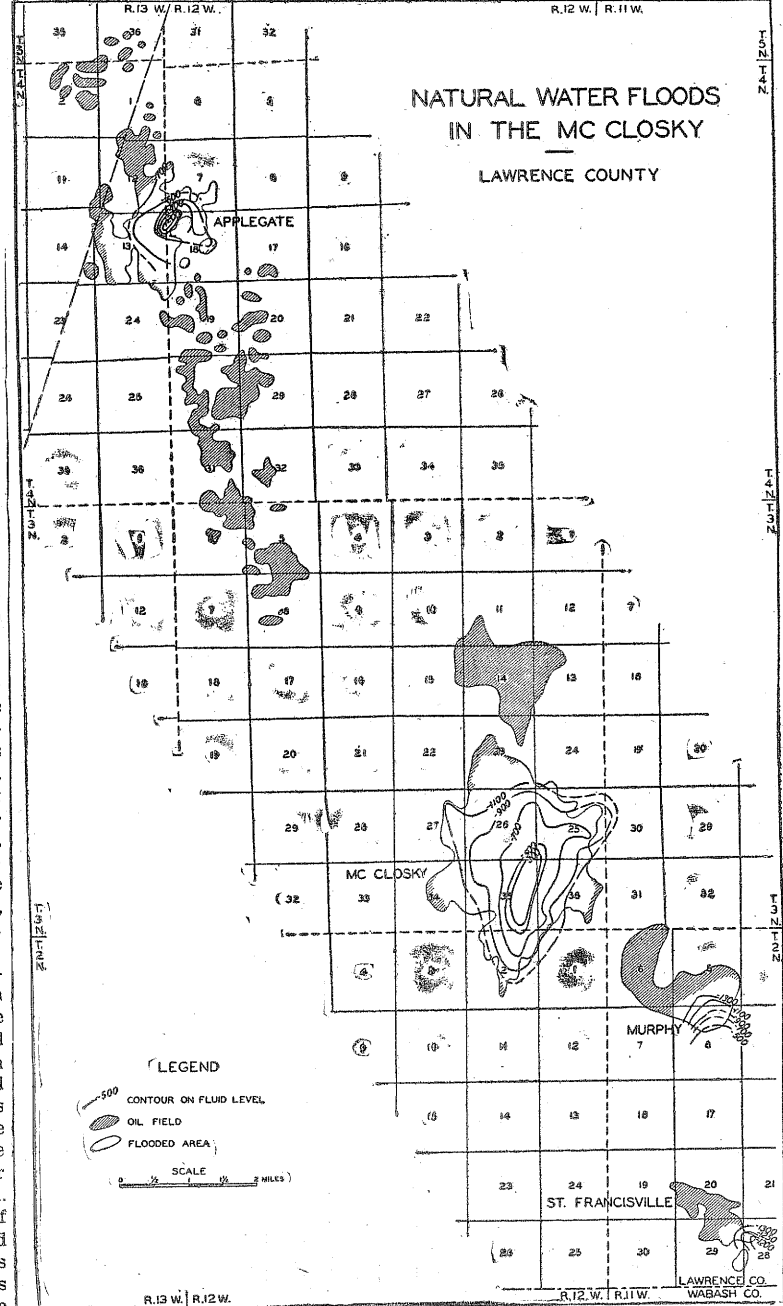


Figure 1.

WOODHULL OPENING LED DEVELOPMENTS IN ORISKANY AREAS

Completions In Past Year As Numerous As Those Of Previous Year

TOTAL INITIAL OPEN FLOW IS MUCH LESS

Extensive Wildcatting In Prospect For 1938, It Is Indicated

Coudersport, Pa., Jan. 25.—From the standpoint of completions, drilling operations in the deep sand gas fields of northern Pennsylvania and southwestern New York during 1937 were about on a par with those of 1936. Sixty-eight wells, 22 of which were wildcat tests, were completed in 1937 against 65 completions, including the same number of wildcats, in 1936. The 1937 completions included 42 producing wells and 26 dry holes. In 1936 45 producing wells were completed and 20 were dry holes.

From the standpoint of new production, however, results varied greatly. While an extension to the Tioga field was the outstanding development of 1936, the new Woodhull field of Steuben county, New York, was discovered in 1937 together with eastward and westward extensions to the Sabinsville field of Tioga county, Pennsylvania.

The combined initial open flow of the 42 producing wells drilled in 1937 was less than 550,000,000 cubic feet, a substantial reduction from the total of 687,000,000 feet for the 45 producers completed in 1936. The average initial open flow of the producing wells completed last year was about 2,000,000 feet under the average of the previous year. In 1936 a 50,000,000 cubic foot well in the Sabinsville and a number of 30,000,000 foot wells in the State Line field were completed and were unequalled by any of the producers completed last year.

Woodhull Leads

The discovery and subsequent development of the Woodhull field in Woodhull township, south central Steuben county, New York, six miles north of the New York-Pennsylvania state line, was, of course, the outstanding development of the year in the two-state area.

The discovery well was completed on May 25 by Atwater and Southwestern Development Co. The well had an initial open flow of 13,000,000 cubic feet, an initial rock pressure of 1,960 pounds and was completed at a total depth of 3,856 feet, one foot in the Oriskany sand. The field is a dome closure on the Van Etten anticline with a northeast, southwest axis similar to other Oriskany pools in this area.

Upon the completion of seismicographic surveys a number of other wells were spudded in and by the end of the year 18, all producers, had been completed. Initial open flows ranged from a low of 3,700,000 feet to a high of 27,000,000 feet. This rapid development, stimulated by unusually good drilling conditions, has already pretty well defined the southwestern limits of the field. If the development of the northeastern limits corresponds to expectations, the pool will have an extent of approximately 6,000 acres and will be the largest of the eight Oriskany sand pools opened in this area in the present decade. The last previous field to be opened was the Sabinsville field in western Tioga county, discovered in 1935.

Nineteen Producers

The 19 Woodhull wells had a combined initial flow of 316,880,000 cubic feet, accounting for the bulk of the new production developed in 1937. All the pipe line construction work in 1937 was centered in connecting lines, most of them six inch, to the new field. These lines were laid by Southwestern Development Co., G. L. Cabot, Inc., New York State Natural Gas Co., Hanley & Bird, Belmont Quadrangle Drilling Co., and Sylvania Corp. The combined length of these six lines is approximately 60 miles.

Other developments of interest were two extensions to the Sabinsville field in Tioga county. Both were drilled by the New York State Natural Gas Co. This company's L. J. Roberts farm test in Clymer

township, good for 3,000,000 cubic feet, extended the field eastward and its test on the A. W. Leonard farm in Westfield township, good for 4,800,000 feet, extended the pool westward. Both extensions approximated one mile.

New production was also developed in Troubsburg township, Steuben county, northeast of the Harrison field. Sylvania Corp. completed a well on the Hendrickson farm that found the Oriskany at 5,106 feet with an initial open flow of 1,000,000 cubic feet. It had an initial rock pressure of 2,160 pounds. Two other tests were drilled in this area at the close of the year.

Production At Howard

A well drilled by the Moss syndicate on the Moss farm in Howard township, Steuben county, also found gas in the Oriskany which it reached at 3,576 feet. It produced 200,000 feet after shot.

Further development of the Harrison field in Potter county accounted for 97,500,000 feet of new production and gave this field second rank in development work for 1937. Eleven wells were completed in the field, ten of which were producers.

The State Line field of Allegany county, N. Y., ranked third with three producers in four tests and 57,400,000 feet; the Sabinsville field of Tioga county, Pa., fourth with three producers and 34,800,000 feet; the Ellisburg field of Potter county, Pa., fifth with three producers in four tests and 21,000,000 feet; the Greenwood pool of Steuben county, N. Y., sixth with one producer in two tests and 15,000,000 feet, and the old Tioga field in Tioga county, Pa., seventh with one producer in two tests and 740,000 cubic feet.

The balance of the new production was from the two wildcat tests in Howard and Troupsburg townships, Steuben county, totaling 1,200,000 feet.

Summary of Completions

A summary of operations by fields follows:

New York—				
Field	Comp.	Gas.	Dry	Initial
Woodhull	.19	19	0	316,880,000
State Line	.4	3	1	57,400,000
Greenwood	2	1	1	15,000,000
Leon	2	0	2	—
Wildcats	.11	2	9	1,200,000
Totals	.38	25	13	390,450,000

Pennsylvania—

Field	Comp.	Gas.	Dry	Initial
Harrison	.11	10	1	97,500,000
Sabinsville	3	3	0	34,800,000
Ellisburg	.4	3	1	21,000,000
Tioga	2	1	1	740,000
Wildcats	.10	0	10	—
Totals	.30	17	13	154,040,000
All fields	.68	42	26	544,520,000

The best well completed in these fields during the year was that of G. L. Cabot, Inc., on the R. C. Towsley farm in Woodhull which had an initial open flow of 23,000,000 cubic feet. Three 27,000,000 foot wells were drilled, one each in the Woodhull, State Line and Sabinsville fields by Hanley & Bird, G. L. Cabot, Inc., and New York State Natural Gas Co. respectively, and 26,000,000 and 25,000,000 cubic foot wells were completed in the Woodhull field by New York State Natural Gas Co. and Sylvania Corp. Four other twenty million foot wells were drilled in the Woodhull field and one in the Harrison field. These contrasted with the one 50,000,000 and half dozen 30,000,000 foot leading wells of 1936.

Wildcatting last year was substantially more successful than in 1936. Besides opening the Woodhull field, wildcats found new production in Troupsburg and Howard townships, Steuben county.

McKean County Wildcat

A wildcat drilled by the H. C. Drilling Co. on the Van Scoy farm in Hamilton township, western McKean county, the first Oriskany test in that immediate area, struck a flow of 3,500,000 cubic feet in the 18 feet of Oriskany sand at 4,750-68 feet. This flow was cut to several hundred thousand feet however when salt water developed and it was plugged back to make a shallow oil producer when it was decided that producing it as a gas well would be unprofitable.

Six wildcats including the Woodhull field discovery well were drilled in Steuben county, two in Allegany county, three in Schuylers county and one in Cattaraugus

county, all in New York, and three in Tioga county, four in Warren county, two in Crawford county and one in McKean county, Pennsylvania. Wildcats tested not only the Oriskany but also the deeper Medina in Allegany, Cattaraugus, Schuylers, Warren and Crawford counties.

At the end of the year wildcats were drilling in Keating and West Branch townships, Potter county; Elk and Watson townships, Warren county; one in Rockland township, Venango county, and in Montour township, Schuylers county. The two Potter county tests, both being drilled by the Potter Development Co., found the Oriskany sand dry and will be deepened to the Medina.

Rotary Is Introduced

An interesting feature of the year was the introduction of rotary drilling in the east. Potter Development Co. is employing the first heavy duty deep well rotary ever used in these fields to deepen its wildcat at Keating Summit, Keating township, Potter county. Developments at this test are being watched closely by other operators considering the addition of rotary rigs to their equipment. This test will be drilled to the Medina, productive of oil and gas in Ohio and gas in New York but dry in the several tests drilled thus far in Pennsylvania. Nearest Medina gas production is in the Leon pool in Cattaraugus county, N. Y., between 50 and 60 miles to the northwest.

Tests were drilling to the Oriskany in the Woodhull and Troupsburg areas at the close of the year. In addition to the further development of the new productive areas opened in 1937, a widespread wildcatting campaign is scheduled for this district in 1938 according to several of the major operators.

Sun Oil Report Shows

Income Gain Last Year

Philadelphia, Jan. 28.—(AP)—The Sun Oil Co. reported today a net income of \$9,544,085 for 1937 as compared with a 1936 net income of \$7,563,554.

The 1937 net income represents \$4.17 per share on common stock outstanding December 15, 1937, prior to the distribution of an eight per cent. dividend.

Weekly A. P. I. Report

The following report shows the daily average crude runs, the total gasoline stocks and the total gas oil and fuel stocks as reported to the American Petroleum Institute for the week ended Jan. 29, 1938. The refining capacity reporting to the Institute is shown in the first column. All figures are in thousands of barrels.

	Capacity Reporting (per cent)	Daily Crude Runs	Total Gasoline Stocks	Gas and Fuel Oil Stocks
East Coast	100.0	489	20,029	11,446
Appalachian	88.4	112	3,334	1,216
Indiana, Illinois, Kentucky	92.4	411	13,959	6,771
Oklahoma, Kansas, Missouri	84.7	263	7,183	3,551
Inland Texas	56.6	119	2,574	1,659
Texas Gulf	95.7	732	12,732	10,487
Louisiana Gulf	96.6	136	2,526	3,281
North Louisiana, Arkansas	63.7	39	507	471
Rocky Mountain	69.7	45	1,924	691
California	90.9	510	15,186	76,430
Reported	89.0	2,856	79,954	118,003
Estimated unreported		314	4,890	2,790
Estimated total Jan. 29		3,170	84,844	117,793
Estimated total Jan. 22		3,220	82,785	118,433
Jan. 29, 1937		3,038	70,878	102,664

RESOURCES

Commercial \$14,011,432.79

Trust 15,286,617.92

TOTAL \$29,298,050.71

YOUR BUSINESS INVITED

Oil City Trust Co.
Oil City, Pa.

BRADFORD-ALLEGANY PRODUCTION

(Reported by Bradford District Oil Producers Ass'n)

