tion of those principles of honesty and tolerance that Lincoln exemplified.

Because Lincoln lived here and because those influences that were to instill in his youthful mind appreciation of absolute justice and political integrity were exerted over him in this state, the shrine that we build becomes in part, at least, a memorial to Indiana's pioneer environment. May we not say that Lincoln and his mother are the proof that the rugged pioneer fathers and mothers that founded this great state were worthy of our everlasting gratitude? If he exemplifies the principles they taught and the life they led, then the memorial to him becomes a memorial to them also.

RESUME OF THE YEAR'S WORK BY DIVISIONS

Division of Geology

Continued the effective and most economical policy of direct co-operation with Indiana University by which the laboratories and technical personnel of the University staff are available to the Department for field investigation and research.

Carried on extensive field investigations in oolitic limestone field with reference to location near railroads, quality, availability and quantity.

Investigated geological and structural conditions in Daviess County and Sullivan County oil fields including location of wells, collecting well logs and plotting.

Studied Borden formation and made investigation of subterranean drainage of Owen, Lawrence and Crawford counties.

Field studies of possible source of cement making products in Hendricks County; of oil possibilities in Tri-County Field of Gibson, Pike and Warrick counties; of coal stripping area in Pike; of ceramic material in Lawrence County; and many field studies for oil lands, flood control, molding sands, rocks and minerals, geologic horizons, highway building materials; asphaltic deposits, and many minor geological matters.

Prepared in co-operation with the U. S. Bureau of Mines, an extensive report on "Analyses of Indiana Coals."

Also prepared and had published reports on Tri-County Oil Fields, gas field in Howard and Tipton and sundry short articles.

Determined through microscopical, mineralogical and chemical methods in the laboratory, 835 minerals.

Conducted extensive archaeological excavations in mounds near Worthington, uncovering 21 burials with numerous materials such as pottery, ornaments, weapons and tools.

Cared for State Museum exhibits and added many valuable articles.

Maintained close touch with oil and gas well drillers—obtaining logs of wells, location and results.

Plugged 203 abandoned wells, thus preventing damage to adjacent wells.

Prepared and distributed a monthly oil and gas report showing all developments in the field.

Division of Entomology

Established European corn borer branch laboratory at Auburn, Indiana, upon finding of this new and extremely dangerous pest in the state.

Carried on educational campaign in quarantined area, holding one hundred and seven meetings with a total attendance of 11,662 people.

Secured thorough clean-up of infested area by farmers on 6,904 farms with 117,039 acres of growing corn and co-operated with U. S. Department of Agriculture by supervising distribution of $208,213.22 from federal funds to farmers.

Carrying on experimental work leading to cheaper and more efficient control of European corn borer.

Maintained eighteen quarantine stations on main highways to prevent movement of corn-on-the-cob to now-infested areas.

Made three hundred and eighty nursery inspections to insure healthy and true-to-name stock to the buyer.

Furnished nurserymen, florists and plant propagators assistance in control and eradication of insect pests and diseases.

Conducted experiments in control of various pests and succeeded in establishing effective methods.

Furnished householders information on control of household insects, such as clothes moths, cigarette beetle, bed bugs and fleas.

Continued in the front rank of all states as authority on greenhouse pests and diseases with great aid to the industry in Indiana.

Inspected 42,314 colonies of bees for foulbrood and other bee diseases, continuing an effective check on these troubles of the bee-keeping industry.

Sponsored one of the greatest honey exhibits ever known at the Indiana state fair.

Division of Forestry

Proved that most of Indiana's timber bearing land is poorly productive and we could save twelve million dollars each year by protecting our present forests from fire and grazing and selective cutting.

Managed the Clark County Forest of 4,487 acres of which 563 acres were added during the year.

Continued extensive research on this forest in 117 definite experimental plantings, i.e., the most extensive investigations in hardwood forestry in the country.

Planted 98,496 trees on the Clark County State Forest within this fiscal year.

Grew and sold 267,455 trees to farmers at cost for planting in woodlots.

Began development of new nursery which will provide one million trees per year to be sold for timber planting only.

Carried out numerous experiments to secure control method against damping-off disease in nursery.

Conducted improvement cuttings to produce crossties, rough lumber and firewood and at the same time improve the stand by leaving best species to mature.

Maintained fire control system and had no fires on the forest.

Held county agents conference and lumberman's conference at State Forest.

Have completed inspection and classification of 21,152 acres of privately owned land which under the forest land tax act is devoted exclusively to the growing of timber.

Division of Lands and Waters

Continued management and development of state parks to afford safe and pleasant enjoyment by hundreds of thousands of people and above all things preserve the nativity and pristine beauty of the park areas including Turkey Run State Park, McCormick's Creek State Park, Clifty Falls State Park, Indiana Dunes State Park, James F. D. Lanier Memorial, Muscatatuck State Park, Nancy Hanks Lincoln Memorial, and Tippecanoe Battlefield.

Demonstrated further the soundness and fairness of a policy of making state parks pay their own maintenance through gate fees, camping fees and rentals from concessionaires.

Furnished in the state park inns, wholesome and moderately priced service to thousands seeking relief from the rigors of city life.

Had 317,090 paid visitors to state parks. Many of these stayed from two to fourteen days so that 500,000 would be a conservative estimate of daily attendance.

Installed nature guide service in three parks to the great benefit and delight of the visitors.

Completed and placed in operation, Potawatomi Inn at Pokagon State Park.

Constructed a new road and new location in Pokagon State Park. In the same park, built boat pier, bath house with capacity of 350 and developed safe drinking water supply and camping facilities.

Completed negotiations for purchase of Indiana Dunes State Park giving Indiana 2,185 acres and 3¼ miles of frontage on Lake Michigan which has already doubled in value due to the extremely low price paid.

Through the liberality of the Patoka Coal Company received as a gift, 157 acres of scenic land adjoining Turkey Run State Park.

Conducted James F. D. Lanier Memorial so as to pay for its entire maintenance the first year it was established.

Erected fire tower and system of fire control for Indiana Dunes State Park and successfully prevented fire in any state park.

Prepared way for restoration of State Capitol at Corydon, and acquisition of Donaldson Woods State Park and a state park in Clay, Greene and Sullivan counties.

Division of Fish and Game

Through efficiency of service and effective law enforcement increased receipts from $212,990.17 in 1925-26 to $272,301.66 in 1926-27. In 1919, the first year of the Department of Conservation, the receipts were $95,159.31. The Division is self-supporting.

Issued 264,811 licenses and permits having to do with fish and game.

36—42279

In addition issued 29,660 free permits to honorably discharged war veterans.

Forwarded 22,559 pieces of mail.

Made 2,251 arrests with 2,110 convictions for violation of the fish and game laws—an increase of 474 arrests over the previous year.

Operated five fish hatcheries from which were planted 13,003,355 fish (including 993,273 black bass) in the waters of the state.

Managed and developed the Brown County game reserve of 10,622 acres and the Kankakee game reserve of 2,302 acres. The Brown County area was purchased entirely by funds from sale of licenses.

Has greatly increased wild life of the reserves which migrates to other sections, thus increasing good hunting.

Planted 12,000 trees on Brown County reservation.

Supplied thirty-two sportsmen's clubs with ring-neck pheasant eggs and thirty clubs with wild rice for marsh planting.

Assisted in the organization and activities of 300 sportsmen's clubs.

Maintained a field worker on birds and conservation through co-operation with National Association of Audubon Societies.

Have registered 26,785 young folks in the Junior Audubon Society in the state, which gives Indiana a standing of third in the United States.

Field worker gave 257 lectures to 53,928 people. Since January 10, 1925, there have been given 760 lectures to 148,566 people.

Continued co-operation with industries in refinement of methods to increase production and prevent stream pollution.

Division of Engineering

Operated twenty stream gaging stations taking daily records of stream flow in major streams.

Continued drainage investigations and has available for distribution 83 county drainage maps.

Continued research into effects of drainage of Kankakee valley.

Rendered service to other divisions of the Department in—

Field survey for road relocation at Clifty Falls.

Topographic survey and map of swimming pool site at McCormick's Creek Canyon State Park.

Minor surveys for Indiana Dunes State Park.

Location survey for road at Pokagon State Park.

Designed water supply system for nursery at Clark County State Forest.

Supervised construction of fire tower at Brown County game reserve.

Detailed map of Nancy Hanks Lincoln Burial Ground prepared for use of landscape architect.

With Sanitary Engineer of Division of Fish and Game designed water supply and sewage disposal for Pokagon State Park, incinerator for garbage disposal at Indiana Dunes State Park.

Made sundry lake level and drainage investigations.

REPORT OF THE DIVISION OF GEOLOGY

W. N. LOGAN, State Geologist.
THEODORE KINGSBURY, Supervisor of Natural Gas.
VERNE PATTY, Curator of Museum.
MADALYN ARDREY, Clerk and Stenographer.

A large number of individuals contribute to the work of the Division of Geology but only three members of the staff draw salaries regularly from the Division funds. These three are members of the office force. During some field seasons one or two members of the field force receive some compensation for one or two months. The gas inspectors are required by law to collect fees from the owners of wells which are inspected by them. A part of the funds so collected is used to defray office expenses and the remaining funds are returned to the inspectors.

Members of the staff acting in an official, advisory, or technical capacity include: W. N. Logan, Economic Geology; E. R. Cumings, Stratigraphy and Paleontology; C. A. Malott, Physiographic Geology; S. S. Visher, Geography; J. E. Switzer, Geography; Arch Addington, Subterrean Drainage; R. E. Esarey, Economic Geology; Howard Legge, Preparator.

Members of the staff engaged in field work during 1927 include: W. N. Logan, E. R. Cumings, Arch Addington, R. E. Esarey, R. R. Shrock, P. B. Stockdale, R. E. Stouder, J. S. Kaserman, Paul Simpson, Lewis Childs, George Whitlach, S. T. Clashman and Horace Rankin.

The members of the gas inspection force are: Theodore Kingsbury, Supervisor; Wm. Kelly, Geneva; John Ersinger, Sullivan; J. P. Horton, Montpelier; Hershell Ringo, Muncie; C. E. Noble, Princeton; O. H. Hughes, Sharpsville; Howard Legge, Bloomington; and Marion Brown, Loogootee.

FIELD INVESTIGATIONS

The investigation in the field of some of the phases of the geology of Indiana is conducted by members of the field staff during the summer season. The field party in the immediate charge of the Head of the Division included: R. E. Esarey, Lewis Childs, Horace Rankin, S. T. Clashman, George Whitlatch, J. S. Kaserman, and R. E. Stouder. Members of this party were engaged in the study of the Indiana oolitic building stone area and in an investigation of the Daviess County oil fields.

The study of the building stone belt included a study of the outcrop belt of the Salem formation from which the building stone is derived; the location of outcrops, railroad connections of quarries and mills; thickness, texture, condition of erosion and decomposition; conditions of overburden with reference to thickness and methods of removal; the relation of the building stone to underlying and overlying strata; and vertical and horizontal changes in the composition and texture of the stone.

A large number of samples of the stone were collected for laboratory investigations. Samples were taken from several cores and one

complete core was obtained. The samples collected will be used in the study of porosity, absorbtion, texture, composition and other physical and chemical properties of the stone. A large number of maps of portions of the stone belt have been prepared and others are in progress. Plane table work was employed in the location of quarries, mills and railroad connections.

PETROLEUM INVESTIGATIONS

An investigation of the geological and structural conditions in the Daviess County oil fields was carried on under the direction of the Head of the Division during the year by Mr. R. E. Stouder, assisted by H. Rankin and J. S. Kaserman for a portion of the field season. The work undertaken in this field included the location of the wells, the determination of the elevation of the wells with reference to sea level, the collecting of well logs and the plotting of these to scale. From the data collected cross-sectional and structural maps were made of the Loogootee, Cannelburg, and Jacobs pools.

The report prepared includes a short history of the development of the field; the physiographic and topographic condition; the geologic conditions; and the producing horizons. Samples of the petroleum from various wells were collected and distilled. The specific gravity and the fractions were determined for each sample. A study was also made of the use of compressed air to increase the amount of recovery. A report consisting of a summary of the work done in Daviess County was furnished newspapers in Daviess and neighboring counties.

Because of the interest produced by the discovery well on the Thomas farm in the northern part of Fairbanks township in Sullivan County, a number of trips were made to this county to secure elevations, collect well drillings and study surface outcrops. By the study of such data as could be obtained from all the available sources it seemed evident that structural conditions similiar to those in the Riley pool existed on the Corniferous limestone in the Thomas pool. The shape and size of the structure can be determined only after the securing of more well records.

By the study of well drillings furnished by the Ohio Oil Company the presence of a strong structure on the Silurian strata in the Shelburn pool was determined. This structure is responsible for some very strong gas wells. There have not been drilled enough wells to enable one to outline the structure. It appears to have a dip of at least 100 feet to the mile to the northwest and an east dip has been determined.

Field investigations in the upper Silurian formations of northern Indiana were carried on by Dr. E. R. Cumings who was assisted by Mr. R. R. Shrock. A large number of outcrops were visited and many fossil forms collected for study and determination. A very important graptolite fauna was discovered. A further study was made of the reef structures and samples of rock from them were collected for study in the laboratory. Maps, cross-sections and illustrations are being prepared to accompany the report.

A field study of the Borden formation was continued during a part of the season by Mr. P. B. Stockdale, who was assisted by Mr. Paul

Simpson. The field work included a study of the Borden formation from in the region of Henryville in Clark County to State Road No. 46 in Brown County. Detailed sections of the formation were made at several points, and samples of rock and fossils were collected for study.

Mr. Arch Addington continued investigations of the subterranean drainage of Owen County and made studies of a similar nature in Lawrence and in Crawford counties. He was assisted for a portion of the time by Mr. S. T. Clashman.

SPECIAL GEOLOGICAL INVESTIGATIONS

Many requests are received from citizens of the state for the solution of special problems in geology which require the use of both field and laboratory methods. A large number of the investigations were of minor importance but among them the following of greater importance received the attention of the Division: The investigation was undertaken of an area of land in southwestern Hendricks County which was supposed to contain cement materials and other rock materials of economic importance. A survey of the region was made and a map and report furnished. A study in the field was made of the Tri-County oil field located in Gibson, Pike, and Warrick counties. A structural map was made and furnished for the guidance of future drilling operations. A survey was made of two areas of building stone lands in Lawrence County and maps and reports supplied. An area of stripping coal land in Pike County was investigated in the field for the purpose of determining the amount and thickness of the overburden. An estimate was made of the quantity of ceramic materials on an area of land in Lawrence County. At the request of a railroad company, the Division made a study of the causes of a flood which had produced damages to the road bed and furnished report. At the request of the owners of the lands, the Division made an investigation of an occurrence of oil in the following counties: Martin, Washington, Lawrence, and Owen; investigated a supposed Indian mound in Orange County; examined a so-called zinc deposit in Greene County; and a supposed fire clay in Shelby County.

Among other problems submitted to the Division for solution were the following, of which only brief mention can be made because of lack of space: Assortment and classification of materials from molding sands from near Montezuma; determination and classification of a collection of rocks and minerals from the Boy Scouts of Indianapolis; determination and classification of a private collection of rocks and minerals, Indianapolis; determination and correlation of geological horizons by study of drillings from deep wells in Ohio and Indiana; similar studies from the Thomas well in Sullivan County and for the South Charleston well, Ohio; location of position of fault line in Harrison County and report as to probable effect on gas production; information regarding petroleum prospects in Knox County; information regarding geology and ground waters in southern part of Marion County; location of limestone for highway construction in Polk Township, Monroe County; location of outcrops of coal in Montgomery Township, Gibson County; location of limestone in Secs. 30 and 31, R3E, T3S, Washington County; information on

pottery clay resources for spark plug company, Detroit; information regarding oil and gas conditions around Greensburg, Elkhart, Delphi, Gentryville, Covington, Rockville and Middleton; information regarding red-burning shales and clays for brick, Brook; analysis and origin of asphaltic material in Borden formation, Borden; information regarding uses and markets for Indiana coal, Chicago; location of limestone beds near Troy; information regarding occurrence and distribution of cement materials in Indiana, Cleveland; distribution of halloysite in Indiana, Louisville; analysis of molding sand, Mishawaka; field examination of oil in limestone, Lawrence County; determination of properties of ground limestone for rock dusting in mine, Bedford and Chicago; information regarding suitability of local clay for manufacture of brick, Nashville; location of material for manufacture of mineral wool, Milwaukee; geological conditions in an area in St. Joseph County; information regarding suitability of clay for ceramic uses, Indianapolis.

PUBLICATIONS

The most comprehensive publication issued during the year is a report on the "Analysis of Indiana Coals" prepared in co-operation with the United States Bureau of Mines. The report has been published by that Bureau. It contains a discussion of the physical and chemical characteristics of Indiana coals, the mode of occurrence, the number of beds, the thickness of the beds, the associated rocks, conditions of mining and transportation and other facts.

A report entitled "The Petroleum Industry in Indiana in 1926" was prepared and published in the transactions of the American Engineering and Mining Institute for March, 1927. This report recorded the development which had taken place within the year, contained statistics on production and recorded the stratigraphical investigations made by the Division during the year in the petroliferous areas of the state.

A report on the Tri-County Oil Pool was prepared and published in transactions of the American Petroleum Institute. This report involved a study of the stratigraphy of the area, the interpretation of the well logs, the study of drillings, the determination of the elevations of the wells, and the making of cross-section and structural maps. The report was prepared by Mr. R. E. Esarey of the Division.

A study of structural conditions in the old gas field lying partly in Howard and partly in Tipton County was made by the Head of the Division and a report published in the proceedings of the Indiana Academy of Science for 1926.

The annual report of the Division was prepared and published in the Year Book for 1926. Other reports prepared were on the activities of the Division in the study of sedimentation for that committee of the National Research Council; the archaelogical work of the Division for the *American Anthropologist;* a survey of mineral development in Indiana during 1926 for the *Indianapolis Star;* a report on oil conditions in Sullivan County for the use of the newspapers of that county, and similar reports for the newspapers of Daviess and Knox counties.

MINERAL AND ROCK DETERMINATIONS

A large number of rocks and minerals were received and determined during the year. These came from land owners, well drillers, and from individuals and companies who were interested in the development of some of the natural mineral resources of Indiana. Many samples of well drillings came with requests for the determination of the geological horizons which had been encountered by the drill. To obtain the information desired required the use of microscopical, mineralogical and chemical methods. Information was supplied concerning the following rocks and minerals:

Well drillings	354	Hornblende	3
Oil samples	43	Pegmatite	2
Clay samples	42	Amber	2
Pyrite	31	Marcasite	2
Quartz	30	Gold	2
Limestone	30	Silt	2
Well cores	29	Millerite	2
Fossils	26	Salt	1
Oil sands	22	Silver instrument	1
Water	16	Conglomerate	1
Mica	16	Sandstone, fossiliferous	1
Sphalerite	16	Smithsonite	1
Granite	16	Obsidian	1
Pyrolusite	15	Lava	1
Resin	15	Lepidolite	1
Shale	15	Slate	1
Sandstone	13	Schist, talcose	1
Quartzite	9	Chlorite	1
Chert	8	Amphibolite	1
Coal	8	Cryolite	1
Calcite	6	Witherite	1
Molding sand	6	Emery	1
Selenite	5	Porphyry	1
Galena	5	Malachite	1
Limonite	4	Chryscolla	1
Schist	5	Lepidodendron	1
Iron ores	3	Coral	1
Quartz aggregate	1	Mercury	1
Jasper	1	Gypsum	1
Mari	1	Ocher	1
Hornblende andesite	1		
Flints	3	Total	835

ARCHAEOLOGICAL INVESTIGATIONS

During the field seasons of 1926 and 1927, the members of the field party of the Division of Geology investigated mounds in several localities. Investigation of mounds near Worthington in Greene County was undertaken at the request of Mr. Fred B. Dyer. In 1926 five small mounds were excavated and three others were sectioned to determine whether there were evidences of occupation. In the summer of 1927, at the request of Mr. Dyer, field investigations were continued by the opening of the Hamlin mound. This mound is located on the valley wall to the west of the common flood plain of Eel and White rivers at their juncture. It forms the most prominent feature on a billowy surface. The mound is located in a cultivated field and its surface and the

surface of the valley wall which descends to the flood plain have yielded many fragments of pottery, arrow points, and other artifacts.

Two burial horizons were found in the mound, the upper one from one to two feet below the present surface, and the lower one from three to four feet below the surface. There was a very notable difference in the decomposition of the materials in these two zones, the materials in the lower zone being much more highly decomposed. There were thirteen burials found in the mound. The materials found consisted of human skeletal materials, pottery, arrow points, ornaments, celts, axes, spear points, charcoal, ocher, awls, flint chips.

The Baker-Lowe mound, which is located about four miles southwest of Worthington, was next investigated. One quadrant of this mound was completely excavated and test pits were dug in the other quadrants. Eight burials were located. The materials found consisted of human skeletal materials, carapace of terrapin, bones of rodents, pottery fragments, bone beads, shell beads, lime concretions, gastropod shells of mollusks, pearl knife blade, stone ax, deer horn awl, flint chips, flint arrow points, hammer stone, spear points, charcoal, ripple marked sandstone and other objects.

LABORATORY WORK

Laboratory methods are required in the study of samples which are collected during the summer field season and for the determination and investigation of samples which are sent to the laboratory. Microscopic sections of rocks and minerals are made for the study of the minute structure. Clays and shales are molded, fired in kilns, and glazed. Molding sands are separated into their constituent particles by mechanical means. Samples of building stones are tested for specific gravity, weight, porosity, absorption and other properties. Oils are fractionated and their properties determined. The samples of drillings from wells are subjected to chemical, mineralogical and microscopic tests.

STATE FAIR EXHIBIT

The Division's exhibit at the state fair was held in co-operation with the Department of Geology of Indiana university and stone companies in the Blomington-Bedford district. It consisted of exhibits of Indiana oolitic limestone, specimens of carved stone, fossils found in the district, models of stone cutting machinery showing the use of diamonds in the industry, and other interesting information. The feature of the exhibit was the carving of stone by an expert from one of the mills.

OFFICE WORK

There was an unusual increase in the number of letters mailed during the year as compared to the preceding year. In the year covered by this report the Division mailed 4,594 letters, compared to 2,527 for the preceding year, an increase of 2,067. A large percentage of these letters were replies to requests for information on the states' natural resources. While the major part of the requests came from residents of Indiana, a great many came from other states and some

from foreign countries. Careful attention was given to make each reply as complete and accurate as possible. This has been an important and direct agency in advertising Indiana's coal, stone, clay, oil, gas and other natural resources. It is very probable that in some instances the information given by this means will lead to further development of these resources, and, which is of equal importance, prevent the expenditure of money on development that would be unprofitable.

Letters received	2,200
Packages received	1,166
Letters mailed	4,594
Packages mailed	248
Reports distributed	444
Annual geological	187
Deep Wells of Indiana	90
Kaolin	21
Southwestern Indiana	36
Petroleum and Natural Gas	43
Handbooks	50
Handbook parts	20
Oral reports	982

STATE MUSEUM

The museum has been closed to the public because of lack of available space. Nevertheless the curator has guarded this priceless collection and cared for many specimens by fumigation and otherwise to prevent deterioration until such a time when the museum can be reopened. A detailed inventory has been completed which showed the museum contains approximately 90,000 specimens, including geological, natural history, historical, and miscellaneous, many of which it would be impossible to duplicate or replace. Efforts have been continued to add suitable collections and specimens to the state's collection.

Following is the list of donations and loans received:

25c Canadian paper money. Donated by Mrs. LaVerne Bowlby, Ft. Wayne, Indiana.

Daguerrotype of T. J. Orr, Greenfield, Co. A. 57 Regt. by Mrs. Gertrude Beeson, Indianapolis.

Sloth, by Management Broad Ripple Park, Indianapolis.

Collection gathered by Prof. Irvin Stanley, Westfield, Indiana, including 2 sooty Albatross, 2 Herring Gulls, 2 gulls, South Indian Ocean Golden Eagle, Loon, Crow, 2 Bluejays, Cowbird, Owl, Wild Goose, Meadowlark, Yellowhammer, Robin, Peacock, Coot, Green Heron, Mergenser, Sooty Tern, Shearwater—one unnamed, Deer, Autter, Buffalo horn, Ox horn, 4 goat horns, six Indian axes, 3 pestles, 5 celts, two-bitted axe, paint stone, hammer stone, 27 arrow heads, 1 hoe, 3 lance heads and 37 spear heads.

Mississippi blue catfish by J. B. Welborn.

The autographs of Queen Marie, Princess Ileana and Prince Nicholai of Roumania and an autographed photograph of Mussolini.

Specimen Indiana iron ore, limonite, by Theodore Kingsbury.

Piece of battle flag of 31st Indiana Regt. Civil War, by Mrs. Emma G. Wheeler.

Portion of scabbard found by Henry S. Doherty, presented by John L. Moorman, Knox, Indiana.

Memorial Badge presented to Mrs. Mary Elizabeth Whitinger March 31, 1892, in commemoration of her protection of the American flag, at school house No. 4, Clay township, Hamilton County in 1892, presented by Albert Whitinger.

Badge worn at the Lafayette commemorative exercises held in Philadelphia, July 21, 1834.

Spencer rifle carried during Civil War by John Walter Plunkett, presented by his son, Gail E. Plunkett, Ocean Park, California.

Autographs of Theodore Roosevelt, Jr., Mrs. Theodore Roosevelt, Valeria Bergere, Fritz Renier and James Buchanan.

Twelve specimens of Triassic ammonites from American Canyon, Nevada, donated by Percy Train.

Autographs of Kenesaw M. Landis, Frieda Inescort, Peggy Wood, Eric Dressler, Rollo Peters, Effie Shannon, John Drew, Henrietta Crossman, O. P. Heggie, John E. Kellerd, Otto Krenger, Mrs. Thomas Whiffen.

Bones and pottery bits from Bradentown Mound, Fla., by L. A. Kiefer, Lakeland, Fla.

Autographs of Jane Addams, Helen Cahagan, J. M. Kerrigan, Geo. M. Eastman, Harry S. Firestone.

Diamond Willow cane carved by a Sioux Indian at Ft. Sully, N. D., by Mrs. Abbie B. Hubbard, Indianapolis.

Autographs of Lowell Thomas and Alan Le May.

Autograph of Princess Beatrice, of England.

Collection of seven birds, mounted, presented by Miss Helen Preston, Indianapolis.

Piece of chert, unfinished knife, (Indian), piece of chipped flint, by Lewis Kiefer, Lakeland, Florida.

Indian pestle found at Centerton, Indiana, presented by Robert Lee Warriner and Earl Warriner, Jr., Centerton.

Autograph of John Philip Sousa.

Autograph of A. B. Crampton, printer in Grant's army.

Pair of brass candlesticks from Philippines province of Alba, Isle of Luzon, presented by Maj. David I. McCormick.

Collection of Middle Trias Ammonites from American Canyon, Nevada, by Percy Train, geologist, Rochester, Nevada.

Osprey, mounted. Donated through Amos W. Butler by Bartholomew County Hospital, Columbus, Indiana.

Collection of currency: One $5.00 Bank of Indiana note (Lafayette branch) 1857; one $3.00 State of Mississippi note, 1870; Mexican currency as follows: one $10; one $5.00; one $1.00; one 50c; one 20c; two 5c. Loaned by J. H. Burlow, Philadelphia.

$1.00 Confederate bill, by Mrs. Nan Grinstead, North Vernon, Indiana.

Badge of Cleveland-Hendricks. Full democratic ticket printed on it, presented by Capt. W. D. Wilson, Indianapolis.

Autograph check of ex-president Warren T. Harding, by his father.

Bullet picked up at Harper's Ferry in 1865 by C. P. Houser while on guard at Harper's Ferry bridge, near John Brown's fort. Presented by Mrs. Amanda E. House, Indianapolis.

Bear trap, made by a blacksmith of Arthur Rothrock family, Milltown, Indiana, over 100 years ago. Secured by Fred Ehlers, Indianapolis.

On August 23, Oolitic Limestone (specimen No. 82) from museum collection was donated to be placed in a church, containing stone from each state. By request of Governor Ed Jackson.

NATURAL GAS SUPERVISION

From the beginning of the present calendar year as accurate record as possible has been kept of the drilling operations in the state. This shows that from January 1, 1927, to the end of September, a period of nine months, 180 wells were drilled for oil and gas, and upon the latter date there were 44 wells uncompleted. Of the number completed, 76 produced oil, 32 gas, and 72 were nonproductive. During this period 10 oil wells were completed in Adams County; 13 in Daviess County; 7 in Jay County; 3 in Knox County; 13 in Pike County; 18 in Gibson County; 4 in Sullivan County and 6 in Vigo County. Productive gas wells were drilled in 14 counties. The cost of completed wells in Indiana for the first half of 1927 averaged $4,500, this average being taken from 67 wells which cost $301,000. The total production of oil in the state for the first half of the year was 409,000 barrels.

Practically all important gas producing areas in the state were visited during the year and inspections of wells and equipment made with a view of discovering gas leaks and making recommendations for the conservation of gas. In some cases subsequent inspections were made and it was gratifying to see that steps had been taken to take better care of wells and lines. This was especially noticeable in Harrison County, where there are about 40 producing gas wells.

In order to protect gas producing areas in which there are old wells which have been abandoned but in which the pipe still remains, the following regulation was approved by the Governor and members of the Conservation Commission, and became effective September 15, 1927:

"Pursuant to Section 6 of an act creating a Department of Conservation, approved March 11, 1919, the Conservation Commission of the State of Indiana hereby makes the following regulation: That all abandoned wells drilled for oil or gas in the State of Indiana shall be plugged; that in case of dispute as to whether or not a well has been abandoned the decision shall be made by the state geologist or his authorized representative; that the plugging shall be done by the holder of the lease on which the well is located, or in case the lease has expired or the land has not been leased then by the land owner."

As a result of this regulation deputy gas inspectors have reported they have been able to have several old gas wells plugged, which under the present plugging law they had no jurisdiction over because the wells still had all the pipe in them. During the year covered by this report the State Gas Supervisor and deputies plugged 203 abandoned oil and gas wells.

The monthly report on oil and gas development activities continues to receive favorable comment and has been sent regularly to about 230 individuals and companies. This is the only available service which enables those interested in oil and gas operations in the state to keep posted on activities and developments. One utility corporation which controls several gas plants in areas where natural gas is used makes copies of this report and sends them regularly to employes in its various offices.

MINERAL PRODUCTION IN INDIANA

In order to give an idea of the vast mineral wealth of the state the following table is taken from the 1926 report of the Bureau of Mines, United States Department of Commerce. It gives the mineral resources of Indiana for the last year for which the figures are available:

PRODUCT		1925	
		Quantity	Value
Cement	barrels	(1)	(1)
Clay products			$18,037,932
Clay, raw	short tons	188,491	204,962(3)
Coal	short tons	21,224,966	42,884,000
Coke	short tons	5,141,940	36,635,104(3)
Iron, pig	long tons	3,350,747	64,807,575(3)
Lime	short tons	127,878	1,067,040
Mineral paints, zinc and lead pigments	short tons	(1, 3)	(1, 3)
Mineral waters	gallons sold	(4)	(4)
Natural gas	M cubic feet	1,168,000	504,000
Peat	short tons	4,000	28,000
Petroleum	barrels	829,000	1,615,000
Potash (K_2O)	short tons		
Rubbing stones, scythestones and whetstones	short tons	275	38,872
Sand and gravel	short tons	12,054,740	5,275,743
Sand-lime brick	thousands	(1, 2)	(1, 2)
Stone	short tons	4,455,310(5)	18,140,974(5)
Sulphuric acid	short tons	(1, 3)	(1, 3)
Miscellaneous			26,199,207
Total value eliminating duplications			$111,833,732

(1) Value included under "Miscellaneous".
(2) Figures obtained through cooperation with Bureau of Census.
(3) Value not included in total value for state.
(4) No canvass.
(5) Exclusive of sandstone, value for which is included under "Miscellaneous".

A PRELIMINARY REPORT OF INVESTIGATIONS CONCERNING SUBTERRANEAN DRAINAGE PHENOMENA DURING THE SUMMER OF 1927

By Arch R. Addington, Geologist, Subterranean Drainage, Division of Geology, Indiana Conservation Department.

Funds for conducting the investigations during the summer were obtained from the Department of Conservation, State of Indiana, and from the geological research fund of Indiana university. I take this means of expressing appreciation of the financial assistance that made the investigations possible.

Three areas involving conditions of subterranean drainage were investigated. These areas were: Patton Cave and vicinity, the Litten Natural Bridges and vicinity, and an area of six and one-half square miles in the vicinity of Donaldson Cave and Hamer Cave. Sufficient topographic mapping was completed in each of these regions to illustrate the general surface condition.

The following is a brief description of the areas investigated. During these investigations I was ably assisted by Mr. S. T. Clashman.

PATTON CAVE AND VICINITY

Location.

Patton Cave is in southeastern Monroe county, Indiana. The cave is situated near the top of a conspicuous bluff. The cavern entrance is practically obscured by the dense tree and brush growth that characteristically mantle the bluffs and hillsides of this area. The exact

location of the cave is the central western part of the northwest ¼ of section 14, township 7 north, range 1 east.

General Description of Patton Cave and Vicinity.

Patton Cave is relatively small, having a total length available for exploration of 304 feet. The entrance is near the top of a bluff and may be reached from the valley below by a small by-path that in places near the entrance is treacherous to the foot. The entrance may also be reached by descending the bluff to the by-path just mentioned. Just above the entrance there is a cliff of approximately 20 feet. Below the entrance there is a sharp "V" shaped ravine, in places too steep to climb and in other places littered with a jumble of rock fragments. A scanty growth of hardwood trees, chiefly oak, is present on top of the bluff; the slope, however, is densely covered with brush and second-growth timber, so that in the summer season the entrance is practically hidden from the view of an observer in the valley below.

The entrance is approximately oval in cross-section outline. The width is 10 feet and the height is 7 feet. From the entrance the cavern extends in a nearly due east direction for 67 feet, then bends to the south and slightly east for 88 feet, then southeast 32 feet, then north and slightly east for 22 feet, at which place one finds a small room partly filled with clay in the surface of which may be seen the so-called "Bear Wallows," depressions in the clay surface. The small room is 15 feet in diameter and approaches a square in ground plan profile. The remainder of the cave leads in a general easterly direction from this room. The channel becomes narrower and narrower until it is necessary for the explorer to edge himself along sideways. Exploration is finally terminated by a cross-joint in the bottom of which there is a pool of water and on the sides considerable mineral deposit.

The floor of the cave for a distance of approximately 150 feet above the entrance is practically free of debris. The remainder of the cavern floor is more or less covered by clay, rock fragments, and sand or gravel. A stream of water flows through practically the entire length of the cave. In dry weather its volume is small but at other times, as evidenced by the disposition of the gravel and sand deposits, a considerable torrent rushes along the passage.

There is only one level in the cave and in this no deep pits are present.

The cavern is developed near the basal portion of The Harrodsburg Limestone. In the immediate vicinity of the cave this stone is approximately 50 feet thick. Its lower portion is somewhat of a shaly composition and in this there are numerous geodes. These are present in considerable numbers in the cavern walls and form interesting details of the cavern interior. As determined by aneroid measurement, the lower part of the Harrodsburg Limestone has an elevation of 600 feet at the cavern entrance.

Below the Harrodsburg Limestone is the Riverside Member of the Borden Series, which in this region has a surface exposure of 70 feet. At the cavern entrance the chief characteristic of the Riverside is that

of a sandy shale, although in places the true shaly phase is exposed. This formation is impervious to water but disintegrates readily under the weathering processes. It is, as a general thing, less resistant than the Harrodsburg Limestone and where streams have cut through both formations cliffs or bluffs are quite frequently conspicuous details of the landscape. This is the condition near Patton Cave.

Principal Physiographic Interest.

The cave is of physiographic interest because of its development near a fault line. A little over 100 yards east of the entrance, the limestone is absent, there being an abrupt transition to the Riverside sandy shale. Field investigations indicate that here is a normal gravity fault with the downthrown side to the west. The limestone slopes rather steeply to the west on this downthrown side, due perhaps to drag along the fault plane.

It is not impossible that in part the general northward trend of Saddle Creek Valley, the immediate principal drainage line near the cave, is dependent upon the fault structure, following in general the line of the fault. The bottom of this valley is entrenched considerably below the base of the Harrodsburg Limestone, thereby favoring circulation of water through the overlying limestone mass.

The cavern has been developed subsequent to the formation of the fault but it seems reasonable to believe that the fault is, in part at least, responsible for the topographic condition that has favored the development of the cave.

The cavern is too small and has too unfavorable a location to become of interest to the public at large. In dry weather it can only be reached with difficulty over a road that for considerable distance follows the bed of Saddle Creek. While working in the region it was reported to me that a certain individual was unable to use his machine for six months, due to the impassable condition of the road.

The country, however, is picturesque. It is well wooded and there are still considerable areas of virgin timber. The surface is much dissected by streams, so that the easiest modes of travel are via the valley bottoms or ridge crests. The region, similar to an adjacent one in Brown county, would make an excellent game preserve.

THE LITTEN NATURAL BRIDGES

Location and Description.

These natural features are in Washington township, central eastern Owen county. Their exact location is the northwest ¼ of section 14, township 10 north, range 3 west. The bridges are near the upper end of a small gorge and are two in number, forming natural rock spans across the gorge. They are a considerable distance from a main traveled road, although a dirt road leads within a few rods of their location.

The first of the bridges is the larger. The span rock has a thickness of four feet, a length of 15 feet, a width of 10 feet and the height of the span above the gorge below is 12 feet.

The second bridge is close to the first and is located just around a bend in the gorge. It is somewhat smaller than the first but none the less picturesque. The rock span is four feet thick, 10 feet long, 6 feet above the bottom of the gorge.

The bridges occur in the upper portion of the Salem Limestone. In this locality the upper part of the stone is somewhat thin-bedded, slightly cross-bedded with occasional prominent layers. It is one of these prominent layers that forms the span rock of the natural bridges. The lower portion of the Salem Limestone is more massive and forms the well-known building stone of the quarrymen.

Origin of the Natural Bridges.

The Litten Natural Bridges are clearly the result of the collapse of adjacent portions of a cavern roof. At the upper end of the small gorge that the bridges span there is an entrance to a cavern. The entrance is low and uninviting, and just within there is a shallow pool of water. To find the bridges, gorge, and cavern in such close proximity suggests a method of origin too plain to be denied.

In the course of time it is possible for a subterranean stream, in an area of soluble rock, to enlarge its channel by solvent action and by erosive processes until portions of the roof fall into the channel of the stream below. When the subterranean channel is not far beneath the surface, the collapse of material into the channel may form a depression on the surface. If two of these depressions develop in close proximity, the rock between them forms a span across the subterranean route beneath. The collapse material is slowly removed by the waters circulating about it, thus increasing the conspicuousness of the bridges. As surface features they are only temporary and in the course of time weathering processes and work of running water will destroy them.

The rather brief explanation just given applies to the formation of the Litten Natural Bridges. The method of formation is not an unusual one and has oftentimes been described.

POSITIONAL RELATION OF THE NATURAL BRIDGES TO THE M'CORMICK'S CREEK STATE PARK

The natural bridges are approximately one-half mile from the northeast corner of the state park property. Between the bridges and the park boundary there is a considerable area of forest cover but practically no large or virgin timber. Two rather interesting ravines heading near the park boundary extend in the general direction of the bridges. The surface is also diversified to some extent by numerous deep, funnel-shaped sinkholes.

The bridges would form an interesting addition to the state park and a trail to them could easily be constructed. The land upon which they are located, however, is underlain with valuable building stone and at the present time is leased by one of the stone companies. As a result it is quite likely the expense of securing additional territory would be prohibitive.

REGION COMPRISING FOUR SQUARE MILES NEAR DONALDSON CAVE AND HAMMER CAVE, LAWRENCE COUNTY, INDIANA*

General Introductory Statement.

The surface condition in this region was studied in considerable detail to see what surface indications, if any, would furnish information regarding the subterranean drainage development of the region. At the present writing further investigations, both of a surface and subsurface character, are deemed necessary before an adequate explanation of the subterranean drainage development and associated drainage changes can be given.

Location and Description.

Physiographically the region is a part of the Mitchell Plain of Indiana. In this locality the surface of the plain is dotted with sinks of various dimensions. There are several sink hole ponds and some of these are stocked with fish.

The principal surface stream present in the area is Mill Creek. This stream is supplied principally by springs, two of which are of large size, namely, those at Donaldson Cave and Hamer's Cave. At the latter place the spring water is conveyed to the cement mills at Mitchell, Indiana, where it is used during the process of cement manufacture.

A considerable portion of sections 4 and 5 is wooded. Excepting the property of Indiana University, there is not a great amount of virgin timber remaining. Most of this has been cleared away and the land is either devoted to agricultural purposes or is covered with dense thicket growth. Very little wash land is present.

University Farm, Property of Indiana University.

This tract, comprising about 200 acres, is primarily of interest for the following reasons:

(1) It has long been the property of Indiana University and has been the site of scientific experiments conducted under the auspices of the university. Litigation, whereby the area was officially transferred to the care of the state university, reveals an interesting historical past, a history that at the present writing it is impossible to include as a part of this brief report.

(2) Under the care and protection of Indiana University most of the virgin timber of mixed hardwoods, of which the predominating tree is white oak, has been preserved. This forest tract stands as an island

* The topographic map of this region appears only in the separate report of the Department of Conservation. The map shows all main surface features located as nearly accurate as could be determined with the means at the disposal of the author. Elevations were determined by aneroid barometer, distances by counting strides from point to point, and directions by compass and ordinary peep sight alidale. It would be erroneous, therefore, to assume that the map represents every sink in the region or that the outlines of the sinks are correctly represented in every detail. It was practically impossible to collect accurate data in those portions of the area that were covered by dense thicket growth. The map is a step in unravelling the physiographic history of this interesting region and may be of value relative to the area adjacent to the caves, if this region should be further developed by the state.