

100TH ANNUAL REPORT OF THE STATE GEOLOGIST

of

INDIANA GEOLOGICAL SURVEY
DEPARTMENT OF NATURAL RESOURCES

for

July 1, 1975 - June 30, 1976

GEOLOGICAL SURVEY
ONE HUNDREDTH ANNUAL REPORT OF THE STATE GEOLOGIST

PERSONNEL

Permanent Personnel

Administration

John B. Patton	State Geologist
Maurice E. Biggs	Assistant State Geologist
Mary Beth Fox	Mineral Statistician

Coal Section

Donald D. Carr	Geologist and Head
Harold C. Hutchison	Geologist and Associate Head
Richard L. Powell	Acting Head and Geologist (Resigned July 18, 1975)
Pei-Yuan Chen	Geologist (From December 15, 1975)
Donald L. Eggert	Geologist
Walter A. Hasenmueller	Geologist
William Smith	Visiting Scientist (From March 28, 1976)
David Clark	Geological Assistant (From May 24, to May 27, 1976)
John F. Hickman	Geological Assistant (From June 21, 1976)
Marvin T. Iverson	Geological Assistant (To May 17, 1976)
Bonnie Burks	Secretary (Maternity Leave January 5, 1976 to May 3, 1976)

Drafting and Photography Section

William H. Moran	Chief Draftsman and Head
Richard T. Hill	Geological Draftsman
Robert E. Judah	Geological Artist-Draftsman
Roger L. Purcell	Senior Geological Draftsman
George R. Ringer	Photographer

Educational Services

Reevan Dee Rarick	Geologist
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Geochemistry Section

Richard K. Leininger Geochemist and Head
Margaret V. Golde Instrumental Analyst
Louis V. Miller Coal Chemist
Pamela Carter Secretary
(Shared with Industrial Minerals Section)

Geology Section

Robert Shaver Paleontologist and Head
Ned K. Bleuer Glacial Geologist
Henry H. Gray Head Stratigrapher
Edwin J. Hartke Environmental Geologist
John R. Hill Glacial Geologist
Carl B. Rexroad Paleontologist
Martha N. Smith Secretary

Geophysics Section

Maurice E. Biggs Geophysicist and Head
Robert F. Blakely Geophysicist
Clarence Haskins Driller
(To May 14, 1976)
John R. Helms Driller
(From May 15, 1976)
Marvin T. Iverson Geophysical Assistant
(From May 17, 1976)
Joseph F. Whaley Geophysicist
Rebecca Covey Secretary
(From January 20, 1976)
Cynthia Prall Secretary
(To January 7, 1976)

Industrial Minerals Section

Donald D. Carr Geologist and Head
Curtis H. Ault Geologist and Associate Head
Michael C. Moore Geologist
Nelson R. Shaffer Geologist
Pamela Carter Secretary

Petroleum Section

Leroy E. Becker	Geologist and Head
Gerald L. Carpenter	Geologist and Associate Head
Andrew J. Hreha	Geologist
Stanley J. Keller	Geologist
Dan M. Sullivan	Geologist
Pat Hall.	Secretary and Curator of Records
Wilma Fisher.	Senior Records Clerk
Sherry Cazee.	Geological Assistant
James T. Cazee.	Geological Assistant
William Hamm.	Geological Assistant

Publications Section

Gerald S. Woodard	Editor and Head
Marsha L. Rohleder.	Senior Sales and Records Clerk (From December 8, 1976)
Donna C. Schultz.	Senior Sales and Records Clerk (To December 5, 1976)

Other Personnel

Coal Section

Kathleen Fowler	Laboratory Assistant (August 24, 1975 to May 1, 1976)
Melissa J. Gibboney	Laboratory Assistant (From September 16, 1975 to January 17, 1976)
Lucia Kuizon.	Geological Assistant (December 28, 1975 to June 30, 1976)
Raymond Pheifer	Geological Assistant (May 2, 1976 to June 30, 1976)
Edythe Rexroad	Secretary (December 28, 1975 to May 1, 1976)
Gail Trout.	Laboratory Assistant (June 13, 1976 to June 30, 1976)

Geochemistry Section

Diane Bader	Laboratory Technician (July 1, 1975 to June 30, 1976)
Charles Cunningham	Laboratory Assistant (August 24, 1975 to November 29, 1975)
Gary R. Day	Laboratory Assistant (August 24, 1975 to June 30, 1976)
Mary Jo Ginther	Laboratory Assistant (September 21, 1975 to April 17, 1976)
Michael Haake	Laboratory Assistant (August 24, 1975 to May 1, 1976)
Dan Honeycutt	Laboratory Assistant (July 1, 1975 to June 30, 1976)
Pat Kippenbrock	Laboratory Assistant (May 2, 1976 to June 30, 1976)
John Krauchs	Laboratory Assistant (September 21, 1975 to April 17, 1976)
Alice Losch	Laboratory Assistant (September 21, 1975 to May 1, 1976)
Sheila Mulhall	Laboratory Assistant (July 1, 1975 to September 20, 1975)
James Regester	Laboratory Assistant (October 19, 1975 to April 1, 1976)
Kenneth Rudy	Laboratory Assistant (July 1, 1975 to April 17, 1976)
Karen Zendler	Laboratory Assistant (July 1, 1975 to August 23, 1975)

Geology Section

John Bassett	Geologist (July 1, 1975 to June 30, 1976)
Dialekti Brown	Laboratory Assistant (August 24, 1975 to May 1, 1976)
Gary Ferguson	Laboratory Assistant (January 25, 1976 to February 23, 1976)
Samuel Frushour	Laboratory Assistant (July 1, 1975 to June 20, 1976)
Irene Hartke	Research Assistant (April 18, 1976 to May 15, 1976)
David Kazmirski	Laboratory Assistant (July 1, 1975 to December 27, 1975)
Marion P. Kolic	Laboratory Assistant (August 24, 1975 to May 1, 1976)
Barry Loshin	Laboratory Assistant (May 16, 1976 to June 30, 1976)
William Mills	Laboratory Assistant (January 11, 1976 to June 30, 1976)
Samuel Reynolds	Laboratory Assistant (August 24, 1975 to June 30, 1976)

Rhoda Summitt Laboratory Assistant
 (July 1, 1975 to June 12, 1976)
 Laura Taylor Laboratory Assistant
 (February 22, 1976 to June 30, 1976)
 Allen Trout Laboratory Assistant
 (June 13, 1976 to June 30, 1976)
 Arthur Waterman Geological Assistant
 (July 1, 1975 to July 26, 1975)
 Wesley Watt Laboratory Assistant
 (July 1, 1975 to August 23, 1975)

Geophysics Section

William Ausich Paleontological Assistant
 (July 1, 1975 to January 24, 1976)
 Michael Bonadio Geophysical Assistant
 (July 13, 1976 to June 30, 1976)
 Peggy Cox Research Assistant
 (July 1, 1975 to September 6, 1975)
 Paul Friesen Programmer
 (May 2, 1976 to June 30, 1976)
 Nancy Hasenmueller Bibliographer
 (July 1, 1975 to June 30, 1976)
 Helen Liebrick Key punch Operator
 (September 7, 1975 to May 1, 1976)
 Janet Martin Key punch Operator
 (May 2, 1976 to June 30, 1976)
 Dennis Parker Laboratory Assistant
 (February 22, 1976 to May 1, 1976)
 Albert Rudman Geophysicist
 (July 1, 1975 to July 12, 1975)
 (May 30, 1976 to June 30, 1976)
 Melissa Swan Key punch Operator
 (January 25, 1976 to June 30, 1976)
 Richard Thoele Laboratory Assistant
 (February 18, 1976 to May 1, 1976)
 Kathryn Watson Key punch Operator
 (August 24, 1975 to September 6, 1975)
 Robert Yost Geophysical Assistant
 (May 2, 1976 to June 30, 1976)
 Thomas Zeller Laboratory Assistant
 (July 1, 1975 to December 13, 1975)

Industrial Mineral Section

Augusta Battle. Laboratory Assistant
 (January 25, 1976 to May 1, 1976)
 Clyde Cody. Laboratory Assistant
 (July 1, 1975 to June 30, 1976)
 Andrew Hoover Laboratory Assistant
 (February 8, 1976 to May 1, 1976)

Petroleum Section

Hazel Barnes	Laboratory Assistant (May 2, 1976 to June 30, 1976)
Victor Berry	Laboratory Assistant (May 16, 1976 to June 30, 1976)
Frank Cioffi	Geological Assistant (July 1, 1975 to June 30, 1976)
John Coleman	Laboratory Assistant (November 2, 1975 to January 24, 1976)
Glenn Connors	Laboratory Assistant (May 16, 1976 to June 30, 1976)
Tony Deniston	Laboratory Assistant (August 24, 1975 to May 1, 1976)
Barbara Dilts	Laboratory Assistant (May 16, 1976 to June 30, 1976)
Paul Dubois	Geological Assistant (July 1, 1975 to January 10, 1976)
Larry Enochs	Geological Assistant (July 1, 1975 to August 23, 1975) (May 30, 1976 to June 30, 1976)
James Goudy	Laboratory Assistant (May 16, 1976 to June 30, 1976)
Jane Jackson	Clerk Typist (July 1, 1975 to June 30, 1976)
Lawrence Kong	Laboratory Assistant (July 1, 1975 to January 24, 1976)
Diane Kormos	Clerical Assistant (August 24, 1975 to June 12, 1976)
Kim Mack	Laboratory Assistant (January 25, 1976 to May 1, 1976)
Debora Mellady	Clerical Assistant (August 24, 1975 to May 1, 1976)
John Nasser	Laboratory Assistant (August 24, 1975 to June 30, 1976)
Joseph Oliver	Geological Assistant (July 1, 1975 to June 30, 1976)
Louis Schultz	Laboratory Assistant (March 7, 1976 to May 15, 1976)
Robert Sheplar	Laboratory Assistant (August 24, 1975 to May 1, 1976)
Janet Steele	Laboratory Assistant (January 25, 1976 to June 30, 1976)
Fred Werner	Laboratory Assistant (February 8, 1976 to May 1, 1976)

Publications Section

Audrey Enyart	Clerk (December 14, 1975 to June 30, 1976)
Marsha Rohleder	Clerk (July 1, 1975 to December 13, 1975)

COAL AND INDUSTRIAL MINERALS SECTION

INTRODUCTION

"Steam is the soul and spirit of our past advancement; at every step its voice, tame as the sigh of love, terrible as the cyclone, is heard, but the food, the nerving fire that drives the great progress, civilization, Christianity and happiness, is coal."

J. Collett, 1894

Stated less eloquently, coal is important to Indiana. This year (1975), it fired Indiana's economy with \$240 million, provided jobs for 3,500 people, and became the great black hope to supply this country's near-term energy needs. Not since 1944 32 years ago, near the end of World War II--has Indiana produced as much coal in one year.

The importance of coal has been talked about for years, but this year special events happened that made the sound ring true. For example, IVTC instituted a new curriculum in coal mining technology and it was an immediate success; the state of Illinois funded a new Coal Extraction and Utilization Research Center and the state of Kentucky put into operation an Institute for Mining and Minerals; two companies gave serious consideration to Indiana as a site for multi-million dollar coal liquification facility; the U. S. Bureau of Mines announced the opening of a new research laboratory in Carbondale, Illinois, to place emphasis on the mining of coal in the Illinois Basin; the U.S. Geological Survey granted federal funds to states to step up the sampling of coals and assist them with chemical analysis; and coal companies, responding to the increased demand for their product, made plans for more and larger mines.

The last observation has had special effect on the Coal and Industrial Minerals Section because the Section was called on repeatedly for information to help plan many of these proposed new mines. Last year members of the Section handled 453 requests for information, an all-time high, 16 percent greater than the previous high in 1974-75. Most of these requests came from industry.

To help cope with the increased demands for more information, the Section began a feasibility study to examine our present data base and to recommend ways of storing, retrieving, and handling coal data more efficiently. If the requests for information continue to grow, and all indications point that way, then the Section must make a choice: increase the efficiency of the Section, increase the size of the Section, or ultimately, cut down on the quality of service rendered. At this time, increasing efficiency seems to be the most practicable alternative.

RESEARCH PROJECTS IN PROGRESS

Strippable Coal Resources

This project is an ongoing and continuing compilation of the strippable coal resources of the State. Strip-minable coal reserves are periodically revamped as new drilling information becomes available and areas are depleted by currently active strip mining. During the year major strip mined areas were brought up to date to January 1, 1976 and additional drilling information was plotted and evaluated. These data enable the Section to keep a running account of available strip-minable coal tonnages of the State.

Preliminary Coal Maps of Greene, Owen, and Putnam Counties

These projects are a continuation of our county reconnaissance type mapping of the distribution, structure, and mined areas of coals. Seventeen counties have been mapped and published to date, and with the completion of these three counties and Posey County a complete survey of the Indiana Coal Field will have been realized.

Little work was done on these projects during the year. A small amount of compilation work was done on Greene County; some 10 percent of the field mapping of Owen County was done; and about 40 percent of the field mapping of Putnam County was accomplished. The data and work maps are on open file in the Section, and thus are available for answering requests for information in these counties.

Distribution of Acid Forming Materials in Overburden

This project is a study of the pyrite content in different types of overburden materials in active coal strip mines. Analysis of samples collected from high walls of active strip mines, along with core drill hole samples from locations in advance of the mining operation, provides the data necessary for planning the handling of obvious acid-producing materials in a selective manner. The objective of this planning is to place the acid-forming materials at depth and cover them by lithologies more suited for plant growth. This selective handling of materials can also assure precipitation runoff of a non-acid nature.

Results of this study have been successfully applied to acid spoil problems at several mines in various coal seams in southwestern Indiana. A manuscript of the original study, one describing a small intensively drilled area in Greene County that provided the basic data for expansion of this project to broader application both stratigraphically and geographically, has been submitted for publication.

Cast Overburden Rock Weathering

Rock size and rates of disintegration of various overburden materials involved with reclamation of strip mined lands have become of increased importance as more and more of the reclaimed lands are being placed into row crop use. A study of the various types of rocks present in active strip mine highwalls and core samples from drill holes in advance of the mining operation provide a projection of the rock size and disintegration rates of the lithologies involved. This data acts as a guide to selective spoil handling to insure that large, slow-weathering materials will be buried to a sufficient depth so as not to interfere with farming machinery.

The initial intensively studied area for this project was located in central Pike County. A detailed report of the findings has been conveyed to the interested company, and an article for the general public has been prepared and will soon be released. The basic data derived from this work is currently being expanded to other geographic and stratigraphic areas of the coal field, and a new outdoor laboratory to study rock weathering rates was opened on the outskirts of the I.U. Bloomington campus. Recently a continuation of the study of acid forming materials in overburden was incorporated into this project, thus insuring additional research that will aid mining companies in handling overburden materials so that maximum use can be made of the land when mining is complete. This project is about 75 percent complete.

Active Coal Mine Map

The annual revision of the "Map of Southwestern Indiana Showing Locations of Active Coal Mines" (Misc. Map No. 7) was completed and published during February 1976. A total of 125 sites were visited with 98 of them active.

Deep Drilling Program for Coal

This project is an ongoing and continuing program to obtain information on Indiana's underground minable coals in the deeper part of the coal basin in the extreme southwestern part of the State. Knowledge of the thickness, quality, reserves, and mineability of the deeper-lying coal seams is the goal of this project. Information on roof and floor conditions associated with each minable seam is obtained as well. During the year 1,983 feet were drilled in three drill holes in southern Knox County. All major coal seams were measured, described, and carefully prepared for chemical analysis. In addition to the above information a test for methane content of each of the coal seams was initiated. Originally this test was conceived to function as a mining safety precaution to determine whether the coal seam's methane content warranted a degasification program ahead of underground mining, but in the nation's search for new energy sources emphasis is now being placed on the possibility of commercial production of methane from coal beds. Thus a two-fold advantage for bleeding methane from coal would be realized.

In the approximately three years that this project has been in existence a total of 5,074 feet has been drilled in seven (7) holes that range in depth from 372 feet to 880 feet. These holes have been drilled on approximately six (6) mile centers commencing in southern Sullivan County and progressing southward to the south edge of Knox County.

A much better interpretation of available electric logs from oil tests in this area has been realized as a result of the drill holes. In addition, phase two, consulting with coal company personnel concerning drilling information in their files, has been commenced. To this point we have been successful in obtaining information from them that ties in very well with our own drilling information.

Phase three of this project, analytical work on the materials that form the roof and floor of the coals, has been started, but it is being carried on in this report under the title of "Characterization of Potential Roof and Floor Rocks Associated with Indiana Coals." A further discussion of this facet of the study is presented below.

Characterization of Potential Roof and Floor Rocks Associated with Indiana Coals

With the exception of two small underground coal mines, all of Indiana's coal is produced by stripping operations. This situation should change in the future, however, because about 7/8 of Indiana's recoverable reserves will probably be recovered by underground mining methods. In anticipation of this eventuality, a project was started to add fundamental knowledge on the physical and chemical properties of rocks that will be affected by the underground mining of coal, mainly the roof and floor materials.

The first phase of the study, the petrographic description of lithologies, was begun using cores from Survey drill holes and rocks collected from active mines. Accurate descriptions of rocks are important to correlations of both stratigraphy and mechanical properties of the rocks. A second phase, identifying the composition of the different lithologies by thin-section and X-ray diffraction analysis, was initiated on 15 samples.

National Coal Data System

This project was initiated with the aid of a grant from the U.S. Geological Survey to increase the amount of specific chemical data on the minable coal seams in Indiana as an aid for production of coal of a quality acceptable for production of energy and to meet pollution control limitations. The objective is to collect channel samples of coal and channel or grab samples of partings, roof rock, and floor-rock at as many of the state's active coal mines as possible for subsequent detailed analysis. The resulting data will be tabulated and isopached to form a basic data bank useful for evaluating the nature of coal currently being produced in Indiana.

During the year, 76 coal samples and 116 parting, roof-rock, and floor rock samples were collected; 1535.85 ft. of stratigraphic section was measured and described. The field portion of this project is now approximately 75 percent complete. Samples representing virtually all of the coal seams being produced in the State and several samples from each of the major coals presently being produced are now included in the data base.

Feasibility Study for an Indiana Coal Data System

A feasibility study was initiated as a first step towards implementing a computerized data handling and mapping system for the Coal and Industrial Minerals Section's large open and confidential files on the coals, coal bearing rocks, and coal mining in Indiana. The objective of this study is to write a feasibility report on a computerized Indiana Coal Data System documenting the objectives the Section hopes to achieve with the aid of the system, provide an analysis of the existing data base in reference to computerization, and identify alternative data handling systems.

During the last three months of fiscal 1975-76, considerable time was spent tabulating information on the number and kinds of requests made of the Section; and tabulating and analyzing the quantity and quality of data in the Section's coal test files, coal analysis files, work maps, mine maps, and abandoned mine card files. These results provide a basis for stating the kinds of data processing we can perform most efficiently with a computerized system as well as identifying limitations that must be imposed on a computerized system because of limitations of file information.

Industrial Minerals

Two mineral discoveries in Indiana highlighted Section activities in 1975-76. In November, 1975, the thickest section of high calcium limestone ever analyzed in Indiana by the Survey was discovered in a Silurian reef drilled by the Survey near Camden, Carroll County. The test hole was drilled as part of a study of reefs in northern Indiana by geologists of the Coal and Industrial Minerals Section and Geology Section. After the discovery was publicized, we responded to large number of requests from industry for additional information.

The Camden discovery followed on the heels of a discovery of large sphalerite masses at a reef at Delphi, Carroll County. This find added emphasis to a timely study of sphalerite and associated minerals in Indiana being conducted in the Section. We handled a large number of requests from industry concerning this and other occurrences of zinc minerals in Indiana.

Although less dramatic than the above events, the basic activities of geologists of the Section continued at an increasing pace. We handled an all time high of 628 service requests in the Industrial Minerals part of the Section, an increase of 17% over 1973-74, the previous high year, and an increase of 25% over 1974-75. Much progress was made on detailed geologic mapping in Putnam County, two directories of mineral producers were issued, and several research projects and environmental reports in which geologists of the Section participated were either completed or in their final stages.

Research Projects in Progress

Data on abandoned limestone quarries - Ault
Environmental Geology of Monroe Co. - Gray and Ault
Silurian reefs in northern Indiana - Shaver and Ault
Fluorite, sphalerite, and barite - Shaffer
Geologic mapping in Putnam County - Moore
Crushed stone resources of the Blue River Group - Carr and Leininger
Peat resources of Indiana - Schneider and Moore

Research Projects completed

Aggregate resources of the Big Blue River Valley - Ault and Moore
Environmental geology of Marion County - Hartke, Ault, Austin, Becker, Bleuer, Herring, and Moore
Map of Indiana showing thickness of Silurian rocks and locations of reefs and reef-induced structures - Ault, Becker, Droste, Keller, and Shaver
Evaluation of sand and gravel deposits near Terre Haute using remote sensing data - West, Mundy, and Moore

DRAFTING AND PHOTOGRAPHY SECTION

The primary function of the Drafting and Photography Section is to provide service to the commodity and research sections of the Geological Survey. The services consist mainly of the final preparation of maps and illustrations for publication and talks, preparation of displays, mounting and framing of maps and photographs, typesetting, diazo printing, photo-copying, film processing and printing, photomicrography, field photography, color proofing of maps and artwork, and preparation of projection slides.

Jobs completed for publishing by the Geological Survey include Bulletin 42-N, "Petroleum Industry in Indiana", Bulletin 53, "Stratigraphy of the Detroit River Formation (Middle Devonian) of Northern Indiana"; Bulletin 54, "Geology of the Catlin-Mansfield Area, Parke and Putnam Counties, Indiana"; Special Report 10, "Urban Geology of Madison County, Indiana"; Special Report 11, "Environmental Geology of Lake and Porter Counties, Indiana -- An Aid to Planning"; Mineral Economics Series 22

"Oil Development and Production in Indiana During 1975"; Occasional Paper 13, "Fortran Program for Correlation of Stratigraphic Time Series"; Occasional Paper 15, "The Limberlost Dolomite of Indiana, A Key to the Great Silurian Facies in the Southern Great Lakes Area"; Occasional Paper 16, "The Seismicity of Indiana Described by Return Periods of Earthquake Intensities"; Occasional Paper 19, "Silurian Reefs in Southwestern Indiana and Their Relationship to Petroleum Accumulation"; "Directory of Clay and Shale Producers and Ceramic Plants in Indiana"; "Directory of Dimension Stone Quarries in Indiana"; State Park Guide 2, "Geologic Story of Clifty Falls State Park"; and Miscellaneous Map 21, "Map Showing Oil, Gas, and Gas Storage Fields in Indiana".

Other jobs finished include a display for the Indiana State Fair, revision of a display showing Geological Survey publications, illustrations for a report on the proposed Clifty Creek Lake region, a cover for environmental studies, design and preparation of a greeting card for the Department of Natural Resources, 3 sets of 6 illustrated news items, renovation of the artwork for the cover of Circular 7, revision of the petroleum exploration maps of Indiana counties and Miscellaneous Map 7, "Map of Southwestern Indiana Showing Locations of Active Coal Mines"; and illustrations for 10 outside publications and 7 talks.

Other drafting jobs in progress are: Occasional Paper 17, "Environmental Geologic Maps for Land Use Evaluations in Morgan County, Indiana"; Occasional Paper 18, "Environmental Geologic Maps for Land Use Evaluations in Johnson County, Indiana"; Miscellaneous Map 22, "Map of Indiana Showing Thickness of Silurian Rocks and Location of Reefs and Reef-Induced Structures"; State Park Guide 3, "Geologic Story of McCormicks Creek State Park"; a display for the Indiana State Fair; and updating state and federal property boundaries on base and petroleum exploration maps of Indiana Counties.

Photographic items produced during the fiscal year consist of 879 camera copies, 152 field and laboratory photographs, 22 photomicrographs, 1148 black and white prints, 9 color prints, 460 film positives and duplicate negatives, 168 stripping film prints of stickup type and symbols, 18 scribesheets, 47 peelcoat films, 12 color proofs of maps and covers, 169 color and tinted slides, and 119 black and white slides.

Approximately 6,000 prints were made on the diazo printer.

EDUCATIONAL SERVICES

The Office of Educational Services was established by the State Geologist to aid in the coordination of the Geological Survey's efforts in providing information about Indiana geology and mineral resources to the public. This office assists in the preparation of materials for newspapers, magazines, public schools, youth as well as adult groups, and all other persons interested in rocks, minerals, fossils and the earth. On request, he participates in radio and television shows which involve something of Indiana geology, minerals, etc. By means of news releases to Indiana's newspapers and articles sent to appropriate magazines, the Office of Educational Services not only aids in informing the public about activities of the Indiana Geological Survey but also aids in the distribution of educational information to the public. In addition to giving public lectures and conducting special field trips, the Educational Services geologist works directly with teachers in public schools, geology clubs, Scout groups, 4-H clubs, conservation clubs, civic groups, and children and citizens throughout the state on programs or projects concerning Indiana's geology and mineral resources. On occasion he serves as guest lecturer and conducts special field trips for college classes. He identifies many of the rock, mineral, and fossil specimens sent to or bought in to the Geological Survey by Indiana citizens. The geologist in charge of Educational Services also aids in the preparation and installation of exhibits and displays for fairs, for professional meetings, for amateur rock shows, and for the displays in the Geology Building.

The program for providing illustrated news items for Indiana newspapers continues. A questionnaire was prepared and mailed to all Indiana newspapers for their comments about the series and whether they wished to continue receiving them. Of the 91 questionnaires returned, nearly all indicated that they used the series regularly or occasionally and that they wished to continue receiving them in the future. The total number of units produced to date was increased to 54 during the past fiscal year. A total of 848 mailings of the series were made to Indiana's newspapers during the past 12 months. Currently, six more illustrated news items are in process.

During the fiscal year 1975 76 the geologist in charge of the Office of Educational Services spent 46 days in the field and traveled more than 11,445 miles. In answer to requests received from the public, 19 public lectures were given and 6 special field trips and 16 tours of the Geology Building were conducted during the 12-month period.

Public lectures, laboratory demonstrations, and film showings were made to the following groups: Princeton Rotary Club, Gibson Co.; 7th and 8th grade classes, Shawswick School, Lawrence Co.; 3rd grade classes, Grandview School, Monroe Co.; members of Apostolic Church School, Monroe Co.; White River Gem Society, Inc., Muncie, Indiana; and 6th grade class, Shawswick School, Lawrence Co.

Special field trips, collecting hikes, and tours were conducted for the following groups: members of the I.U. Biology Department's summer garden program; participants of Indiana State University's annual Honors Seminar For Science Students; 4th grade class, Childs Elementary School, Bloomington; Walker Chapel Church (Monroe Co.) Summer Bible School group; Stony Creek Elementary School group, Noblesville, (Hamilton Co.); South Terrace Elementary School's 4th grade class (Posey Co.); 3rd grade classes, University School, Bloomington; Apostolic Christian School group (Monroe Co.); 3rd grade classes, Grandview School, Monroe Co.; Manchester College science students; 3rd and 4th grade classes, Rogers School, Bloomington; group of Day Care children, Christian Center, Bloomington; and the participants of the 1976 Indiana University Annual High School Science Institute.

The Educational Services geologist again served as the Geological Survey's representative of the Department of Natural Resources' State Fair Committee for the 1976 Indiana State Fair.

Articles submitted and published in OUTDOOR INDIANA included: "The Fossils Called Indian Beads", by N. Gary Lane (March 1976); "Our Great Doughnut and Pimple Fields", by N.K. Bleuer (December 1975); "Versailles Park: Where History, Geology, and Nature Meet", by Carl B. Rexroad (October 1975); and "Clay and Shale: Material for Indiana Industry", by Donald D. Carr and R. Dee Rarick.

During the past fiscal year the geologist in charge of the Office of Educational Services submitted 6 news releases to Indiana's newspapers about the activities of the Geological Survey. Also, he participated in a Channel 4 WTTV television program "INDIANA OUTDOORS" about the rapidly growing hobby of rockhounding in Indiana.

Exhibits prepared by the Indiana Geological Survey for public display included a major exhibit for the 1975 Indiana State Fair and a smaller one that was taken to the annual meeting of the Illinois Basin Chapter of the American Petroleum Institute, Division of Production, held at Evansville, Indiana. The Geological Survey's portable publications exhibit was installed at the annual rock show of the Kyana Geological Society in Louisville, Kentucky.

During the 1975 4-H Fair season, geology and weather exhibits were judged for the Marion County 4-H Fair and the Monroe County 4-H Fair.

The Educational Services geologist participated in the 21st Annual High School Science Institute conducted by Indiana University. In addition to the preparations for the lecture and tours of the building, he served as co-leader of a geologic field trip conducted locally for the group of participants.

Professional meetings attended during the past fiscal year included the annual meeting of the Illinois Basin Chapter of the American Petroleum Institute, Division of Production, held in Evansville; the 1976 Earthwatch Program, the Indiana portion of this program was conducted by the Indiana Department of Public Instruction's special committee of judges (the Educational Services geologist served as a member of this committee); and meetings of the Indiana Geologists.

GEOCHEMISTRY SECTION

Samples collected by all of the sections of the Geological Survey are analyzed to determine their chemical composition. Spectrographic, x-ray, atomic absorption, and wet chemical methods were used in these routine analyses in order to learn what minerals and elements are present in the samples, what uses might be made of these materials, and whether potentially dangerous substances are present in them.

In the course of this work during the year a large number of samples were processed and determinations made. Included in the section's analyses were: 120 special samples of carbonate rock from which 720 determinations were made; 139 samples of coal overburden rocks; 236 samples by x-ray methods; 142 samples of coal from which 985 determinations were made, 292 samples by spectrographic methods for 2592 determinations, and 1,416 determinations in the wet chemistry laboratory.

GEOLOGY SECTION

The Section's accomplishments during 1975-76 may be summarized as follows:

Members of the section worked actively on 16 formal projects and completed five of them (environmental studies of Marion, LaPorte, Morgan, and Johnson Cos. and geology Coastal Zone Management Program). Four of the 16 were begun as new projects (environmental study of Grant Co., U.S. Geol. Survey Quarternary map U.S.A. (Indiana portion), geology for Coastal Zone Management Program, and Teays Valley of Indiana). The greater effort (10 projects) was spent on more practical endeavors, including 6 environmental, 2 mapping, and 2 otherwise applied, but significant progress was made in the 6 scientific efforts.

We continue to be encouraged by the rate of fruition of our projects, especially their publication. Published Survey environmental reports are for Lake and Porter, Madison, and Hendricks Counties and outside reports in this area are on land use of the Lake Monroe area and geologic guidelines for planning in Indiana. In addition are these completed reports awaiting Survey publication: environmental studies for Morgan, Marion, LaPorte, and Johnson Counties and for Evansville. Earlier submitted report for Allen County remained unpublished. We also worked actively on environmental studies of Monroe, Grant, and Cass Counties. The latter two are new projects, but the Cass County work has not yet been formalized.

The Survey-wide environmental committee was disbanded, a large part of whatever remains of the committee's function having been placed directly with the Geology Section. As suggested in the 1975-1976 summary, the program needed evaluation and possibly reorientation, whether with greater or lesser efforts in the future. No conscious reorientation of the kinds of effort may have been made, but the section began two new environmental projects (Cass and Grant Cos.) after discharge of the committee. Probably, our environmental effort will become less obvious, identified as such, but some new projects of geologic-subject orientation will have application. The project to study the form and fill materials of the Teays Valley is an example, but this project will be limited if we cannot arrange for sufficient deep drilling.

In the nonenvironmental area several projects are well along and saw reports published or submitted on Silurian and Mississippian conodont biostratigraphy, Silurian stratigraphy, Devonian stratigraphy, and Pleistocene stratigraphy. Similarly, several educational items were published or produced on state parks, caves, and glacial features.

Three applied projects saw progress nearly to completion or to completion: Indianapolis Regional Geologic Map remapping, Indiana portion of U.S. Geol. Survey Quaternary map of U.S., and geology for Coastal Zone management Program.

The Section had a total of 15 reports and 4 abstracts published, 6 of the reports being published by the Survey. They total 385 pages and 168 illustrative materials, which is the largest of any annual output of the Section. A two-year continuing encouraging note is that only two reports (190 p., 57 illus.) that were more than one year old remained in the backlog, which is still going down from 794 pages and 110 illustrations two years ago.

Members of the section submitted for publication 13 reports and 2 abstracts (298 p., 108 illus.) that remained unpublished. These reports, when added to the two remaining from more than one year, brings the backlog to 15 reports and 2 abstracts (488 p., 165 illus.), a little more than for last year.

Eleven memorandum reports were prepared (total of 135p., 68 illus.), most of which were environmentally oriented. Of these 11, 5 are planning oriented (including 3 for the Coastal Zone), 2 are directed to housing construction sites, 1 to a natural phenomenon (subsidence), 1 to reservoir construction, 1 to educational purposes, and 1 to landfill construction. The requestors, or benefactors, are 2 county governments, 2 state planning regions, 1 private citizen, 1 educational organization and the U.S. Corps Engineers and the Div. Water.

Members of the Section conducted 25 papers, talks, and field trips. Of these, 13 were essentially scientific or technical and were given at meetings of professional organizations, and 14 were educational (classes, camps, clubs, public, and other groups). The field trips, included in figures above, were given for the National Science Teachers Association, North-Central Section of Geological Society of America, and a group of Denver geologists.

Staff of the section also were involved in 436 conferences and conference-type field trips of record, of which most were calls upon us for information. This activity is about one third more than was recorded for any year during the past five years and probably is greater than for any previous year as well.

The volume of correspondence also continued to increase, and some of this, of course, involves requests for information.

Environmental questionnaires, very nearly all directed to street and highway construction, were down by one third.

The accomplishments of the section may be typified in four ways:

- (a) A large effort was placed on environmental matters, particularly on formal county-based projects that included both old and new projects and that brought several projects to fruition.
- (b) We were again increasingly called upon for specific pieces of information, the origin of such requests also becoming more diversified (not more concentrated as they once were for landfill matters). Most of these requests were for applied information.
- (c). We produced some new basic stratigraphic information, mostly for middle Paleozoic and Pleistocene materials (both drift and valley fill). The one new significant project we began in this kind of endeavor is the study of the Teays Valley (form, materials, stratigraphy, resources).
- (d) In relation to the above, we carried on a significant mapping effort, one nearly to complete the remapping for the 1° x 2° Indianapolis Regional Geologic Map, and the other, newly begun and nearly finished effort was to compile Quaternary map units for the entire state as a contract arrangement with the U.S. Geological Survey.

GEOPHYSICS SECTION

During the 1975-76 fiscal year the Geophysics Section continued to maintain a program of field work, laboratory measurements, and development of computer programs to assist the interpretation of geophysical data.

A seismic refraction crew has worked throughout the year on numerous field surveys to measure the unconsolidated material above bedrock. These projects mainly were done in cooperation with the Division of Water to determine the possibility of geologic conditions suitable for the development of ground water resources. Seismic refraction surveys were made in Shelby, Hancock, and Boone Counties; Jay and Adams Counties; and along Beanblossom Creek. This work required 456 shots and is only partially completed. Computation of field records made during the summer field season continued during the remainder of the fiscal year.

Members of the section brought several projects to completion during the year. Most important were a report entitled "The Seismicity of Indiana", by Bob Blakely, and two reports on computer programs with geophysical applications.

Bob Blakely's work with computer utilization continued with the final development of a Petroleum Data File, and start of a Coal Data File. The latter promises to be both more useful and more difficult than the petroleum file as it involves a system for turning out maps of Indiana by computer.

MINERAL STATISTICIAN

During 1975, the value of minerals produced in Indiana amounted to \$436,409,439.00 (reported at first stage of salability), an increase over the previous year of 26.5 percent. The processing of limestone for construction purposes, and the manufacture of clay products and cement added more than \$100 million to the total value of mineral production in the state. Related industries such as lime manufacture, recovery of sulfur, and expanding of perlite, all from imported raw materials, increased the total value of mineral production by several million dollars.

The rising demand for fuels, and the resulting higher prices, have caused coal, crude oil, and natural gas to account for 76.4 percent of the total value of mineral production. Coal alone accounted for 65.1 percent; coal production increased 4.2 percent in quantity and 40.2 percent in value. Two new river loading docks, a new preparation plant and conveyor belt, and two new draglines were completed during the year, and construction was started on two other draglines.

Although the total number of wells drilled for oil and gas (excluding service wells and those drilled in connection with gas storage operations) increased by only two, wells related to secondary recovery projects increased by 66 from the previous year. This fact, together with an increase of more than 81,000 feet in footage drilled, indicates major emphasis and increasing dependence on secondary recovery methods. Oil production declined 5.8 percent in quantity but increased 15.1 percent in value. Of the total oil produced, 52.5 percent is credited to secondary recovery methods.

Of the construction materials, gypsum, crushed limestone, and sand and gravel showed declines in the quantities produced and increases in the total income, clay and shale declined in both quantity and value, and dimension sandstone increased in both quantity and value.

A 30.0 percent increase in the amount of agricultural limestone sold during the year was not sufficient to offset the decrease in the other use categories of crushed limestone. The amount of sand and gravel used in building construction increased 12.1 percent over the previous year, but all other uses categories of sand and gravel declined.

Building limestone quarried in Lawrence and Monroe Counties increased 15.5 percent in volume, but lower units prices for block stone resulted in 8.5 percent less income at that stage. However, income from processing the stone for construction purposes was 10.1 percent higher than in 1974. Stone production in Franklin, Putnam, and Rush Counties for walls, foundations and other construction, and as flagging increased 43.2 percent in volume and 102.9 percent in value.

Greene, Pike, Sullivan, Vermillion, and Warrick Counties accounted for 60.5 percent (not including oil and gas) of the total value of all mineral commodities produced in Indiana during 1975. Coal production in Warrick County alone amounted to 25.8 percent of the state total. The following counties led in production of minerals (excluding oil and gas):

<u>County</u>	<u>Value-Raw Materials</u>	<u>Value-Including Mfd. Products</u>	<u>Commodities</u>
<u>More than \$20 million</u>			
Warrick	\$112,599,529	-----	Coal
Pike	63,493,084	-----	Coal, Sand and Gravel
Sullivan	32,366,156	-----	Coal, Crushed limestone, Sand and Gravel
Vermillion	31,725,966	C	Clay and Shale, Clay products, Coal, Sand and Gravel
Greene	23,895,900	C	Clay and Shale, Clay products, Coal, Sand and Gravel

<u>County</u>	<u>Value-Raw Materials</u>	<u>Value-Including Mfd. Products</u>	<u>Commodities</u>
<u>\$10 - \$20 million</u>			
Clay	12,693,170	\$ 19,875,680	Clay and Shale, Clay Products, Coal
<u>\$5 - \$10 million</u>			
Spencer	6,166,598	-----	Coal
Hamilton	5,825,306	-----	Crushed limestone, Peat, Sand and Gravel
Marion	5,771,242	-----	Crushed limestone, Sand and Gravel
Putnam	5,717,749	C	Cement, Clay and Shale, Crushed limestone, Dimension limestone, Sand and Gravel
Crawford	C	-----	Crushed limestone
Allen	5,355,438	-----	Crushed limestone, Peat, Sand and Gravel

Cement was manufactured in Cass, Clark, Lake, Lawrence, and Putnam Counties, and clay products in Clay, Greene, Huntington, Jackson, Lake, Morgan, Parke, Porter, Pulaski, and Vermillion Counties. Limestone was processed for building purposes in Franklin, Lawrence, and Monroe Counties.

19741975

	<u>Quantity</u>	<u>Value</u>	<u>Quantity</u>	<u>Value</u>
Coal	24,253,632 tons	\$202,760,364	25,269,159 tons	\$284,278,039
Limestone, crushed	30,249,556 tons	53,781,363	27,418,844 tons	55,215,341
Sand and Gravel	25,421,227 tons	34,694,330	22,951,928 tons	36,211,683
Petroleum	4,919,380 bbls	42,405,056	4,632,282 bbls	48,824,252
Limestone, dimension	2,487,177 cu. ft.	5,144,481	2,941,701 cu. ft.	4,936,653
Clay and Shale	1,317,296 tons	1,980,271	1,193,804 tons	1,841,484
Peat	166,920 cu. yd.	821,448	153,373 cu. yd.	702,327
Natural gas	176,300,000 cu. ft.	23,900	346,300,000 cu. ft.	134,900
Undistributed - includes dimension sandstone, gypsum, marl, and whetstones		<u>3,377,685</u>		<u>4,264,760</u>
TOTAL		\$344,988,898		\$436,409,439
Value added for additional processing of dimension limestone and manufacture of clay products and cement		\$ 97,412,686		\$100,033,594

PETROLEUM SECTION

The chief functions of the Petroleum Section consist of (1) services, (2) projects that are performed annually, (3) projects that are related to records, (4) subsurface study projects, and (5) special projects.

Services

The services offered consist mostly of requests, conferences, and correspondence about subsurface records such as well locations, driller's logs, geophysical logs, samples, cores, and interpretations made from these data. The section handled 355 visitors during the fiscal year. In addition to the visitors, requests for subsurface information is received daily by correspondence or telephone.

Annual Projects

Indiana Drilling Statistics -- Drilling statistics were compiled for wells drilled in Indiana during the year. These statistics comprise a part of the nationwide totals compiled by the American Association of Petroleum Geologists and the American Petroleum Institute.

Indiana Exploration Development -- An annual review of exploration activity in the state was compiled for inclusion in the Bulletin of the American Association of Petroleum Geologists.

Indiana Oil Production -- Preparation of the annual oil production statistics by fields in the Survey's Mineral Economic Series was completed.

Indiana Oil Reserves -- The section participated in the program sponsored by the American Petroleum Institute of formulating statistics on remaining oil reserves and oil recovery. The statistics are a part of the nationwide figures published by the American Petroleum Institute.

Review of Petroleum Exploration Map Series -- The individual county petroleum map transparencies were up-dated at year's end. Fifty maps were revised and 42 were checked with no revisions necessary.

Records Improvement

Upgrading County Exploration Maps -- A project of upgrading County Petroleum Exploration Maps to show the current status of each well was started in August. Field work began in Spencer County in August and was completed in November. After the Spencer County map was revised and brought up to date, forty other County Exploration Maps were checked for abandonments and proper symbolization and brought up to date. Work will continue on the project until all county maps are upgraded. It is estimated the project is 75 percent complete.

Gibson County Well Records -- Field work involved in the Gibson County upgrading project is virtually complete. Review of file data and publication of the new PE map in early 1977 will complete this project.

Master File Indexing -- A special project of indexing on master file envelopes information available on each well and typing permit numbers on the master file envelopes is more than 50 percent complete. This new system will aid the section office staff, geologists, and visitors to quickly determine the type of information that is available on each well filed in the Petroleum Section. The addition of permit numbers to the envelopes will aid in proper re-filing of well data after use by visitors and staff.

Revision of Cincinnati Tops on Lithologic Strips -- During the year Andrew Hreha reviewed all the Cincinnati tops on the lithologic strips and made other appropriate formation changes where necessary. Stanley Keller assisted with the Michigan Basin portion of the study. This project, which began in March, 1975, is virtually complete except for changes on the Well Data Cards.

Subsurface Studies

A report, "The New Albany Shale and Equivalent Strata in Indiana," by Leroy E. Becker and Stanley J. Keller was submitted to ERDA, Morgantown, West Virginia for inclusion in the proceedings of the Devonian Shale Symposium held at Morgantown, West Virginia 3 March, 1976.

Occasional Paper 19, "Silurian Reefs in Southwestern Indiana and Their Relation to Petroleum Accumulation," by Leroy E. Becker and Stanley J. Keller was completed and sent to the Publications Section 21 April, 1976. A shorter version of the same paper was submitted to the Kentucky Oil and Gas Association for inclusion in the Proceedings of the Meeting held in Lexington, Kentucky 18 June, 1976.

Stanley Keller and Leroy E. Becker participated with Curtis Ault, John B. Droste, and Robert H. Shaver in compiling a Miscellaneous Map entitled "Map of Indiana Showing Thickness of Silurian Rocks and Locations of Reefs and Reef Structures."

Leroy E. Becker and John B. Droste are preparing a paper, "General Sedimentological History of Late Silurian and Early Devonian Events in Southwestern Indiana," for the Eastern Section of the AAPG meeting which will be held in Lexington, Kentucky, 7-8 October, 1976.

Leroy E. Becker assisted E.J. Webb, Anadarko Production Co., T.J. Buschbach, Illinois State Geological Survey, and Ed Wilson, Kentucky Geological Survey in constructing a cross section showing Cambrian rocks from Wisconsin to Virginia.

Special Projects

Bulletin 42N, "Petroleum Industry in Indiana", by G. L. Carpenter, T. A. Dawson, and Stanley J. Keller was received from the printer 10 December, 1975.

An article entitled "Is It A Well, Or Just a Hole In The Ground?" was prepared by Gerald Carpenter and Homer Brown for Outdoor Indiana.

Miscellaneous Map 21, "Map Showing Oil, Gas, and Gas Storage Fields in Indiana," by Gerald Carpenter and Dan Sullivan was received from the printer 7 June, 1976.

Reviewing Process for County Strat Tests -- Following completion in 1975 of the county strat test acquisition program, it was recognized that many of the strat test wells contained useful stratigraphic data in areas of the state where such data was lacking. About 1650 wells fell into this category, with 350 already field checked, leaving 1300 to be reviewed or field checked. Thus, a program for incorporating county strat test well records into our master well records file was started in March 1976. The process involves the verification of the elevation and location of each individual strat test record by use of topographic maps and location maps obtained from the company which drilled the strat tests. As some discrepancies do occur, it is necessary to field check certain wells. Strat test wells with good data but no company map available will need to be field checked in the future. To date 188 of 1300 county strat test wells have been added to our master well records file through the reviewing process.

Sample Consolidation -- A project to consolidate well samples in order to create additional storage space in the existing well sample library continued during the year. More than 50 percent of the wells have been processed. It is estimated that an additional 15 years storage space has already been created by consolidating the samples.

Core Storage Building

Construction began in mid-June on a new core storage facility to replace the present quonset. The maximum storage capacity of the quonset was reached in 1972.

The new building will be approximately 50' x 100' with the largest area used for storage of cores. A smaller area will provide ample space for visitors to the core storage to examine the cores with natural daylight as well as the overhead and portable lighting that will be available. This area will also be used for the preparation of cores that will be added to the file. A small utility area will provide for the complete security of confidential cores. Heat, air conditioning, rest room facilities and exterior access doors are also included. This facility should serve the storage needs of the Survey for many years.

PUBLICATIONS SECTION

During the past fiscal year the Publications Section sold 5,742 reports and 11,573 maps. The section sent 2,047 reports and 133 maps on exchange to institutions in the United States and in foreign countries. It also distributed without charge 2,794 reports and 1,488 maps to members of its own organization and to individuals, libraries, and companies in the United States and abroad. The Publications Section served 3,196 office customers, handled 1,729 letters pertaining to geologic reports and maps, and sent out 1,109 announcements of new publications.

Sixteen reports, one new map, and 52 revised maps were issued during the fiscal year. In addition, two reports were reprinted. A new series, Occasional Papers, which was introduced late in the fiscal year 1973-74, was an active series in 1975-76 as it was in 1974-75. Five reports were issued as Occasional Papers during 1975-76.

Midway in the fiscal year the Publications Section acquired additional composing equipment. The IBM "Selectric" composer, which was purchased in 1967, was modified for use as part of the IBM magnetic tape "Selectric" composer system, and an IBM MT-V recorder and input writer, a magnetic tape reader, and a composer console were purchased. Conversion to the magnetic tape system has made the composition of camera copy for offset-printed publications faster and more efficient.

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Austin, George S., 1975, Clay and shale resources of Indiana: Indiana Geol. Survey Bull. 42-L, 40 p., 2 pls., 13 figs.

Carr, Donald D., and Hatfield, Craig B., 1975, Dimension sandstone resources of Indiana: Indiana Geol. Survey Bull. 42-M, 28 p., 1 pl., 16 figs., 3 tables.

Carpenter, G. L., Dawson, T. A., and Keller, Stanley J., 1975, Petroleum Industry in Indiana: Bull. 42-N, 57 p., 1 pl., 31 figs., 1 table.

Nicoll, R. S., and Rexroad, C. B., 1975, Stratigraphy and conodont paleontology of the Sanders Group (Mississippian) in Indiana and adjacent Kentucky: Bull. 51, 36 p., 6 pls., 2 figs., 1 table.

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Bleuer, N. K., and Moore, M. C., 1975, Buried pinchout of Saginaw Lobe drift in northeastern Indiana: Indiana Acad. Sci. Proc., v. 84, p. 362-372, 4 figs.

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Hill, J. R., April 1976, Geologic information for the Indiana Coastal Zone Management program in the northern parts of Lake, Porter, and LaPorte Counties, Indiana: 6 p., 2 figs. (for Div. Water, Dept. Nat. Res.).

Hill, J. R., May 1976, Geologic information for the Indiana Coastal Zone Management Program in the northern parts of Lake, Porter, and LaPorte Counties, Indiana: 9 p., 3 figs. (for Div. Water, Dept. Nat. Res.).

Hill, J. R., May 1976, Geologic information for the Indiana Coastal Zone Management Program in the northern parts of Lake, Porter, and LaPorte Counties, Indiana: 13 p., 9 figs. (for Div. Water, Dept. Nat. Res.).

Johnson, Donald O., 1972 unpublished Ph.D. thesis, Stratigraphic analysis of the interval between the Herrin (No. 6) coal and the Piasa Limestone in southwestern Illinois.

Smith, Ned K., May 1962, A study of data and materials gathered by the management of the Stony Creek Quarry.

Snider, John L., 1954, Reconnaissance for uranium in the Indiana coal field, U.S.G.S. unpublished thesis.

PAPERS PRESENTED AT PROFESSIONAL MEETINGS

Indiana University Paleontology Seminar (William Ausich, John Droste, Alan Horowitz, Saleh Okla, Robert Shaver, Diane Suchomel, and James Welch, Indiana University; also Curtis Ault and Carl Rexroad, Indiana Geological Survey), 1976, The search for a Silurian reef model: Great Lakes area (abs.): Amer. Assoc. Pet. Geol. Bull., v. 60, p. 684.

Becker, Leroy E., The New Albany Shale and equivalent strata in Indiana, presented at the Appalachian Geology Symposium at Morgantown, West Virginia, March 1976.

Decker, Leroy E., and Keller, Stanley J., Silurian reefs in southwestern Indiana and their relation to petroleum accumulation, presented at the annual meeting of the Illinois Basin Chapter of the American Petroleum Institute at Evansville, Indiana, April, 1976, and at the annual meeting of the Kentucky Oil and Gas Association at Lexington, Kentucky, June 1976.

Blakely, R. F., Whaley, J. F., Biggs, M. E., and Rudman, A. J., Computer-generated "scale functions" for conversion of resistivity to pseudovelocity logs, American Association Petroleum Geologists, April 1976.

Hreha, Andrew, Pre-Knox (Cambrian) stratigraphy in Indiana, by Leroy E. Becker, Andrew J. Hreha and T. A. Dawson, at the Oil and Gas Technical Conference at Urbana, Illinois, October 1975.

Patton, John B., Urbanization and mineral resources, presented at the annual meeting of the Indiana Mineral Aggregates Association, February 1976.

PUBLIC LECTURES

Ault, C. H., Geology as a profession, Church of Jesus Christ of Latter-Day Saints, July 1976.

Ault, Curtis, Silurian reef and interreef rocks of northern Indiana: stratigraphy, high-calcium limestone, associated sphalerite, and field trip review, Indiana Geologists, April 1976.

Ault, Curtis, Fossils and rocks, April 1976.

Bleuer, N. K., Sept. 22, 1975, The ancient Teays watercourse, its course and history from its rise in mountains to its mouth in the Gulf of Mexico: Indianapolis Sci. Club.

Bleuer, N. K., Oct. 31, 1975, Remnant magnetism of Pleistocene sediments in Indiana: Indiana Acad. Sci., Indianapolis,

Bleuer, N. K., Nov. 22, 1975, Geology of Warren County: Warren Co. Hist. Soc., Independence, Ind.

Bleuer, N. K., Feb. 1976, Geology of streams and rivers of Indiana: Indiana Univ. experimental class on Indiana rivers.

Carr, D. D., Coal Resources of Indiana, Bloomington Central Lions Club, April 1976.

Gray, H. H., June 16, 1976, Geology of southern Indiana: Youth Conservation Corps., Branchville, Ind.

Hartke, E. J., Mar. 15, 1976, Organization and function of the Geological Survey in relation to its environmental program: Indiana Assoc. Regional Councils, Indianapolis.

Hartke, E. J., May 8, 1976, Value of accurate and detailed water well logs to geologic investigations: Nat'l. Water Well Assoc., Nashville, Ind.

Hill, J. R., Nov. 4, 1975, Environmental geology: Grandview School, Indianapolis.

Hill, J. R., May 19, 1976, Rocks and minerals and other geology of Brown County: Gnaw Bone Camp for elementary school children, Gnaw Bone, Ind.

Moore, Michael, The birth of three rivers -- a glacier molds the land, Three Rivers Rock and Mineral Society, June 1976.

Patton, John B., October 1975, The interruptible contract between nature and society: non-renewable resources and non-renewable civilizations, at the Methodist Conference, Nashville, IN,

Patton, John B., May 1976, Brick by brick - stone by stone, presented at the annual meeting of Historic Madison, Inc.

Patton, John B., June 1976, Limited resources and unlimited demand, for the Land Use Conference at I.U. Campus, South Bend.

Rexroad, C. B., Oct. 31, 1975, Paleoeecology and provincialism of conodonts: Indiana Univ. micropaleontology class.

Rexroad, C. B., Nov. 3, 1975, Conodont biostratigraphy: Indiana Univ. geology class.

Rexroad, C. B. (with Liebe, R. M.), April 29, 1976, Conodonts from Alexandrian and early Niagaran rocks in the Joliet, Illinois, area: North-Central Sec., Geol. Soc. America, Kalamazoo, Mich.

Shaffer, Nelson, Meteorites, Bloomington Gem and Mineral Club, September 1975.

Shaffer, Nelson, Meteorites, Indiana Geologists, December 1975.

Shaffer, Nelson, Meteorites, Muncie Rock and Mineral Club, May 1976.

Shaffer, Nelson, Industrial minerals of Indiana, Bloomington Gem and Mineral Club, May 1976.

Shaver, R. H., Sept. 24, 1975, Problems in Silurian stratigraphy of the Michigan Basin: Michigan Basin Geol. Soc., East Lansing, Mich.

Shaver, R. H., Oct. 4, 1975, Status of national SEPM and plans for its 50th anniversary observation: Great Lakes Sec., Soc. Econ. Paleontologists and Mineralogists, Fort Wayne, Ind.

Shaver, R. H. (with Droste, J. B.), Oct. 6, 1975, Collation of Salina evaporite cycles in the Michigan Basin and reef-bearing rocks of the Wabash Platform: Eastern Sec., Am. Assoc. Petroleum Geologists, East Lansing, Mich.

Shaver, R. H., Oct. 11, 1975, Nature of fossils: Seventh Day Adventists Church Camp, Bloomington, Ind.

Shaver, R. H., Dec. 15, 1975, A regional stratigraphic synthesis for Silurian reefs, evaporites, and hydrocarbons: Indiana-Kentucky Geol. Soc., Evansville.

Shaver, R. H., Feb. 13, 1976, The great Silurian facies: a synthesis from reef and evaporite stratigraphy of the Great Lakes area: Univ. Illinois Geology Colloquium, Urbana.

Shaver, R. H., Mar. 18, 1976, Middle and Upper Silurian stratigraphy of Great Lakes area: Indiana Univ. class.

Shaver, R. H., May 1, 1976, Silurian rocks and faunas of northern Indiana and Illinois: field trip group of North-Central Sec., Geol. Soc. America, Harvey, Ill.

Shaver, R. H., for Indiana Univ. Paleontology Seminar, May 27, 1976, Search for a Silurian reef model: Great Lakes area: Auspices Great Lakes Sec., for Soc. Econ. Paleontologists and Mineralogists 50th Anniversary Commemorative Session, New Orleans.

PUBLIC FIELD TRIPS

Hartke, E. J., and Rexroad, C. B., October 1975, A real geology field trip in southern Indiana (for Nat'l. Sci. Teachers Assoc.).

Hutchison, H. C., Greene and Clay Counties for graduate students from the I.U. Department of Geology, May 1976.

Patton, John B., Led a walking tour to sites of historic scientific interest in New Harmony for the Spring meeting of the Indiana Academy of Science, April 1976.

Patton, John B., Hosted a meeting and field trip of committee C-18, Natural Building Stone, of American Society of Testing and Materials. Was elected vice-chairman for 1976-77, April 1976.

Shaver, R. H., February 28 - March 1, 1976, Silurian reefs of Indiana and Ohio (for Denver geologists).

Shaver, R. H., April 30 - May 1, 1976, Silurian reefs, interreef facies, and faunal zones of northern Indiana and northeastern Illinois (for North-Central Sec., Geol. Soc. America).

ACTIVITIES

Curtis Ault -- Chairperson of Indiana University Staff Council for 1976.

President of Indiana Geologists for one year beginning April 1976.

Member of I.U. Salary Equity Review Committee.

Leroy E. Becker -- Member of the Potential Gas Committee.

Gerald Carpenter -- Member of the AAPG Committee on Statistics of Drilling.

Donald D. Carr -- Secretary-Treasurer, Industrial Minerals Division, SME of AIME; nominated to Chairman-Elect of the Division.

Appointed a member of the Research Committee of the Interstate Mining Compact Commission.

Appointed to membership on the AAPG Strategic Committee on Public Affairs to act as a direct communicator with representative Lee H. Hamilton.

Member of delegation headed by the Lt. Governor that discussed the advantages of an Indiana site for a coal liquification plant with Gulf Mineral Resources Company in Denver.

Appointed to the Lt. Governor's Science Advisory Committee to study Indiana's natural gas situation, September 1975.

Pei-Yuan Chen -- Working member of the Committee on Correlation of Kaolin Genesis and Age (International Geological Congress) 1975.

Harold C. Hutchison -- Appointed to the Lt. Governor's Science Advisory Committee to study Indiana's natural gas situation, September 1975.

Stanley J. Keller -- Contributed data on natural gas, crude oil and shale production in Indiana for the Lieutenant Governor's Science Advisory Committee.

Michael Moore -- Central Area Correspondent for the National Speleological Society News.

John B. Patton -- Served on the Energy Task Force of the Lt. Governor's Science Advisory Committee, July - September 1975.

John I. Patton -- Attended meeting of American Commission on Stratigraphic Nomenclature as member representing the Association of American State Geologists. October 1975.

Participated in meeting of Natural Construction Materials Committee, October 1975.

Participated in meeting of Association of American State Geologists, October 1975.

Participated in the Spring meeting of the Indiana Academy of Science, April 1976.

Served on the Agricultural Resources Utilization Task Force of the Midwest Governor's Conference, May 1976.

Served as chairman of the Resolutions Committee of the Association of American State Geologists, June 1976.

Participated in meeting of Interstate Oil Compact Commission at Wichita, Kansas as member of the Research Committee and the Energy Committee, June 1976.

Presented the annual Honorary "Aggie" Award "In recognition of outstanding years of service to the Indiana Mineral Aggregates Association and the people involved." at the annual meeting of the Indiana Mineral Aggregates Association, February 1976.

R. Dee Rarick -- Served as a participating judge for the 1976 Earthwatch Scholarships Project sponsored by the Department of Public Instruction, March 1976.

Robert H. Shaver -- Served as a representative of the Soc. Econ. Paleontologists and Mineralogists at Washington, D.C., The American Geol. Institute sponsored a conference at the White House on Energy, Environment and Education.

Served as a representative of SEPM at the American Association of Petroleum Geologists Advisory Council meeting in Tulsa, Oklahoma.

Served as a representative of SEPM at the American Geol. Inst. Governing Board meeting at New Orleans, La., May 1976.

Served as a representative of SEPM at the American Geol. Inst. Governing Board meeting at Salt Lake City, October 1975.

Dan Sullivan -- Served as a member of the API's 13-man national committee on crude reserves.

Member of the API Subcommittee, Tri-State Area that gathers reserve data for Illinois, Indiana, Kentucky and Michigan.