

the cooperation of drillers, operators, and interested observers. These data are kept up to date in a card file, and each month the *Indiana Oil and Gas News* is published, incorporating the most recent news of operations in the state. This mimeographed bulletin is mailed gratis to an extensive list of operators, drillers and other persons interested in oil and gas developments. Through the *Indiana Oil and Gas News*, the Division of Geology, the operators and drillers are enabled to keep in touch with one another.

During the past year, a greater number of drillers and operators consented to keep samples of the rock formations passed through in drilling oil, gas or test wells. Sample bags for this purpose were furnished by the Division of Geology. The microscopic and chemical examination of the samples was carried on at the state laboratory in the Department of Geology at Indiana University, under the personal direction of the State Geologist, and has furnished the Division and operators with many detailed and accurate sample studies. Data obtained from well samples have been very valuable when used in conjunction with drillers' logs.

Owing to intense interest in oil and gas possibilities in southwestern Indiana, there was again during the past fiscal year a great demand for information concerning drilling and production during the past years. Many companies contemplating operations in Indiana requested all available information of this nature. Many landowners asked for information concerning leases and leasing practices. A number of abandoned gas wells in the old Trenton area were examined by the natural gas inspection force, and were subsequently plugged according to law. During the fiscal year ending June 30, 1938, 148 abandoned oil or gas wells or dry holes were plugged in the state under the supervision of the State Gas Supervisor and deputies, netting fees amounting to \$1,480.00.

OFFICE WORK

Routine work in the office of the Division of Geology consisted largely in furnishing information to callers, answering correspondence, and tabulation of data on the occurrence and production of Indiana's mineral resources. In addition, the office force during the past year has prepared several reports and many maps. The information requested from this office often requires a great amount of research or laboratory work before a satisfactory answer can be offered. Records for many years past must be consulted and the information collected in a form which can be used. Each year several hundred rock and mineral specimens are sent or brought to the attention of members of the division for examination and identification. In many cases, the owner of the specimen requires information upon the uses, value, composition, occurrence and distribution of the material. Numerous inquiries are received concerning coal, oil, gas, lime, cement, ground water, and other water supply, building stone, mineral wool, sands, gravels, molding sands soils, clays and kaolins, and their occurrence and distribution. In many cases, the Division is called upon for infor-

mation about the economic status of industries utilizing our natural resources. Other requests require information upon state parks and forests, caves, fossils, rock garden materials, physiography, topography, and various other phases of geology.

Samples thought by the owner to contain gold or some other precious metal exceed all other samples in number, but such metals are seldom found in Indiana, owing to the fact that none of them are native to the rocks of this state, except in extremely small quantities. During the past year, many supposed meteorites were submitted to the Division for identification, but none proved to be authentic. The Division of Geology welcomes all requests which might lead to the discovery of previously unknown deposits of natural mineral resources, and is glad to dispense all information available.

FIELD INVESTIGATIONS

The field survey continued through the first two months of the past fiscal year under the direction of the State Geologist. The field party, consisting of Hollis Fender, George Heap, and Frank Williams, confined their studies to Daviess, Martin, and Dubois counties, and located and examined rock outcrops in an attempt to determine the stratigraphy and structure of the area. This type of work is of inestimable value in completing the knowledge of the coal-bearing rock strata of Indiana.

A large amount of field work was necessary in connection with projects of the Department of Conservation; with work necessary to the enforcement of the conservation laws pertaining to natural mineral resources, in particular oil, gas, and ground water; and with the collection of data for use in oil and gas production reports.

PUBLICATIONS

In February, 1938, a report entitled "Oil and Gas Developments in Indiana in 1937" was prepared to be used in the publication of the American Institute of Mining and Metallurgical Engineers, "Petroleum Development and Technology, 1938." This report discusses in tabulated form the area, production, wells, and producing rock in every field now producing oil or gas in the state. Reprints of this paper are available at the office of the Division.

A report upon the production of natural gas was prepared for incorporation in the "Minerals Yearbook, 1937," a publication of the United States Bureau of Mines. During the year, the members of the Division also compiled data upon the future petroleum reserve in the known fields of Indiana, for use by the American Petroleum Institute.

During the past year, the Division published the doctorate thesis of Dr. William D. Thornbury of Indiana University, entitled "Glacial Geology of Southern and South-Central Indiana." This report embodies the latest data available upon the deposits left by the ice sheets during the Glacial Period, and may be obtained only from this Division. A series of mimeographed publications, containing the records of wells drilled in various counties since 1931, were also started, and proved to be very much in demand by persons in the oil and gas industries.

These pamphlets are supplements to Publication 108, "Sub-Surface Strata of Indiana," by Dr. W. N. Logan, former State Geologist.

Work was started on another series of pamphlets dealing with the geology, history, utilization and location of deposits of the various natural mineral resources throughout the state. In addition, mimeographed maps were prepared, showing in a generalized manner the economic geology, stratigraphic geology and physiographic features of the state. During the year, work was completed upon the series of oil and gas field maps, and county dry hole maps. These maps have proved to be extremely popular in the past year, owing to the general interest following the discovery of new oil fields in Indiana, Illinois, and Kentucky. Many requests were received for all publications dealing in any way with the oil and gas exploration of the past, and for logs of wells which had not been made available in printed form. Distribution of publications during the past fiscal years was as follows:

Free publications distributed.....	985
Publications and well logs sold.....	\$1,452.84

DEPARTMENTAL WORK

During the past fiscal year, the members of the Division of Geology have continued the co-operative work with other state and federal agencies in their projects which required geological investigations. Geological examinations were made at the sites of "made lakes" on properties owned by both state and federal agencies. Such investigations at dam sites included the determination of the form of the bedrock stream channel, and the amount and character of the alluvial fill material; the type and extent of the bedrock; the presence, character, direction and spacing of joints or laminations in the rock; the position of the beds; the permeability of the bedrock; the depth to which weathering has affected the rock; and the ability of the foundation material to withstand dynamic and hydraulic pressure after the dam has been completed.

The earth fill materials used in the construction of dams was selected under the supervision of members of the Division of Geology. Samples of these materials were taken, and laboratory soil tests were made to ascertain the suitability for construction purposes prior to the opening of barrow pits where the earth fill material was obtained.

Requests for geological examinations of fish hatchery and rearing pond sites have also been numerous during the past year. Materials used in the levees and bottoms of the ponds were selected under the supervision of this Division. This type of work has been carried on for many conservation clubs prior to and during the construction of hatching and rearing ponds and small bodies of water. During the past year the Division of Geology has also co-operated with the Works Progress Administration in the geological examination of proposed lake sites and in the selection of earth materials to be used in the construction of the dam.

The Division of Geology and the Department of Public Health continued to sponsor a program of sealing of abandoned strip and

slope mines, but the program was ended at the close of the fiscal year, although the work was far from completion. The numerous abandoned "workings" throughout the coal district of Indiana continue to furnish many thousands of tons of sulphuric acid to the streams of the state. This acid is generated from the sulphides in the coal when they come in contact with the air and water simultaneously. Formerly some streams which received this waste were entirely devoid of plant and fish life, but sealing the offending mines made it possible for this life to again flourish in a short time. Many strip pit lakes which were high in acid content prior to the sealing program are now capable of supporting a normal amount of fish. This water is also suitable for the use of other forms of wildlife, and it is hoped that acid may be eliminated from other waters of this type in the near future.

During the past fiscal year, the Division of Geology continued the cooperative research agreement with the Ground Water Division of the United State Geological Survey. During the winter, some of the observation wells were checked, and arrangements were made to make an intensive study of conditions in two of the larger cities of the state. The observation wells are situated throughout the entire state in areas representing all variations of topography, altitude, and water-bearing strata. Semi-monthly observations of the water level were made, and the readings were sent to the federal survey where the data are assembled and studied. Several wells are located in municipal areas where the ground water resources are used in great quantities, and the observation of the behavior of the static level of the water will lead to valuable information concerning the safe yield of water in these areas. During the past year, the U. S. Geological Survey published the results of the first readings of the wells in this state in a comprehensive report covering the entire country. The continuance of this program will result in a wealth of valuable data concerning many problems, such as: The amount of ground water available; the effects of land drainage projects on the ground water table; whether and where a progressive and permanent decline of the water table is taking place; and the effect of soil erosion control methods on the ground water levels.

MAPPING

During the past year, the Department of Conservation cooperated with the United States Geological Survey in a topographic mapping program, wherein each sponsor is to furnish \$25,000 annually for this purpose. This work is carried on under the direction of engineers from the federal survey, and the data are compiled in the offices of that organization. The Divisions of Geology and Engineering have charge of the selection of areas to be mapped, as well as the selection of a portion of the personnel of the survey parties. The completed maps are lithographed and printed, and are made available to the public at a nominal charge.

During the twelve months, preceding June 30, 1938, many parties had worked on the vertical and horizontal control, and mapping of

several areas bordering the Ohio River Valley, as well as an area in Steuben County and one in Greene and Owen counties. During the year, two map sheets in preliminary form were published, and most of the field work was completed on several other sheets in the same general areas. The finished maps, showing all the features of the surface including hills, valleys, streams of all sizes, railways, roads, houses and many other features, will be of nearly limitless value in flood control projects along the major streams. The utility of these, the most accurate maps in the world, is indeed great, and this fact alone should justify the expenditures of money for this purpose. The program now in progress should be extended for a sufficient time to allow the complete mapping of the state.

OIL AND GAS OPERATIONS—1937-1938

During the first half of the past fiscal year, new operations in the oil and gas fields of Indiana showed a great decrease over the previous six months. However, during the last half of the year activity again showed an increase throughout the entire state. Production figures indicated that more oil was produced during the year than has been taken from the ground for several years. An increase in oil price allowed more old wells to be returned to service, after a shut-down period resulting from low prices. The following table shows the number of completed wells in Indiana during the past fiscal year.

WELLS COMPLETED IN INDIANA—JULY 1, 1937 TO JUNE 30, 1938

COUNTY	PROVEN AREA			WILDCAT AREA			Totals
	Oil	Gas	Dry	Oil	Gas	Dry	
Daviess.....		5	4			4	13
Dearborn.....		2					2
Decatur.....		1					1
Delaware.....		1					1
Dubois.....						1	1
Gibson.....	1	4	6				11
Greene.....						1	1
Hamilton.....					1		1
Hancock.....		5					5
Harrison.....		1				1	2
Henry.....		1					1
Huntington.....						1	1
Jasper.....			1				1
Jay.....	4						4
Jennings.....		1					1
Knox.....	1	4	2		1	1	9
Martin.....						1	1
Parke.....						1	1
Perry.....	7	1	4			6	18
Pike.....	6	4	6			2	18
Posey.....				1		1	2
Rush.....	1	1	1				3
Spencer.....	4	1	4				9
Sullivan.....	4	3	2			5	14
Vanderburgh.....	4						4
Vigo.....	9			1		1	11
Wabash.....			1		1		2
Warrick.....						1	1
Wells.....			1				1
Total.....	41	35	32	2	3	27	140

Of the 140 wells completed in the state during the past twelve months, 59 were dry, 38 produced gas, and 43 yielded oil. The decrease in number of completions in comparison with former years was due in part to inclement weather during the winter and spring, and in part to increased activity in adjoining states. The greater part of the drilling has been in Pike, Perry, Daviess, Sullivan, Vigo, and Gibson counties.

Several gas wells were completed in the Oaktown gas field, and near the close of the year several good wells extended the field to the eastward. One wildcat well drilled nearly one mile east of previous producing territory was brought in as a good gas well. Pressures in this field have dropped so much that the pipeline company saw fit to construct a pumping station at the edge of the field during the year. This field, however, again produced more gas than any other individual field in the state, although several wells were abandoned because of water conditions. The other gas fields continued to hold up fairly well, and several new gas wells were completed in the old Trenton area of east-central Indiana.

Of the oil fields, the Siosi field of Vigo and Sullivan counties led all others in production. The shallower fields of southwestern Indiana, in some cases, showed a slight increase in production because of the reconditioning of old producing wells, and the completion of new wells on inside locations. Drilling was especially heavy in the shallow Troy area of Spencer and Perry counties, where small wells are obtained at a depth only a few hundred feet below the surface.

Wildcat drilling far from known production was heavy in Sullivan County, where several deep tests were completed during the year, without obtaining production. One of these tests, east of Sullivan, was completed at a depth of 4,160 feet in the St. Peter sand. This was the deepest hole drilled in Indiana, so far as is known. Wildcat tests led to the discovery of the Prairie Creek field, a few miles north of the Siosi field, in Vigo County. This new area was developed after the discovery of oil in the Devonian limestone approximately 2,150 feet below the surface, and several of the new wells flowed naturally. At the end of the year, development was continuing to the north. A new field was also discovered upon the completion of an oil well in eastern Posey County, a few miles from the city limits of Evansville.

During the past year, repressuring projects have been under way in two of the southern Indiana oil fields. One project uses natural gas and the other compressed air for injection into the oil sand, and in both cases satisfactory results have been reported. Acid treatment of wells has continued to be popular in reconditioning stripper wells producing from limestone horizons. In many cases, production has been doubled through the introduction of acid and the proper cleaning out. Acidization has been accepted as standard practice in the completion of new wells producing from the Devonian and Silurian limestones. During the past year, it has been the practice to shoot the well lightly with nitroglycerine before the introduction of a few thousand gallons of acid. This method seems to allow the acid easier ingress at the proper place.