

## REPORT OF THE DIVISION OF GEOLOGY

(Sixtieth Annual Report of the State Geologist)

RALPH E. ESAREY, State Geologist.  
M. M. FIDLAR, Supervisor of Natural Gas.  
W. H. CORDELL, Assistant Geologist.  
VERNE PATTY, Curator of Museum.  
MARY E. LIVENGOOD, Clerk-Stenographer.

Members of the Geology Department at Indiana University who, in accordance with the plan of co-operation with the Department of Conservation, acted in an official, technical, or advisory capacity during the year were: Ralph E. Esarey, state geologist; E. R. Cumings, stratigraphic geology; C. A. Malott, physiographic geology; J. J. Galloway, paleontology; S. S. Visher, geography; J. E. Switzer, geography; W. D. Thornbury, glaciology, and Howard Legge, preparator. These men receive no salary from the Department of Conservation.

## NATURAL GAS SUPERVISION

The State Gas Supervisor and his deputies enforce the State Conservation laws and regulations, supervise the plugging of abandoned and dry wells, inspect well and pipe line equipment, and collect geological data in the oil and gas fields of the state.

The natural gas inspection force in Indiana is composed of Marion Brown, Loogootee; Herman Chanley, Laconia; William Connors, Vincennes; L. W. Edmundson, Pennville; Fred Harrer, Tell City; J. P. Horton, Montpelier; O. H. Hughes, Sharpsville; H. W. Legge, Bloomington; Herschell Ringo, Muncie, and James Wyman, Sullivan. These deputy gas inspectors draw a percentage of the fees collected for supervising the plugging of abandoned oil and gas wells in their respective territories.

The progress of the wells being drilled throughout the state has been kept up to date in the office files through the co-operation of deputies, drillers, operators and other observers. This information is kept in a card file, and on the first of each month the most recent news of operations in the state is incorporated in the *Indiana Oil and Gas News*, mimeographed and mailed to a rather extensive list of operators and persons interested in oil and gas developments in Indiana. Through the *Oil and Gas News* the Division of Geology, the drillers and the operators throughout the state are enabled to keep in contact with one another.

Samples have been kept for the Division of Geology by some drillers who were willing to take this additional duty. The sample bags are furnished by the Division, and it has been found that much valuable information may be obtained by the study of the samples in the laboratory. The examination of the drilling samples has provided the office with some detailed and accurate well records.

A number of land owners were given advice concerning leasing practices in wildcat areas, and representatives of out-of-state oil and gas operators have requested data from the office files, concerning the history, development and production of various of the Indiana fields.

A number of abandoned gas wells were examined and records were kept of these wells until they were satisfactorily repaired or plugged. Many of our citizens are not acquainted with the regulations applying to the plugging of abandoned wells, and many requests applying to these regulations were answered. During the twelve months ending June 30, 1936, 205 dry or abandoned wells were plugged in Indiana, under the supervision of the State Gas Supervisor or his deputies.

#### OFFICE WORK

The routine work of the office force of the division consists largely in answering correspondence, dispensing information to callers, preparing maps and geological reports and tabulating information regarding oil and gas developments. Often the information requested necessitates considerable office or laboratory work before a satisfactory answer can be offered. Each year several hundred specimens of minerals are brought or sent to the office for examination as to their uses, value, composition, occurrence and distribution. Other inquiries are about coal, oil, gas, lime, cement, building stone, mineral wool, sands, gravels, soils, water supplies, clays and kaolins and their occurrence, distribution, the economic condition of the industry and where publications dealing with them may be had. Inquiries about state parks, caves, fossils, rock garden material, physiography, topography and other phases of geology are received frequently. The division welcomes such inquiries and is glad to dispense to the citizens of the state whatever information is available.

#### GEOLOGICAL FIELD INVESTIGATIONS

There was no regular field survey during the summer of 1936. Field investigations have been restricted largely to those connected with projects of the Department of Conservation and those necessary in enforcing the conservation laws pertaining to natural resources, in particular oil and gas, and gathering data to use in oil and gas reports.

#### PUBLICATION

In February, a report entitled "Oil and Gas Developments in Indiana in 1935," was prepared to be used in the American Institute of Mining and Metallurgical Engineers' publication, "Petroleum Development and Technology, 1936." Separates of this paper on Indiana are available at the office of this division.

A special effort has been made to increase the distribution of our available publications, especially to the colleges and universities in Indiana, and to city libraries throughout the state. Our free publications were sent to the many students who were interested enough to write for them. Our list of available publications has been revised and distributed widely. Formation logs of oil and gas wells drilled since the publication of "Sub-Surface Strata of Indiana" are made available at ten cents each. Distribution of publications during the year is as follows:

Sale publications and well logs, 456; total \$342.22. Free publications distributed, 735.

## DEPARTMENTAL WORK

The Division of Geology has made a careful examination of the bedrock formations in the bottom and sides of valleys in which earth fill dams are being constructed on state properties. This geologic investigation of the dam site included the determination of form of bedrock channel, depth and character of filling in it; kind of bedrock; presence, character, direction, and spacing of joints; position of beds; depth of weathering in rock; permeability of materials; ability of rock to withstand hydraulic and dynamic pressure.

The earth fill material used in the dam is selected and is placed under the supervision of members of the Division of Geology. Samples of the soil are taken and laboratory soil tests are made during the preliminary examination.

We have also been called upon to investigate sites for fish hatcheries. The material used in the levees and bottoms of the ponds is selected by the Division of Geology and advice is given on the best methods of placing these materials. We are also called upon for advice from local conservation clubs that are building hatcheries and small dams.

The Division of Geology and the Department of Public Health are sponsoring a program to seal abandoned coal mines in several counties in southwestern Indiana. Sulphuric acid is formed by air and water coming in contact with the iron sulphide contained in the coal. By eliminating one of the two conditions, acid water can be prevented from entering the streams. In the strip mines small dams are built to raise the water above the coal outcrop. In this way we shut off the air. In the shaft mines, all the openings can be closed, preventing the circulation of air, or the water level raised. In Pike County alone it was estimated that 54,800 tons of acid were entering the streams yearly before this program was started. In some of the strip pits that were highly acid before work was started, they are now neutral and are supporting fish life. By the continuation of this program it is hoped to render all the pits and creeks capable of supporting fish life.

In the fall of 1935 the Division of Geology entered into a research agreement with the U. S. Geological Survey. Observation wells were established in areas representing both types of source material, that is, bedrock and glacial drift. Some of the wells are situated in areas of intensive ground water development and will give valuable information in regard to the safe yield of these areas. Observations are taken semi-monthly and the readings sent to the Division of Geology, where the data is assembled. As the well measurement work progresses, the records will be found to be increasingly useful in connection with many problems, such as studies of amount of ground water available for use, the determination of whether and where a progressive and permanent decline of the water table is taking place, the effects of land drainage projects on the water table and the effects of soil erosion control methods on the water table.

Since the creation of the State Planning Board, the Division of Geology has been called upon to supply information for their economic

studies on mineral resource industries of Indiana. At the present time the State Geologist is a member of the permanent State Planning Board.

#### MAPPING

The United States Geological Survey, using funds supplied by the Public Works Administration, completed the field work connected with the topographic mapping of three quadrangles in Indiana, the Bedford quadrangle and the Oolitic quadrangle in Lawrence County, and the Porter quadrangle in Porter County. Advance sheets have been received, and these maps will soon be available to the public in their final form.

The Division of Geology is endeavoring to have a permanent topographic mapping program adopted by the State. Such a program is being incorporated in the activities of the State Planning Board. At the present time, only 10.1 per cent of the total area in Indiana is covered by topographic maps prepared under the supervision of the United States Geological Survey. This work is done entirely by members of the federal survey, and the cost of mapping and printing is shared by the State and National Government on a 50-50 basis. The utility of such accurate maps is great, and this fact alone should justify the expenditures of money for this purpose. The State of Indiana will at some time be completely mapped topographically, and it will be a distinct advantage to have this done in the near future so as to have more use from the completed maps.

#### OIL AND GAS OPERATIONS—1935-1936

Oil and gas operations in Indiana during the past fiscal year from July 1, 1935, to June 30, 1936, showed a marked increase over those of the previous five or six years. A better price for crude oil, the absence of too restrictive proration, and the discovery of several new small fields in the southwestern part of the State all tended to bring about an increase in the oil and gas business.

Exploratory drilling for gas was pronounced in the Daviess County field, and activity was great in the Oaktown field, Knox County. Several good gas wells were completed in the last year, and have enabled the producers to meet the demands for natural gas.

Of the 242 wells completed in the state in the past 12 months, 122 were dry, 58 produced oil and 62 yielded gas. This is a good ratio between dry holes and producers, in view of the amount of wildcat drilling carried on. On the other hand, a large proportion of the exploration is "inside" drilling, within the bounds of proved areas. The greater part of the drilling activity has been in Daviess, Gibson, Knox, Perry, Pike, Spencer, Posey and Vanderburgh counties in southwestern Indiana.

Among the gas field of the state, the Unionville field in Monroe County is the only one lying idle because of the lack of suitable market for its production. The production in all the fields in southwestern Indiana is being used to supply the demand of cities and towns using natural or mixed gas for domestic and commercial purposes. The old Trenton field is still furnishing gas to several towns in eastern and northeastern Indiana, after 50 years of steady production. Many of the

wells in the Trenton field have been depleted and plugged, but some drilling in the Trenton area has been in progress during the past year.

Some of the better gas pools of the southwestern portion of the state have been injured by competitive property line drilling, competitive production of gas, poor casing and other faulty operating and drilling technique, poor equipment and unwise offset drilling are shortening the lives of some of the wells. A good example of unwise drilling is the Vanderburgh pool north of Evansville. Here the oil wells have had a very short life, owing to the great number of holes drilled into the oil-bearing sand. Too heavy a shot often floods out production in what would otherwise be a good well, and breaks in second-hand casing have often ruined new wells. Failure to pump or plug wells making water has no doubt ruined surrounding wells, by bringing about the flooding of the oil sand with water. On the other hand, natural water floods have increased production in some wells.

Production in Indiana may be increased in several ways. Repressuring and controlled flooding have been quite successful in recovering additional oil and gas in other states, and will undoubtedly be tried in Indiana. Additional production may be obtained by drilling to deeper horizons in proved areas. Acidizing of lime wells has become popular in this area, and most of the wells thus treated have shown a worthwhile increase in production.

#### STATE MUSEUM

The Indiana State Museum has made several changes in the placing of display cases which gives added space. The improvement is very noticeable in the increased number of objects shown.

Added facilities give a better showing of the work of many of the noted Hoosier artists and also the display of arms.

A recent bequest of a collection of antique jewelry adds interest. The jewelry will be placed on exhibition the latter part of the year.

Strides toward a better display and added space have been made during the year. It has been estimated that the Indiana State Museum collection will approximate a million dollar value and the attendance during the year will approximate 50,000.

#### REPORT OF THE DIVISION OF ENTOMOLOGY

FRANK N. WALLACE, State Entomologist, Chief of Division.

PAUL T. ULMAN, Assistant Entomologist.

HERALD K. RIPPEY, Assistant Entomologist.

PALMER E. MART, Assistant Entomologist.

JAMES E. STARKEY, Chief Inspector of Apiaries.

THOMAS C. JOHNSON, Deputy Bee Inspector.

BENJ. H. WILKINS, Deputy Bee Inspector.

E. P. CASSIDY, Deputy Bee Inspector.

A. O. SMITH, Deputy Bee Inspector.

G. L. HODSON, Deputy Bee Inspector.

G. W. GRAHAM, Deputy Bee Inspector.

W. A. HORST, Deputy Bee Inspector.

AGNES P. WYSS, Clerk and Stenographer.